NEW HORIZON
COLLEGE OF ENGINEERING
New Horizon Knowledge Park, Ring Road, Marathalli
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

The Trust is a Recipient of Prestigious Rajyotsava State Award 2012 Conferred by the Government of Karnataka
Awarded Outstanding Technical Education Institute in Karnataka-2016
Ring Road, Bellandur Post, Near Marathalli, Bangalore -560 103, INDIA

Batch of 2018-22, 2019-23, 2020-24
(175 Credit Scheme)
BE – Mechanical Engineering

Open Elective Syllabus

CONTENTS

VISION

To create competent mechanical engineers capable of working in diversified disciplines fortransformative impact on societal progressive development in the field of mechanicalengineering through creative research and lifelong learning.

MISSION

- To impart excellent education by proving state of art research facilities in the field of mechanical engineering.
- To develop alliances with industries and other organizations for excellence in teaching learning process, research and consultancy projects.
- To enhance the students in intellectual, entrepreneurial and ethical challenges through active participation by critical thinking.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- **PEO 1**: The graduates will be able to apply the overall knowledge of Mechanical Engineering along with concepts of Mathematics, Science, Communication and Computing skills to understand specific problem areas and finding the optimal solutions for the same.

- **PEO 2**: The graduates will be able to implement ideas of Mechanical Engineering for the challenging tasks in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

- **PEO 3**: The graduates will be widely talented in the fields of manufacturing, service and design industries, which will not only improve their employability but also aid in establishing the above said industries.

- **PEO 4**: The graduates will develop lifelong learning attitudes, ethics and values that will help their career employability and growth in engineering, academia, defence, state and central government sectors.

MAPPING OF PEOs TO DEPARTMENT MISSION

Program Educational Objectives	M1	M2	M3
PEO 1	3	2	3
PEO 2	2	1	3
PEO 3	3	2	2
PEO 4	2	2	3

PROGRAM OUTCOMES (POs)

Graduate Attributes	PO #	Program Outcomes
Engineering knowledge	1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex mechanical engineering problems
Problem Analysis	2	Identify, formulate, review research literature, and analyze complex engineering problems in Mechanical Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
Design Development of Solutions	3	Design solutions for complex engineering problems and design system components or processes of Mechanical Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
Conduct Investigations of Complex Problems	4	Use research-based knowledge and research methods including design of experiments in Mechanical Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
Modern tool usage	5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities in Mechanical Engineering with an understanding of the limitations.
The Engineer and society	6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Mechanical Engineering.
Environment and Sustainability	7	Understand the impact of the professional engineering solutions of mechanical Engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
Ethics	8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
Individual & team work	9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
Communication	10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project management and finance	11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, manage projects and in multidisciplinary environments.
Lifelong learning	12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After successful completion of mechanical Engineering Program, the graduates will be able to:

PSO1	Specify, fabricate, test and operate various machines along with essential documentations.
PSO2	Analyze, design, develop and implement the concepts of mechanical systems and processes towards product development

OPEN ELECTIVES SYLLABUS

BIG DATA ANALYTICS USING HP VERTICA-1

Course Code	20NHOP601/701
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP601/701.1	Analyse data in Oracle & Vertica databases using SQL statements.
20NHOP601/701.2	Explore Vertica for organizing and faster processing of data.
20NHOP601/701.3	Create projection partition manually using Vertica for efficient data analysis.
20NHOP601/701.4	Apply copy, delete, merge, purge operations in Vertica database.
20NHOP601/701.5	Design multi-node clustering in Hadoop for real time applications.
20NHOP601/701.6	Illustrate working of Hadoop ecosystem tools for big data analysis.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP601/701.1	3	2			3				3			2		
20NHOP601/701.2	3				3				3					
20NHOP601/701.3	3		2	1	3				3					
20NHOP601/701.4	3				3				3					
20NHOP601/701.5	3	2	2		3				3	2		2		
20NHOP601/701.6	3									2				

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT / REFERENCE BOOKS:

1) Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2016.

2) Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill, 2016.

3) Tom White, "HADOOP: The definitive Guide", O Reilly 2015.

Module No	Module Contents	Hrs	COs
1	**Introduction to SQL and HP Vertica:** Types of SQL, Data Types, Constrains, JOINS, Types of JOINS,Clause, Group by, Having, Order by, Where Clause with examples, SQL Alias, Views, Union, Union all, aggregate functions, Operators **Introduction to HP** : Vertica Database, Vertica Analytics Platform, Columnar Orientation, Advanced Compression, High Availability, Automatic Database design, Massively Parallel Processing, Application Integration. **Hands on sessions:** 1) Creation of tables with constrains and insertion of values into tables 2) Hands-on DML commands to apply different aggregate function, 3) Group by-Having-Order by clause, Operators. 4) Creation of views and working with joins.	**9**	**20NHOP601/701.1**
2	**HP Vertica- 1:** Projections, Query Execution ,Vertica Transactions, Hybrid datastore – WOS & ROS, **Projection Design**: Projection fundamentals, Projection types, Projection properties, Replication and Segmentation Database Designer, Comprehensive mode, Incremental mode,Sample data, Sample queries, DBD Advantages **Hands on sessions:** 1) Creation of schema, tables and execution of SQL statements on Vertica Database 2) Running Database designer 3) Hands-on projections	**9**	**20NHOP601/701.2** **20NHOP601/701.3**
3	**HP Vertica -2:** Loading data via INSERT-COPY-MERGE, Deleting data in Vertica- delete vector, design for delete, process of deleting Truncate, Purge, Update, Partitioning, Tuple Mover- Move Out Parameter, Merge Out Parameter, Working with Vertica Management Console. **Hands on sessions:** 1) Loading data files from different sources to Vertica database 2) Verifying the log files after loading the data into Vertica database. 3) Hands-on partitions.	**9**	**20NHOP601/701.4**
4	**Big Data Analytics with Hadoop:** Big data overview, Introduction to Hadoop, Overview of Hadoop Distribution File Systems[HDFS] and Map reduce Operations, Clustering types in Hadoop- Standalone mode, Pseudodistributed mode, Fully distributed mode. **Hands on Sessions :** 1) Verifying Hadoop installation (Pseudo distributed mode) Java path 2) Hadoop location 3) Hadoop configuration files 4) Name Node setup, Job Tracker 5) Metadata files 6) Accessing Hadoop on browser	**8**	**20NHOP601/701.5**
5	**Hadoop Ecosystem:** Introduction to SQOOP, Overview of PIG - Standalone mode, cluster mode, when to use PIG latin, Introduction	**9**	**20NHOP601/701.6**

	to HIVE, Introduction to HBASE- comparison of Hadoop hdfs and HBASE. **Hands on Sessions:** 1) Moving data from local file system to Hadoop file system 2) Performing MAP Reduction operation in Hadoop 3) Verification of operation results through terminal and browser		

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assign ments	Daily Assessments
Marks	**25**	**15**	**10**
Remember			
Understand	5		
Apply	5	7.5	5
Analyze	5		
Evaluate			5
Create	10	7.5	

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	5
Apply	10
Analyze	10
Evaluate	5
Create	20

VM WARE VIRTUALIZATION ESSENTIALS-1

Course Code	20NHOP602/702
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP602/702.1	Understand the common terms and definitions of Operating System, Cloud Computingand Virtualization.
20NHOP602/702.2	Learning the business benefits and considerations of VMware virtualization.
20NHOP602/702.3	Knowing various approaches to server virtualization, its relevance to the modern data center, available platforms and important features.
20NHOP602/702.4	Analyzing the implications of virtualization on Data Center Challenges.
20NHOP602/702.5	Enable to configure the VMware vSphere storage and network virtualization.
20NHOP602/702.6	Enable to configure the VMware vSphere storage and network virtualization.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP602/702.1	2	2	2	2	2	1			1	2	1	1		
20NHOP602/702.2	2	2	2	2	2	1			1	2	1	1		
20NHOP602/702.3	2	2	2	2	2	1			1	2	1	1		
20NHOP602/702.4	2	2	2	2	2	1			1	2	1	1		
20NHOP602/702.5	2	2	2	2	2	1			1	2	1	1		
20NHOP602/702.6	2	2	2	2	2	1			1	2	1	1		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) Nick Marshall, Scott Lowe (Foreword by) with Grant Orchard, Josh Atwell, Mastering VMware vSphere 6, Publisher: Sybex; 1 edition (24 March 2015).
2) Matthew Portnoy, Virtualization Essentials, 2nd Edition, Wiley India Pvt. Ltd.

REFERENCE BOOKS:

1) Thomas Kraus, Kamau Wanguhu, Jason Karnes , VMware Network Virtualization: Connectivity for the Software-Designed Data Center , VMware Press Technology 1st Edition.
2) Bill Ferguson, vSphere 6 Foundations Exam Official Cert Guide (Exam #2V0-620): VMware Certified Professional 6 VMware Press, 1st Edition.

Module No	Module Contents	Hrs	COs
1	**Understanding Virtualization:** Operating Systems Essentials: Process Management, Memory Management, and Storage Management. **Cloud Computing Essentials:** Introduction to Cloud Computing, Cloud Deployment Models, and Challenges. **Virtualization Essentials:** Importance of Virtualization, Examining today's trends, Virtualization Software Operations: Virtualizing Servers, Virtualizing Desktop, and Virtualizing Applications.	**8**	**20NHOP602/702.1**
	List of programs: 1) Using vSphere Web Client. 2) Creating a Virtual Machine.	**4**	
2	**VMware vSphere Virtualization Overview:** Introduction to Data Center Virtualization, Traditional Architecture, Virtual Architecture, Types of Virtualization**.** **Understanding Hypervisors:** Describing hypervisor, Type-1 Hypervisor, Type-2 Hypervisor**.** **vSphere Products & Features:** vSphere Motion, vSphere HA, vSphere DRS, vSphere FT, vSpherereplication, vSphere data protection.	**9**	**20NHOP602/702.2**
	List of programs: 1) Deploying Virtual Machines Using Cloning, Templates, and a Content Library 2) Modifying Virtual Machine Settings	**4**	
3	**Creating & Managing Virtual Machines: Creating, Managing, Monitoring & Configuring VM:** vSphere Client and vSphere Web Client,vSphere Web Client UI, **Creating VM**:VM Components, Installing Guest OS, **Managing VM:** Start-up and Shutdown of VM's, Creating and Managing Snapshots, RDM	**9**	**20NHOP602/702.3**
	Configuring VM: Memory/CPU Hot Plug, Swap Files**.** **Creating Clones, Templates & Content Libraries:** Cloning VM, Creating Templates, OVF Templates, and Types of Content Library.	**4**	
4	**vSphere Solutions to Data Center Challenges: Data Center Challenges:** Availability, Scalability, Optimization, Management, Application Upgrade & Cloud Challenges. **vSphere for Scalability and Business Continuity:** vSphere Motion, vSphere HA, vSphere DRS, vSphere FT, vSphere replication, vSphere data protection.	**9**	**20NHOP602/702.4**
	List of programs: 1) Managing Tasks, Events, and Alarms 2) Using vSphere Apps, Managing Multi tiered Applications	**4**	
5	**Understanding VMware vSphere Storage & Network Virtualization Storage Virtualization:** Storage Concepts, iSCSI Concepts, NFS Data stores, VMFS Data stores, Virtual SAN Data stores, Virtual Volume **Network Virtualization:** Introduction to vSphere Standard Switch, Configuring Standard Switch Policies, Introduction to vSphere Distributed Switch	**9**	**20NHOP602/702.5**
	List of programs: 1) Using vSphere vMotion and Storage vMotion to Migrate Virtual Machines 2) Implementing a vSphere DRS Cluster	**4**	

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Daily Assessments
Marks	**25**	**15**	**10**
Remember			
Understand	5		
Apply	5	7.5	5
Analyze	5		
Evaluate			5
Create	10	7.5	

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	5
Apply	10
Analyze	10
Evaluate	5
Create	20

BIG DATA ANALYTICS USING HP VERTICA-2

Course Code	20NHOP604/704
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP604/704.1	Analyze Big data in Hadoop ecosystem using Mapreduce operations.
20NHOP604/704.2	Utilize import and export functionalities of SQOOP tool.
20NHOP604/704.3	Analyze Big data using Pig tool to address societal issues.
20NHOP604/704.4	Develop Pig Latin scripts to demonstrate real time applications
20NHOP604/704.5	Apply HQL to analyze various data sets.
20NHOP604/704.6	Create tables in HBase and illustrate various HBase commands.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP604/704.1	3	3			3				3					
20NHOP604/704.2	3				3				3			2		
20NHOP604/704.3	3	3			3				3	2		2		
20NHOP604/704.4	3	3	1	1	3				3	2				
20NHOP604/704.5	3	3			3				3					
20NHOP604/704.6	3				3				3					

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Module Contents	Hrs	COs
1	**VERTICA & Hadoop Review** **Vertica Cluster Management:** Adding nodes to an existing cluster, Removing nodes from a cluster, Replacing nodes, Noderecovery in vertica, Rebalancing data across nodes **Hands on sessions** ➢ Check hadoop configuration file ➢ Load a .csv file from local file system to hadoop file system ➢ Perform analysis on loaded files using hadoop mapreduce programs and verify the output using hadoop commands aswell as browser ▪ Count ▪ Grep **SQOOP** ➢ Verifying Sqoop status through cloudera manager ➢ Hand-on Practice on various Sqoop basic commands ▪ List-database ▪ List-table ▪ Eval ➢ Import of tables from Mysql database to hdfs ▪ Import of all tables ▪ Import of specific tables to default directory /target directory ▪ Import of subset of tables using 'where' clause ▪ Import table as sequence file ▪ Incremental import ▪ Export files from hdfs to mysql database	**9**	**20NHOP604/704.1** **20NHOP604/704.2**
2	**Apache Pig Architecture**: -Apache Pig components, Pig Latin Data Model: atom, tuple, bag, relation, map. **Basic grunt shell commands,** Running local mode - mapreducemode, **Pig Latin 1:** Pig Latin Statements: **Data types-** simple & ComplexData Types **Hands on sessions:** **Operators (Part 1) :** ▪ Loading and storing - from/to local file system, from/to hdfs ▪ Diagnostic operator – Dump, Describe, Explain, illustrate ▪ Filtering – filter operator; For Each Generate operator: projection, nested projection, schema; Distinct Operator ▪ Arthematic operators ▪ Comparision operator ▪ Boolean Operators **Hands on Sessions:** Operators (Part 2) ▪ Grouping & Joining Operator – GROUP, CO-GROUP, JOIN(INNER, SELF JOIN) ▪ Combining & splitting – UNION, SPLIT ▪ Sorting – ORDER BY, LIMIT	**9**	**20NHOP604/704.3**
3	**Pig Latin Built-in functions:** ▪ Eval functions: AVG, SUM, MIN, MAX, COUNT, SIZE, CONCAT, TOKENIZE ▪ Bag&Tuple Functions: TOTUPLE, TOBAG, TOMAP	**9**	**20NHOP604/704.4**

	▪ String Functions: SUBSTRING, INDEXOF, LCFIRST(), UCFIRST(), UPPER(), LOWER(), REPLACE() ▪ Math Functions: ABS, CBRT, SQRT, COS, SIN, TAN, CEIL, FLOOR, EXP, LOG, LOG10, ROUND **Apache Pig - Running Scripts:** ▪ Creating pig script ▪ Commenting pig script ▪ Executing –running pig script ▪ Sample examples: word count program using pig script, count of similar events from a log file, simple twitter case study example.		
4	**HIVE** **Hive:** Why hive? , components of hive, simple architecture of hive, data-model of hive(database, table, partition, bucket) ***Hands on Session:* Hive Commands** *Data Definition Language (DDL)* ▪ CREATE database/ table/ external table , DROP, ALTER, SHOW, DESCRIBE Statements. ***Data Manipulation Language (DML)*** ▪ LOAD, INSERT Statements- INSERT INTO, INSERT OVERWRITE ***Built-in Operators-*** Relational Operators- Arithmetic Operators- Logical Operators - Complex Operators- example: simple querieson these operators ***Order by clause- Group by clause-*** aggregate functions(sum, avg, count, min, max) **Joins, Create and drop of views**	**9**	**20NHOP604/704.5**
5	**HBASE : Various types of No Sql Databses – when HBASE is used?** **HBase Data Model**(Table, Rowkey, Column families, Column qualifiers,Cell, Timestamp) **Hands on Sessions:** ▪ HBase shell Command: Create table with /without version – ▪ put command ▪ get command with / without version ▪ Scan command ▪ delete column – column family ▪ disable – enable ▪ drop table	**9**	**20NHOP604/704.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assign ments	Daily Assessments
Marks	**25**	**15**	**10**
Remember			
Understand	5		
Apply	5	7.5	5
Analyze	5		
Evaluate			
Create	10	7.5	

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	5
Apply	10
Analyze	10
Evaluate	5
Create	20

VM WARE VIRTUALIZATION ESSENTIALS-2

Course Code	20NHOP605/705
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP605/705.1	Learn the common terms and definitions of data center, vSphere Virtual infrastructure
20NHOP605/705.2	Learning the vCenter Server architecture, virtual machine and importance of VMware tools
20NHOP605/705.3	Analyze virtual machine management, resource management and monitoring.
20NHOP605/705.4	Learning vSphere products and solutions for protecting data
20NHOP605/705.5	Enable to configure the VMware vSphere products and solutions
20NHOP605/705.6	Enable to configure the VMware vSphere products and solutions

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP605/705.1	3	2	2	2	2				2	1		2		
20NHOP605/705.2	3	3	2	2	2				2	1		2		
20NHOP605/705.3	3	3	2	2	2				2	1		2		
20NHOP605/705.4	3	3	2	2	2				2	1		2		
20NHOP605/705.5	3	3	2	2	2				2	1		2		
20NHOP605/705.6	3	3	2	2	2				2	1		2		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) Nick Marshall, Scott Lowe (Foreword by) with Grant Orchard, Josh Atwell, Mastering VMware vSphere 6, Publisher: Sybex; 1 edition (24 March 2015).
2) Matthew Portnoy, Virtualization Essentials, 2nd Edition, Wiley India Pvt. Ltd.

REFERENCE BOOKS:

1) Thomas Kraus, Kamau Wanguhu, Jason Karnes , VMware Network Virtualization: Connectivity for the Software-Designed Data Center , VMware Press Technology 1st Edition.
2) Bill Ferguson, vSphere 6 Foundations Exam Official Cert Guide (Exam #2V0-620): VMware Certified Professional 6 VMware Press, 1st Edition.

Module No	Module Contents	Hrs	COs
1	**Introduction to vSphere and the Software-Defined Data Center:** Describe the topology of a physical data center, Explain the vSphere virtual infrastructure, Define the files and components of virtual Machines, Describe the benefits of using virtual machines, Explain the similarities and differences between physical architectures and virtual architectures, Define the purpose of ESXi, Define the purpose of vCenter Server, Explain the software-defined data center, Describe private, public, and hybrid clouds.	**8**	**20NHOP605/705.1**
	List of programs: **Using vSphere Web Client.**		
2	**vCenter Server:** Introduce the vCenter Server architecture, Deploy and configure vCenter Server Appliance, Use vSphere Web Client Backup and restore vCenter Server**,** Examine vCenter Server permissions and roles Explain the vSphere HA architectures and features, Examine the new vSphere authentication proxy**,** Manage vCenter Server inventory objects and licenses**,** Access and navigate the new vSphere clients**.** **Creating Virtual Machines:** Introduce virtual machines, virtual machine hardware, and virtual machine files Identify the files that make up a virtual machine, Discuss the latest virtual machine hardware and its features, Describe virtual machine CPU, memory, disk, and network resource usage, Explain the importance of VMware Tools™, Discuss PCI pass-through, DirectI/O, remote direct memory access, and NVMe, Deployand configure virtual machines and templates, Identify the virtual machine disk format.	**9**	**20NHOP605/705.2**
	List of programs: 1) Creating a Virtual Machine. 2) Manage vCenter Server inventory objects		
3	**Virtual Machine Management**: Use templates and cloning to deploy new virtual machines, Modify and manage virtual machines, Clone a virtual machine, Upgrade virtual machine hardware to version 12, Remove virtual machines from the vCenter Server inventory and data store, Customize a new virtual machine using customization specification files, Perform vSpherev Motion and vSphere Storage vMotion migrations, Create and manage virtual machine snapshots, Create, clone, and export vApps, Introduce the types of content libraries and how to deploy and use them.	**9**	**20NHOP605/705.3**
	List of programs: 1) Create clone, templates and manage virtual machines 2) Perform vSpherev Motion migrations.		
4	**Resource Management and Monitoring:** Introduce virtual CPU and memory concepts, Explain virtual memory reclamation techniques**,** Describe virtual machine over-commitment and resource competition**,** Configure and manage resource pools**,** Describe	**8**	**20NHOP605/705.4**

	methods for optimizing, CPU and memory usage, Use various tools to monitor resource usage, Create and use alarms to report certain conditions or events, Describe and deploy resource pools, Set reservations, limits, and shares, Describe expandable reservations, Schedule changes to resource settings, Create, clone, and export vApps, Use vCenter Server performance charts and esxtop to analyze vSphere performance. **List of programs:** 1) Create virtual machine snapshots 2) Manage resource and monitoring of virtual CPU and memory concepts		
5	**vSphere HA, vSphere Fault Tolerance ,and Protecting Data:** Explain the vSphere HA architecture, Configure and manage a vSphere HA cluster, Use vSphere HA advanced parameters, Define cluster wide restart orderingcapabilities, Enforce infrastructural or intra-app dependencies during failover, Describe vSphere HA heartbeat networks and data store heartbeats, Introduce vSphere Fault Tolerance, Enable vSphere Fault Tolerance on virtual machines, Support vSphere Fault Tolerance interoperability with vSAN, Examine enhanced consolidation of vSphere Fault Tolerance virtual machines, Introduce vSphere Replication, Use vSphere Data Protection to back up and restore data. **List of programs:** 1) Perform vSphere HA 2) Perform vSphere Fault Tolerance	**9**	**20NHOP605/705.5**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assign ments	Daily Assessments
Marks	**25**	**15**	**10**
Remember			
Understand	5		
Apply	5	7.5	5
Analyze	5		
Evaluate			5
Create	10	7.5	

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	5
Apply	10
Analyze	10
Evaluate	5
Create	20

SAP

Course Code	20NHOP607/707
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP607/707.1	Understand the concept of production system and facilities, automation, Computer Aided Process planning (CAPP), Material Requirement Planning (MRP), Master Production Schedule (MPS), capacity planning
20NHOP607/707.2	Understand SAP system along with its navigation in the software
20NHOP607/707.3	Create master data for new vendor and new trading goods in Materials Management
20NHOP607/707.4	Evaluate and create production order for the product group
20NHOP607/707.5	Create master data for new customer
20NHOP607/707.6	Facilitate the flow of goods between producer and the purchaser for near fail proof logistic operations

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP607/707.1	3	1				3	1	1	2	2	3	2		
20NHOP607/707.2	3	1			3	3	1	1	2	2	1	2		
20NHOP607/707.3	2	2	2	2	3	3	1	1	2	2	3	2		
20NHOP607/707.4	2	2	2	2	3	3	1	1	2	2	3	2		
20NHOP607/707.5	2	2	2	2	3	3	1	1	2	2	3	2		
20NHOP607/707.6	3	2	2	2	3	3	1	1	2	2	3	2		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT / REFERENCE BOOKS:

1) Automation, Production System & Computer Integrated Manufacturing, M. P. Groover, Person India, 2015, 3rdEdition.
2) Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India.
3) A beginner's guide to SAP, Martin Munzel, Sydney McConnel
4) Online course material for SAP

Module No	Module Contents	Hrs	COs
1	**Computer Integrated Manufacturing Systems:** Introduction, Production system facilities, Manufacturing support system, Automation definition, Types of Automation, Reasons for Automation, limitations of Automation, Automation principles & Strategies, CIM, Information Processing Cycle in Manufacturing, Production concepts **Computerized Manufacturing Planning System:** Introduction, Computer Aided Process Planning, Retrieval types of process planning, Generative type of process planning, Material requirement Planning, Fundamental Concepts of MRP, Inputs to MRP, Capacity planning.	**9**	**20NHOP607/707.1**
2	**Introduction to SAP**: Case study of Global bike group (GBI) **Materials Management (MM) Case study**: Creation of new vendor, Creation of material master for trading goods, create purchase requisition, creating request for quotation, Create and display purchase order, create and verify goods receipt for purchase order, create invoice receipt from vendor, post payments to vendor, display and review goods ledger account balances	**9**	**20NHOP607/707.2** **20NHOP607/707.3**
3	**Production Planning and Execution (PP) Case study:** Change material master record, change routing, display product group, creating sales and operation plan, Transfer SOP to demand management, Review demand management, Run MPS with MRP, Review stock and requirement list, convert planned order into production order, receiving goods from inventory, issuing goods to production order, review production order status, confirm production completion, receive goods from production order, review costs assigned to production order, settle costs of production order.	**9**	**20NHOP607/707.4**
4	**Sales and Distribution (SD) Case study:** Creation of new customer, create contact person for customer, changing the customer, create customer inquiry and quotation, create sales order referencing for quotation, check stock status, display sales order, start delivery process, pick materials on delivery note, post goods issue, create invoice for customer, display billing document and customer invoice, post receipt of customer payment, review the document flow	**9**	**20NHOP607/707.5**
5	**Warehouse Management (WM) Case study:** Create purchase order, display material inventory, display material inventory value, receive the goods, display material inventory and value, run bin status report, create transfer order, confirm transfer order	**8**	**20NHOP607/707.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assign ments	Report
Marks	**25**	**15**	**10**
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	5
Understand	5
Apply	
Analyze	5
Evaluate	5
Create	30

SCHNEIDER- INDUSTRIAL AUTOMATION

Course Code	20NHOP608/708
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP608/708.1	Explore the various aspects of industrial automation.
20NHOP608/708.2	Analyze the architecture of PLC.
20NHOP608/708.3	Select an appropriate communication protocol to communicate with PLC using Open Systems Interconnection model.
20NHOP608/708.4	Develop a suitable logic for various real time applications using specific programming language for PLC.
20NHOP608/708.5	Deploy Schneider Electric PLC for various industrial applications using dedicated software tool Unity Pro.
20NHOP608/708.6	Build a Human Machine Interface for various applications through Vijeo Designer software.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP608/708.1	3	2				3	1	1	2	2	3	3		
20NHOP608/708.2	3	2	3	2	3	3	1	1	2	2	3	3		
20NHOP608/708.3	3	2	3	2	3	3	1	1	2	2	3	3		
20NHOP608/708.4	3	2	3	2	3	3	1	1	2	2	3	3		
20NHOP608/708.5	3	2	3	2	3	3	1	1	2	2	3	3		
20NHOP608/708.6	3	2	3	2	3	3	1	1	2	2	3	3		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) Programming Industrial Control Systems Using IEC 1131-3 (IEE CONTROL ENGINEERING SERIES) Revised Edition, by Robert W. Lewis
2) Programmable Logic Controllers and Industrial Automation: An Introduction 2nd Edition, by Madhuchhanda Mitra and Samarjt Semgupta.
3) Industrial Controls and Manufacturing (Engineering) 1st Edition by Edward W. Kamen

REFERENCE BOOKS:

1) Industrial Instrumentation Paperback, by K Krishnaswamy, S. Vijyachitra.
2) Overview of Industrial Process Automation Paperback, by K.L.S. Sharma
3) Industrial Process Automation Systems 1st Edition, by B.R. Mehta Y. Jaganmohan Reddy

Module No	Module Contents	Hrs	COs
1	**Basics of Automation:** Automation Strategy- Evolution of instrumentation and control, role of automation in industries, benefits,types. **Structure of PLC:** Evolution of PLC - Principle of operation- Elements of Power supply unit - PLC Scan –Memory organization – Input Types - Types and Selectionof PLC- Application- Schneider M340 pedagogic bench for wiring of input and output elements.	**9**	**20NHOP608/708.1** **20NHOP608/708.2**
2	**Standard Communication Protocols:** Definition- Open System Interconnection (OSI) model, Communication standards -RS232 and RS485, Modbus- ASCII and RTU, Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), Internet protocols. **Application-** Analysis of a PLC configuration and communication devices communication devices **Sensors in industrial automation:** Types and characteristics of most used sensors in industry. Applicationto sensors in PLC environment. Analysis of several sensors (technologies, performances) and connections to PLC	**9**	**20NHOP608/708.3**
3	**PLC Programming :** Types–Programming devices – Logical operations–Relay type instructions –Timer and Counter Instructions –Program Control Instructions – Data Manipulation Instructions – Data Compare Instructions – Arithmetic Instructions – Sequence Instructions - PID Instructions – PWM Function – Applications- PLC programming using ladder and FBD methods as per IEC61131.	**9**	**20NHOP608/708.1** **20NHOP608/708.2** **20NHOP608/708.4** **20NHOP608/708.5**
4	**Sequential Functional Chart (SFC) Programming :** SFC Structure- SFC programming as per IEC61131, Advances in SFC- Applications	**9**	**20NHOP608/708.1** **20NHOP608/708.3** **20NHOP608/708.5**
5	**Human Machine Interfacing (HMI) :** Evolution of HMI, Building HMI graphics, Communication with PLC, Overview of software (Vejio Designer)- Applications	**9**	**20NHOP608/708.1** **20NHOP608/708.6**

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	**25**	**10**	**10**
Remember			
Understand	5	5	
Apply	10	5	10
Analyze			
Evaluate			
Create	10		

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	10
Apply	15
Analyze	
Evaluate	
Create	25

ROUTING AND SWITCHING-01

Course Code	20NHOP609/709
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP609/709.1	Compare the network models and the protocols at each layer
20NHOP609/709.2	Construct IP addressing table and perform subnetting in IPv4 and IPv6 network.
20NHOP609/709.3	Analyze the network to implement LAN security to mitigate threats and attack
20NHOP609/709.4	Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol.
20NHOP609/709.5	Examine the operation of Spanning tree protocols and Ether channel for network scalability
20NHOP609/709.6	Analyze Dynamic Host Configuration Protocol (DHCP) operation for scalablenetworks.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP609/709.1	3	3	3	3	3									
20NHOP609/709.2	3	3	3	3	3							2		
20NHOP609/709.3	3	3	3	3	3	2		2	2		2			
20NHOP609/709.4	3	3	3	3	3		3							
20NHOP609/709.5	3	3	3	3	3		3				2			
20NHOP609/709.6	3	3	3	3	3		3					2		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) CISCO Netacad Course-1 : CCNAv7-Introduction to network(ONLINE ACCESS)
2) CISCO Netacad Course-2 : CCNAv7-Switching, Routing and Wireless Essentials (ONLINE ACCESS)
3) CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand), 2016.

REFERENCE BOOKS:

1) Data Communications and Networking. Forouzan,5th Edition, McGraw Hill, Reprint-2017.

Module No	Module Contents	Hrs	COs
1	**Networking Today:** Network Components, Protocols and Models:The Protocol Suites, Reference Models, Data Encapsulation, Data Link Layer: Purpose of the Data Link Layer, LAN Topologies, Ethernet Switching: Ethernet Frame, Ethernet MAC Address, The MAC Address Table , Network Layer: Network Layer, IPv4 Packet, IPv6 Packet, Router Routing Tables, MAC and IP,ARP, Transport Layer: Port Numbers, TCP Communication Process, UDP Communication, Application Layer: Application, Presentation, and Session **LAN Security Concepts:** Endpoint Security, Access Control, Layer 2 Security Threats, MAC Address Table Attack, LAN Attacks, Switch Security Configuration: Implement Port Security. 1) **Basic Switch and End Device Configuration:** Cisco IOS Access, IOS Navigation, The Command Structure, Basic Device Configuration, Save Configurations, Configure IP Addressing, Verify Connectivity. 2) **SSH and Telnet Configuration** 3) **Switchport security Configuration**	**9**	**20NHOP609/709.1** **20NHOP609/709.3**
2	**IPv4 Addressing:**IPv4 Address Structure,IPv4 Unicast, Broadcast, and Multicast,Types of IPv4 Addresses, Network Segmentation, Subnet an IPv4 Network **IPv6 Addressing:** IPv6 Address Representation, IPv6 Address Types, GUA and LLA Static Configuration, Dynamic Addressing for IPv6 GUAs,Dynamic Addressing for IPv6 LLAs, Subnet an IPv6 Network 1) **Basic Router Configuration :**Configure Initial Router Settings, Configure Interfaces, Configure the Default Gateway, Ping and Traceroute Testing 2) **Subnetting Scenarios using IPv4 address** 3) **IPv4 address Configuration** 4) **IPv6 address Configuration**	**9**	**20NHOP609/709.2**
3	**VLAN :**Overview of VLANs, VLANs in a Multi-Switched Environment, VLAN Configuration, VLAN Trunks, Dynamic Trunking Protocol. **Inter-VLAN Routing:**Inter-VLAN Routing Operation, Router on-a-Stick Inter-VLAN Routing. 1) **VLAN Configuration** 2) **Dynamic Trunking Protocol Configuration** 3) **InterVLAN routing Configuration**	**9**	**20NHOP609/709.4**
4	**Spanning Tree Protocol :** Purpose of STP,STP Operations,Evolution of STP,RSTP,RSTP+, Portfast, BPDU Guard. **EtherChannel:** EtherChannel Operation, LACP, PAGP, Passive and Active mode in Etherchannel. 1) **Spanning Tree Protocol Configuration** 2) **Etherchannel Configuration**	**9**	**20NHOP609/709.5**
5	**DHCPv4:**DHCP4 ConceptsConfigure a Cisco IOS DHCP4 Server; Configure a DHCP4 Client, **SLAAC and DHCPv6:**IPv6 Global Unicast Address Assignment, SLAAC, DHCPv6, Configure DHCPv6 Server. **DHCPv4 Configuration** **DHCPv6 Configuration**	**9**	**20NHOP609/709.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assign ments	Quizzes
Marks	**25**	**15**	**10**
Remember			
Understand			5
Apply	20	10	5
Analyze	5	5	
Evaluate			
Create			

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	5
Apply	10
Analyze	10
Evaluate	5
Create	20

DATA ANALYTICS

Course Code	20NHOP610/710
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP610/710.1	Apply various data modeling techniques and fundamentals of Data analytics
20NHOP610/710.2	Create tables using Oracle and Vertica database.
20NHOP610/710.3	Design Projections and Partitions on Vertica database.
20NHOP610/710.4	Analyze projections by running Database designer.
20NHOP610/710.5	Classify different Web Analytics techniques.
20NHOP610/710.6	Categorize different Marketing Analytics techniques.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP610/710.1	3	2	3	3								3		
20NHOP610/710.2	3		3	3	3				3			3		
20NHOP610/710.3	3	2	3	3	3				3					
20NHOP610/710.4	3	2	3		3				3					
20NHOP610/710.5	3													
20NHOP610/710.6	3									1				

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT / REFERENCE BOOKS:

1) The Data Warehouse Lifecycle Toolkit Second Edition, by Ralph Kimball, Margy Ross, Warren Thornthwaite, Joy Mundy and Bob Becker, 2008.
2) Marketing Analytics : Data Driven Techniques with Microsoft-Excel, Wayne L. Winston, John Wiley & Sons, Inc. 2014

Module No	Module Contents	Hrs	COs
1	**Data Modeling and Introduction to Data Analytics:** Overview of the Data Warehouse and Data mart modeling process, Dimensional modeling, Snowflake and Star schema, Aggregate fact tables, Fact Constellation schema, The characteristics of dimension table and fact table. Fundamentals of Data analytics, Phases in Data Analytics, Types of Data Analytics, Challenges in Data Analytics	**9**	**20NHOP610/710.1**
2	**Introduction to basic SQL and HP Vertica:** Introduction to Structured Query Language, Types of SQL, Data types, Constraints, Select, Insert, Delete and Update statements inSQL , Aggregate functions. Introduction to HP-Vertica Database, Vertica Analytics Platform, Columnar Orientation, Advanced Compression, High Availability, Automatic Database design, Massively Parallel Processing,Application Integration **Hands on sessions** a) Creation of databases, Creation of schema, Creation of tables b) Inserting values to the table, select operations c) Delete and update operations d) Creation of tables with constrains and insertion of values into tables e) Hands-on DML commands to apply different aggregate function	**9**	**20NHOP610/710.2**
3	**HP Vertica-2:** Projection fundamentals, Replication and Segmentation, Hybrid data store – WOS & ROS. Database Designer, Comprehensive mode, Incremental mode, COPY command, Merge and Partitioning, Basic VERTICA Analytic functions. **Hands on sessions** a) Hands-on projections b) Running Database designer c) Copying a file to Vertica database and verifying error logs	**9**	**20NHOP610/710.3** **20NHOP610/710.4**
4	**Web Analytics :** Descriptive, Predictive and Prescriptive analytics	**9**	**20NHOP610/710.5**
5	**Marketing Analytics and CASE Studies :** Introduction, Market segmentation : Cluster analysis, Using classification trees for segmentation; Advertising : Pay Per Click Online advertising; Internet and Social marketing : Networks,Viral marketing, Text mining **CASE Studies :** Bristol Myers Squibb, Xerox , Kroger, Weather.com, Pratt and Whitney, AVIS-Budget Car Rental.	**9**	**20NHOP610/710.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	**25**	**15**	**10**
Remember	2		
Understand	2		
Apply	10	10	5
Analyze	7	5	5
Evaluate	2		
Create	2		

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

MACHINE LEARNING

Course Code	20NHOP611/711
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP611/711.1	Apply the basics of Python programming platform to build Machine Learning algorithms
20NHOP611/711.2	Apply the mathematical knowledge and conduct statistical investigations to interpret the data given
20NHOP611/711.3	Formulate Regression models to obtain solutions for data with continuous output using Pythonprogramming
20NHOP611/711.4	Formulate Classification models to obtain solutions for data with discrete output using Pythonprogramming
20NHOP611/711.5	Identify and analyse complex engineering and societal problems through case studies to develop solutions using the knowledge gained with Machine Learning
20NHOP611/711.6	Demonstrate knowledge and work in multi-disciplinary domain through working on Machine Learning projects

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP611/711.1	3				3									
20NHOP611/711.2	3	1		1	3									
20NHOP611/711.3		1		1	3									
20NHOP611/711.4		1		1	3									
20NHOP611/711.5	3		1			1						2		
20NHOP611/711.6	3								1	1	1	2		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) Machine Learning, Tom M Mitchel, McGraw Hill Education, July 2017, ISBN: 978-1-25-9096952.
2) Business Analytics, U Dinesh Kumar, Wiley India Pvt Ltd, 2017, ISNB:978-81-265-6877-2.
3) Machine Learning using Python, Manranjan Pradhan, Wiley India Pvt Ltd, 2019, ISBN-10: 8126579900

REFERENCE BOOKS:

1) Machine Learning, An Algorithmic Perspective, Stephen Marsland, Chapman and Hall, Nov 2014, ISBN: 978-1466583283.
2) THE ART OF R PROGRAMMING, Norman Matloff, 2011, No Starch Press,ISNB-10 1593273842

Module No	Module Contents	Hrs	COs
1	**Introduction to Machine Learning**: What is Machine Learning? Descriptive, Predictive and Prescriptive analysis techniques, classification of Machine Learning algorithms. **Introduction to Python Programming:** Making Decisions and loop control: Simple if, if-else and if-elifstatements. **Python Data Types**: List, Tuples, Dictionaries, Basic operations, Indexing and Slicing. **Functions**: Introduction to functions, functions with multiple arguments, lambda function. **Numpy**: Introduction to Numpy, Basic operations. Pandas and Matplotlib: Titanic Case Study.	**9**	**20NHOP611/711.1**
2	**Data Visualization and Linear Regression: Descriptive Statistics:** Summarize the data, Measure of central tendency and dispersion, Types of distribution, Box and Whisker plots and the 5 number summary. **Hypothesis testing:** one-tailed and two-tailed test, Type of errors-Type I Error, Type II Error. P-value method and z-score method. **Linear regression:** SLR and MLR Model Building, Estimation of parameters using OLS, Standardized regression co-efficient, Qualitative variables Interpretation of Regression coefficients, Validation of model – R-Square, Residual Analysis. **Case study on Model Building using linear regression**	**9**	**20NHOP611/711.1 20NHOP611/711.2 20NHOP611/711.3 20NHOP611/711.5**
3	**Logistic regression:** Introduction to Classification problems and binary logistic regression, Estimation of parameters, classification table, Sensitivity, Specificity, ROC curve, Optimal Cut-off probability, Gain chart and Lift chart **Case study on Model Building using logistic regression**	**9**	**20NHOP611/711.1 20NHOP611/711.4 20NHOP611/711.5**
4	**Decision Tree and Random Forest:** Decision Trees; Classification Technique, C4.5 and CART introduction, Gini Gain, Entropy and Information Gain computation Random Forest: Ensemble Modelling, Bagging, Random Forest Algorithm, Out of Bag Error Rate, Grid Search CV. **Case study on Model Building using Decision Tree**	**9**	**20NHOP611/711.1 20NHOP611/711.4 20NHOP611/711.5 20NHOP611/711.6**
5	**Clustering:** Simple Clustering, Steps in Clustering analysis, Hierarchical clustering- Distance computation, Chebyshev, Manhattan, Agglomerating clustering, Non Hierarchical clustering-k means clustering, Optimal no. ofclusters.	**8**	**20NHOP611/711.1 20NHOP611/711.5 20NHOP611/711.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Report
Marks	**25**	**15**	**10**
Remember	2		
Understand	3		
Apply	8	5	
Analyze	7	5	
Evaluate	3	5	5
Create	2		5

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	5
Create	5

ROUTING AND SWITCHING-02

Course Code	20NHOP612/712
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP612/712.1	Configure and troubleshoot advanced operations of routers and implement static and dynamic routing protocols (OSPF) for IPv4 and IPv6
20NHOP612/712.2	Configure and troubleshoot advanced operation of ACL and implement standard ACL, Extended ACL for IPv4 and IPv6.
20NHOP612/712.3	Configure and troubleshoot Network address translation (NAT) for IPv4
20NHOP612/712.4	Evaluate the ethical principal and practice of Wired LAN, Wireless LAN and Networksecurity of Home environment
20NHOP612/712.5	Examine the operations of WAN, WAN Authentication Protocols, virtual private networks (VPNs) and tunnelling.
20NHOP612/712.6	Evaluate the operation of network virtualisation and network automation for life long learning in real networking environment.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP612/712.1	3	3	3	3	3					3		3		
20NHOP612/712.2	3	3	3	3	3					3		3		
20NHOP612/712.3	3	3	3	3	3					3		3		
20NHOP612/712.4	3	3	3	3	3	2	2	2	3	3		3		
20NHOP612/712.5	3	3	3	3	3	2	2	2	3	3		3		
20NHOP612/712.6	3	3	3	3	3	2	2	2	3	3		3		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) CISCO Netacad Course-1 : CCNAv7-Introduction to network(ONLINE ACCESS)
2) CISCO Netacad Course-2 : CCNAv7-Switching, Routing and Wireless Essentials (ONLINE ACCESS)
3) CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand), 2016.

REFERENCE BOOKS:

1) Data Communications and Networking. Forouzan,5th Edition, McGraw Hill, Reprint-2017.

Module No	Module Contents	Hrs	COs
1	**Routing Concepts:** Path Determination, Packet Forwarding, IP Routing Table, Static and Dynamic Routing, IP Static Routing Static Routes **(Course 2 -Last Modules)** **Single-Area OSPF Concepts:** OSPF Features and Characteristics, OSPF Packets, OSPF Operation, OSPF Router ID, Modify Single-Area OSPFv2. **(Course 3, 1-2 Chapter)**	**9**	**20NHOP612/712.1**
	HANDS-ON 1) Configure IP Static Routes 2) Configure IP Default Static Routes 3) Configure Static Host Routes 4) Single-Area OSPFv2 Configuration		
2	**ACL Concepts:** Purpose of ACLs, Wildcard Masks in ACLs, Guidelines for ACL Creation, Types of IPv4 ACLs-Standard ACL and Extended ACL. **(Course 3- 4 & 5 Chapters)**	**9**	**20NHOP612/712.2**
	HANDS-ON 1) ACLs for IPv4 Configuration 2) Configure Standard IPv4 ACLs 3) Secure VTY Ports with a Standard IPv4 ACL 4) Configure Extended IPv4 ACLs		
3	**NAT for IPv4:** NAT Characteristics, Types of NAT, NAT Advantages and Disadvantages, Static NAT, Dynamic NAT, PAT, NAT64.**(Course 3 - Chapter 6)**	**9**	**20NHOP612/712.3**
	HANDS-ON 1) Configure Static NAT 2) Configure Dynamic NAT 3) Configure PAT		
4	**WLAN Concepts :** Introduction to Wireless, Components of WLANs, WLAN Operation, Channel Management, WLAN Threats, Secure WLANs**(Course 2- Chapter 12 & Chapter 13) Network Security Concepts :** Threat Actors, Malware, Common Network Attacks, IP Vulnerabilities and Threats, TCP and UDP Vulnerabilities, IP Services, Cryptography **(Course 3-Chapter 3)**	**9**	**20NHOP612/712.4**
	HANDS-ON 1) Remote Site WLAN Configuration 2) Configure a Basic WLAN on the WLC 3) Configure a WPA2 Enterprise WLAN on the WLC		
5	**WAN Concepts:** Purpose of WANs ,WAN Operations, VPN and IPsec Concepts: VPN Technology, Types of VPNs, IPsec**(Course 3- Chapter 7 & Chapter 8)** **Network Virtualization**: Cloud Computing, Virtualization, Virtual Network Infrastructure, Software-Defined Networking Controllers**(Course 3 -Chapter 13)** **Network Automation:** Data Formats, APIs, REST, Configuration Management Tools, IBN and Cisco DNA Center **(Course 3 - Chapter 14)**	**9**	**20NHOP612/712.5** **20NHOP612/712.6**
	HANDS-ON Configuration of PPP WAN Authentication and VPN 2 Configuration of CDP,LLDP,NTP		

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assign ments	Daily Assessment
Marks	**25**	**15**	**10**
Remember			
Understand			5
Apply	10	10	5
Analyze	10	5	
Evaluate	5		
Create			

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	
Apply	20
Analyze	20
Evaluate	10
Create	

INDUSTRIAL INTERNET OF THINGS – EMBEDDED SYSTEMS

Course Code	20NHOP613/713
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP613/713.1	Understand the fundamentals of Embedded system and microcontrollers
20NHOP613/713.2	Apply the concept of Embedded System for its Software development.
20NHOP613/713.3	Analyse the Linux operating system and Wi-Fi for raspberry pi.
20NHOP613/713.4	Enable to configure various Sensors and Actuators, Memory, Communication Interface I2C
20NHOP613/713.5	Discuss the Architecture and features of Raspberry Pi and become familiar with thedesign aspects of I/O and Memory Interfacing circuits.
20NHOP613/713.6	Use modern tools to acquire competency in various storage devices and apply the knowledge gained in designing websites.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP613/713.1	3	3	3	3	3	2	1	1	3	3	3	3		
20NHOP613/713.2	3	3	3	3	3	2	1	1	3	3	3	3		
20NHOP613/713.3	3	3	3	3	3	2	1	1	3	3	3	3		
20NHOP613/713.4	3	3	3	3	3	2	1	1	3	3	3	3		
20NHOP613/713.5	3	3	3	3	3	2	1	1	3	3	3	3		
20NHOP613/713.6	3	3	3	3	3	2	1	1	3	3	3	3		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) Introduction to Embedded Systems, Shibu K V, 2009, TMH.
2) Embedded Systems – A contemporary Design Tool, James K Peckol, 2014, John Wiley.

REFERENCE BOOKS:

1) Microprocessors and Interfacing – Programming & Hardware Douglas Hall, 2nd edition, 1990, McGraw Hill.
2) Microprocessors and Microcontrollers: Architecture, Programming and System Design, Krishna Kant, 2007, PHI.
3) The Intel Microprocessors Architecture, Programming and Interfacing, Barry B. Brey, 2007, Pearson Education.

Module No	Module Contents	Hrs	COs
1	**Introduction to Embedded Systems and Embedded OS:** Embedded System its importance, Embedded Systems Vs. General Computing Systems, Classification of Embedded System, Major Application areas of Embedded System, Purpose of Embedded System, and The Innovative Bonding of lifestyle with Embedded Technology, CISC vs. RISC, fundamentals of Von-Neumann/Harvard architectures, types of microcontrollers, selection of microcontrollers	**8**	**20NHOP613/713.1**
2	**OS installation & Setting up Wi-Fi for raspberry pi:** Download of Linux OS Latest version, installation, and partitioning, Embedded development environment - GNU debugger - tracing & profiling tools - binary utilities - kernel debugging - debugging embedded Linux applications - porting Linux - Linux and real time - SDRAM interface Wireless connection using Wi-Fi for raspberry pi.	**9**	**20NHOP613/713.2 20NHOP613/713.3**
3	**I/O & Serial protocol programming for Embedded development:** Core of the Embedded System, Sensors and Actuators, Memory, Communication Interface, Embedded Firmware, Other System Components Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, quality attributes of embedded system **Understanding I2C and I2C Interface, programming I2C** Understanding of serial communication protocol I2C, Details of sensors and actuator using I2C protocol, APIs to configure the I2C module on raspberry-pi and communicate to other devices over I2C,Programming the GPIO and interfacing peripherals With Raspberry Pi, Boot Process of Raspberry-Pi	**9**	**20NHOP613/713.4**
4	**Introduction to single board computer:** Types of Processors, Advantages and Applications of Raspberry Pi. Introduction to Embedded Software Development, Compiling the applications, software flow, input, output and peripheral accesses, Microcontroller interfaces, Raspberry Pi board and its Data Sheet, , Client-Server programming **Hands-on with the Raspberry Pi 3 Model:** Raspberry Pi board data sheet, Using lib curl (for JSON objects), Boot Process of Raspberry-Pi, Client-Server programming.	**9**	**20NHOP613/713.5**
5	**Single board computer and peripherals interfacing:** Lego Train's IR protocol("LPF RC Protocol": LEGO Power Function RC Protocol),I2C GPIO expander board(using MCP23017),I2C GPIO Expander IC MCP23017/MCP23S17,Sample code to use I2C GPIO Expander, Understanding Stepper Motor, Using LDR Sensor Module with Raspberry Pi,BCM2835-ARM-Peripherals,BCM-2835 SOC details, Generating PWM signals through the Pi	**9**	**20NHOP613/713.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Report
Marks	**25**	**15**	**10**
Remember			
Understand	5		
Apply	10	10	10
Analyze		5	
Evaluate	5		
Create	5		

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	5
Apply	30
Analyze	5
Evaluate	5
Create	5

BLOCKCHAIN

Course Code	20NHOP614/714
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP614/714.1	Apply the fundamentals of Blockchain Technology in different domains.
20NHOP614/714.2	Apply and analyse the various cryptographic mechanisms used in Blockchain
20NHOP614/714.3	Design smart contracts using solidity
20NHOP614/714.4	Analyse various Ethereum environment and wallets
20NHOP614/714.5	Design and develop solutions with Ethereum concepts using any open source tools
20NHOP614/714.6	Design projects based on smart contracts.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP614/714.1	3	3			3							3		
20NHOP614/714.2	3	3	3		3							3		
20NHOP614/714.3	3	3	3	2	3							3		
20NHOP614/714.4	3	3	3		3									
20NHOP614/714.5	3	3	3	2	3			1	1	1	1			
20NHOP614/714.6	3	3	3	2	3			1	1	1	1			

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

Module No	Module Contents	Hrs	COs
1	**Fundamentals of Blockchain:** History of Blockchain, Distributed ledgers, Problems with distributed ledger, Blockchain popularity, Pros and Cons of Blockchain, Use case of Blockchain, The problem of trust, Trust through consensus, Consensus models and mining, Types of Blockchain platforms, Crypto currencies, P2P applications, Genesis Block, Blockchain wallets, Decentralized applications. **Hands-On** 1) Installation Metamask 2) Getting free Ethers 3) Explore mining and live transactions 4) Explore Past transactions and blocks 5) Blockchain Demo	**9**	**20NHOP614/714.1**
2	**Blockchain Cryptography:** Understanding digital signatures, Encryption, Decryption, Types of encryption, Stream Ciphers, Block Ciphers, Encryption Algorithms, Elliptical curve cryptography, Public and private keys in Blockchain,Transaction Signing, Hashing, Merkle Trees. **Hands-On** 6) Encryption and Decryption using SHA/MD5 7) Public and private keys	**9**	**20NHOP614/714.2**
3	**Smart Contract Programming with Solidity:** A smart contract, Lifecycle of Smart Contract, need of smart contracts, Smart contracts in B2C applications (Business to consumer), Smart contracts in B2B applications (Business to business), **Solidity Programming: S**olidity - Introduction, Need and features, Language: Types, Structures, Control Flow and Smart contract structure. **Hands-On** 1) Interacting with smart contracts 2) Writing a basic smart contract 3) Compiling a smart contract 4) Deploying a smart contract 5) Debugging smart contract code	**9**	**20NHOP614/714.3**
4	**Fundamentals of Ethereum:** History of Ethereum, Ethereum Concepts and Terminology, Ethereum Virtual Machine, Ethereum Releases, Ethereum Networks, Ethereum Wallets, Ethereum currency and units (ether, gwei, wei), Gas, Types of Ethereum Accounts, Ethereum Blockchain Explorers, Ether Faucets, Ethereum clients. **Hands-On** 1) Creating Ethereum wallets 2) Creating Ethereum accounts 3) Transacting between Ethereum accounts 4) Exploring Ethereum mining and transactions	**9**	**20NHOP614/714.4**
5	**Ethereum Infrastructure Development and Testing** Introduction to geth client, interacting with Ethereum network using geth, Ethereumdevelopment tools, Setting up the development environment. **Hands-On** 1) Installing Ethereum Clients 2) Basic geth Node Administration 3) Mining with geth 4) Writing unit tests for smart contract functions 5) Testing deployments	**9**	**20NHOP614/714.5** **20NHOP614/714.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments (Mini Project)	Quiz
Marks	**25**	**20**	**5**
Remember			
Understand	5		
Apply	10	10	10
Analyze		5	
Evaluate	5		
Create	5		

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	
Apply	20
Analyze	10
Evaluate	10
Create	10

PRODUCT LIFE CYCLE MANAGEMENT

Course Code	20NHOP615/715
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP615/715.1	Integrate the various stages of PLM into engineering product categories and portfolios that willevaluate into commercial success.
20NHOP615/715.2	Interpret the data with information and/or communicate the same for the supply chain and valuesupplier chain quotation to ensure sustainable development.
20NHOP615/715.3	Examine life cycle management strategies and knowledge to develop new and/or appropriate engineering design solutions in engineering environment.
20NHOP615/715.4	Translate and implement the legal, environmental and international regulatory frame works into product design, development and manufacturing requirements.
20NHOP615/715.5	Assess system for corrective and preventive action to track production qualityissues through digital manufacturing.
20NHOP615/715.6	Incorporate preventive approaches concentrating on minimizing waste, hazard and risk associatedwith product design, development and Manufacturing.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP615/715.1	3		3											
20NHOP615/715.2	3			1	3									
20NHOP615/715.3	3		3						1					
20NHOP615/715.4		2	3											
20NHOP615/715.5					3									
20NHOP615/715.6					3						1			

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) Product Lifecycle Management : Grieves, Michael, McGraw-Hill Publications, Edition 2013, ISBN:978-0071452304.
2) Product Lifecycle Management Volume I: Stark, John, Springer, 3rd Edition, 2016, ISBN: 978-3319174396.
3) Product Lifecycle Management Volume II: Stark, John, Springer, 3rd Edition, 2016, ISBN: 978-3319244341

REFERENCE BOOKS:

1) Fabio Guidice, Guido LaRosa, Product Design for the environment –A life cycle approach, Taylor and Francis 2013, ISBN:978-1420001044
2) Robert J.Thomas, "NDP:"Managing and forecasting for strategic processes", Wiley Publications, 2013 ISBN:978-0471572268
3) Stark, John, "Product Life cycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2015. ISBN:978-3-319-17440-2
4) Saaksvuori, Antti and Immpnen, Anselmi. " Product Lifecycle Management", Springer- Verlag, 2013. ISBN978-3-540-26906-9
5) PDM: Product Data Management: Burden, Rodger, Resource Pub, 2013. ISBN:978- 0970035226
6) Suggested Software Packages: CatiaV5R19, DelmiaV5R19,3DviaComposer,3DXML player, Smart TeamV5R19

Module No	Module Contents	Hrs	COs
1	**Introduction to Product Life Cycle Management(PLM):** Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM, Opportunities and Benefits of PLM, Views, Components and Phases of PLM, PLM feasibility Study, PLM Visioning. Case Study of Life Cycle of Products using PLM software	**9**	**20NHOP615/715.1**
2	**PLM Concepts, Processes and Workflow:** Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM. Case study of drivers of PLM using software **Collaborative Product Development:** Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management	**9**	**20NHOP615/715.2** **20NHOP615/715.3**
3	**Collaborative Product Development** Bill of Materials and Process Consistency, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral. Case Study on collaborate product development for simple product using PLM software	**9**	**20NHOP615/715.3** **20NHOP615/715.4**
4	**Digital Manufacturing – PLM:** Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning. Digital Manufacturing case study using PLM software	**9**	**20NHOP615/715.4**
5	**Developing a PLM Strategy and Conducting a PLM Assessment:** Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications. PLM strategy and assessment using software	**8**	**20NHOP615/715.5** **20NHOP615/715.6**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Daily Assessment
Marks	**25**	**15**	**10**
Remember	5		
Understand	5	5	5
Apply	5	5	5
Analyze	5	5	
Evaluate	5		
Create			

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

NETWORK SECURITY AND CRYPTOGRAPHY

Course Code	20NHOP617A/717A
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP617A/717A.1	Apply the classical and modern algorithms and block cipher principles to perform symmetric encryption
20NHOP617A/717A.2	Apply fundamentals of secret and public cryptography and key algorithms for problem solving along with the ability of distinguishing between symmetric key and asymmetric key cryptosystems.
20NHOP617A/717A.3	Analyze the authentication and security requirement of MAC and Hash functions.
20NHOP617A/717A.4	Evaluate the various security designs for public networks using available secure solutions
20NHOP617A/717A.5	Identify the various issues and threats related to security in particular to the cyber application.
20NHOP617A/717A.6	Keep the knowledge boundaries expanded for lifelong learning and indulge in applications of ethical hacking for ensuring complete cyber /network security to the society

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP617A/717A.1	3	3	3		3				3			3		
20NHOP617A/717A.2	3	3	3		3				3			3		
20NHOP617A/717A.3	3	3	3	3	3				3			3		
20NHOP617A/717A.4	3	3	3		3	3		3	3	3		3		
20NHOP617A/717A.5	3	3	3	3	3	3		3	3	3		3		
20NHOP617A/717A.6	3	3	3	3	3	3		3	3	3		3		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition
2) Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition (Chapters – 1,3,4,5,6,7,11,12,13,14,15,19 (19.1-19.5),21(21.1-21.2),22(22.1-22.4),25
3) CCNA Cybersecurity Operations 1.1(ONLINE) -Networking academy Course

REFERENCE BOOKS:

1) Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay, Mc-Graw
2) Cyber Law simplified- Vivek Sood, Mc-Graw Hill, 11th re-print, 2013
3) Cyber security and Cyber Laws, Alfred Basta, Nadine Basta, Mary brown, Ravindra Kumar,Cengage learning

Module No	Module Contents	Hrs	COs
1	**INTRODUCTION TO CYBER SECURITY:** Cyber security and the Security Operations Center, Attackers and Their Tools, Common Threats and Attacks, Network Attacks- A Deeper Look, Observing Network Operation, Attacking the Foundation **BASICS OF CRYPTOGRAPHY:** Classical Encryption techniques, Elementary Substitution Ciphers, ElementaryTransposition Ciphers **Hands-On:** 1) Creating Codes: Use Cryptii Encoding and decoding tool encrypt the plaintext using substitution ciphers and transpositio ciphers 2) Using TCP/UDP Endpoint Viewer to Explore Processes,Threads, Handles, and Windows Registry 3) Getting Familiar with the Linux Shell, Linux command line to identify servers running on a given computer. Navigating the Linux File system and Permission Settings using Cyber Ops Workstation Virtual Machine.	**9**	20NHOP617A/717A.1 20NHOP617A/717A.5
2	**BLOCK CIPHERS:** Traditional Block Cipher Structure, Data Encryption Standard, Block Cipher Design Principles, Block cipher Modes of Operation. Advanced Encryption Standard: Structure, Transformation Functions and Key Expansion **PUBLIC KEY CRYPTOGRAPHY:** Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman key Exchange, Elliptic Curve Arithmetic **Hands-on:** 1) Creating Block Codes: Use Cryptii Encoding and decoding tool to encrypt the plaintext using AES and different Block Cipher modes. 2) Introduction to Wireshark: Capture and Analyze ICMP Data in Wireshark, to Examine and Analyze Ethernet Frames. 3) Using Wireshark to Observe the TCP 3-Way Handshake, Analyze Packets using TCP dump.	**9**	20NHOP617A/717A.1 20NHOP617A/717A.2
3	**AUTHENTICATION**: Authentication–I - One-way Authentication, Mutual Authentication, Dictionary Attacks, Authentication – II – Centralized Authentication, Kerberos, Biometrics. **MESSAGE AUTHENTICATION CODES:** Message Authentication requirements, Message Authentication functions, Requirements and Security of MACs. **HASH FUNCTIONS:** Requirements and Security of HashFunctions. **KEY MANAGEMENT AND DISTRIBUTION:** Symmetric Key distribution using symmetric and asymmetric encryption, Distribution of Public Keys. **Hands-on:** 1) Creating Hash and HMACCodes: Use Cryptii Encoding and decoding tool to encrypt the plaintext using Hash function and HMAC with MD5 and SHA Algorithm 2) Creating Hashes with Open SSLAttacking a my SQL Database 3) Encrypting and Decrypting Data Using Open SSL and Hacker tool.	**9**	20NHOP617A/717A.2 20NHOP617A/717A.3 20NHOP617A/717A.6
4	**IPSECSECURITY AT THE NETWORK LAYER**– Security at Different layers, IPSec in Action, Internet Key Exchange (IKE) Protocol, Security	**9**	20NHOP617A/717A.4 20NHOP617A/717A.5

	Policy and IPSEC, Virtual Private Networks. **SECURITY AT THE TRANSPORT LAYER**- Introduction, SSL Handshake Protocol, SSL Record Layer Protocol, OpenSSL. **WEB SECURITY AND ENDPOINT SECURITY**–Motivation, Technologies for Web Services, WS- Security,Endpoint Protection, Endpoint Vulnerability Assessment. **IEEE 802.11 WIRELESS LAN SECURITY** - Background, Authentication, Confidentiality and Integrity, Viruses, Worms,and Other Malware **Hands-on:** 1) Using Wireshark to Examine TCP,UDP, UDP DNS Captures 2) Using Wireshark to Examine HTTP and HTTPS 3) Examining Telnet and SSH in Wireshark 4) Using Wireshark to Examine a Virus file [PCAP file]		20NHOP617A/717A.6
5	**INTRUSION PREVENTION AND DETECTION**-Types of Instruction Detection Systems, DDoS Attacks Prevention/Detection, Network Firewalls, Content Filtering, Threat Intelligence. **INTRUSION DATA ANALYSIS:** Data Collection, Data Preparation, Data Analysis, Incident Response and Handling: Incident Response Models, CSIRTs and NIST 800- 61R2,Casestudies:Worm and Distributed Denial of Service (DDoS) Agent Infestation, Unauthorized Access to Payroll Records. **IT ACT:**Aim and objectives, Scope of the act, Major Concepts, Important provisions, dispatch of electronic records, Secure electronic records and Digital signatures, X.509 Certificates, secure digital signatures. **Hands-on:** 1) Digital Certificate Authority Stores: Certificates Trusted by Your Browser, Checking for Man-In-Middle. 2) Snort and Firewall Rules: Firewall and IDS Logs, Terminate and Clear Mini net Process. 3) Extract an Executable from a PCAP: Analyze Pre-Captured Logs and Traffic Captures. 4) Interpret HTTP and DNS Data to Isolate Threat Actor: Investigate an SQL Injection Attack, Data Exfiltration Using DNS. 5) Isolated Compromised Host Using 5-Tuple: Reconnaissance, 6) Exploitation, Infiltration, Review the Logs.	**9**	20NHOP617A/717A.5 20NHOP617A/717A.6

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Daily Assessment
Marks	**25**	**15**	**10**
Remember	5		5
Understand	5		
Apply	10	15	
Analyze	5		5
Evaluate			
Create			

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

PHYSICAL DESIGN

Course Code	20NHOP618A/718A
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP618A/718A.1	Understand VLSI Technology back-end design flow and its implementations
20NHOP618A/718A.2	Apply the procedure of Floor planning in physical design
20NHOP618A/718A.3	Use the placement algorithms in physical design
20NHOP618A/718A.4	Examine routing and design rule check for a given physical design
20NHOP618A/718A.5	Evaluate clock tree synthesis and power management of the circuit
20NHOP618A/718A.6	Engage in independent learning and perform the physical design of selected VLSI circuit

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP618A/718A.1					3									
20NHOP618A/718A.2	3	3	3		3									
20NHOP618A/718A.3	3	3	3		3									
20NHOP618A/718A.4	3	3	3	2	3									
20NHOP618A/718A.5	3	3	3	2	3									
20NHOP618A/718A.6	3	3	3	2	3				1	1		1		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS:

1) VLSI physical design automation : theory and practice by Sadiq M Sait and Habib Yusuf, McGraw-Hill Book Co.
2) VLSI Physical Design: From Graph Partitioning to Timing Closure Andrew B. Kahng Jens
3) Lienig, Igor L. Markov, Jin Hu2011, Springer.

REFERENCE BOOKS:

1) J. Bhasker, R Chadha,., —Static Timing Analysis for Nanometer Designs: A Practic Approach‖, Springer, 2009.
2) Michael John Sebastian Smith, —Application - Specific Integrated Circuits‖ Addiso Wesley Professional; 2005.

Module No	Module Contents	Hrs	COs
1	**Introduction to Physical Design :** Introduction to PD flow, Inputs of PD – Library files, Net list, SDC(Synopsis Design Constraints), LEF(Library Exchange File),Output of PD – GDSII, Area, Power, Timing reports.	**9**	20NHOP618A/718A.1 20NHOP618A/718A.6
2	**Partitioning and Floor planning :** Partitioning, Floor planing, Floor plan Algorithms, Pin Assignment, Floor plan-Die size estimation, Aspect Ratio, Core Utilization, Macros and Types –Soft macros, Hard macros, Firm macros	**9**	20NHOP618A/718A.2 20NHOP618A/718A.6
3	**Placement Algorithms :** Placement algorithm – Simulated Annealing/Force directed/Breuer's Algorithm Type of Placement – Standard cell placement, Building block placement Cell types – Well tap cells, End cap cells,Decap cells, Filler cells, Spare cells, Timing driven placement, Congestion driven placement, Placement Congestion – Global route congestion, Congestion map,Easing congestion	**9**	20NHOP618A/718A.3 20NHOP618A/718A.6
4	**Routing :** Grid Routing, Global Routing, Detailed Routing, Design Rule check, clock route vs signal route, shorts, drc, opens, routing signals in higher layers, Getting attributes like route length, number of vias etc for a given net	**9**	20NHOP618A/718A.4 20NHOP618A/718A.6
5	**Power plan** – Rings, Stripes, Rails, Core power management, I/O cell power management, IR drop – types of IR drop Skew, Latency, Jitter, Early clock tree, Useful skew, Hold fixing func mode and shift mode, Generated clocks, clock groups vs false paths, clock routing, NDR	**9**	20NHOP618A/718A.5 20NHOP618A/718A.6

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assign ments	Daily Assessment
Marks	**25**	**15**	**10**
Remember			5
Understand			5
Apply	15	5	5
Analyze	10	5	
Evaluate		5	
Create			

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	
Understand	
Apply	20
Analyze	15
Evaluate	15
Create	

AI DATA ANLYSIS WITH PYTHON

Course Code	20NHOP619A/719A
L: T: P:S	3:0:0:0
Exams Hours	03

Credits	03
CIE Marks	50
SEE Marks	50

Course Outcomes: At the end of the Course, the student will be able to:

20NHOP619A/719A.1	Explore predictive modeling techniques with necessary python packages
20NHOP619A/719A.2	Apply predictive modeling and descriptive statistics concepts for data preparation
20NHOP619A/719A.3	Examine and use appropriate methods for data wrangling
20NHOP619A/719A.4	Inspect and submit efficient solution for the given data source as a team.
20NHOP619A/719A.5	Prepare an effective written documentation about significance of feature selection
20NHOP619A/719A.6	Demonstrate Big data tools used for analytics

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
20NHOP619A/719A.1					3							3		
20NHOP619A/719A.2	3				3							3		
20NHOP619A/719A.3		3			3							3		
20NHOP619A/719A.4				3	3				2	2		3		
20NHOP619A/719A.5					3				2			3		
20NHOP619A/719A.6	3				3							3		

Ratings: 3 for high, 2 for substantial, 1 for low. To be followed in mapping.

TEXT BOOKS / REFERENCE BOOKS::

1) J. Jayalakshmi , D. Stalin Alex , B. Mahesh Prabhu,S. , Problem Solving and Python Programming , Chand publication,1 January 2018
2) Data Preparation for Machine Learning by Jason Brownlee , 2020
3) Master Machine Learning Algorithms Discover How They Work and Implement Them From Scratch by Jason Brownlee, 2016.

Module No	Module Contents	Hrs
1	**Introduction to python:** Introduction to Data, Expressions, Statements: Introduction to Python and installation, variables, expressions, statements, Numeric data types: Int, float, Boolean, string. Basic data types: list--- list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters. Dictionaries: operations and methods. **Hand on:** • Understanding of data types • Understanding of list and operation • List to array • Understanding of dictionaries	**10**
2	**Packages Concepts** Python Packages: Numpy , Matplotlib , pandas ,scipy , scikit , Data frame , Loading Machine Learning data **Hand on:** • Learning Objectives • Understanding the Domain • Understanding the Dataset • Python package for data science • Importing and Exporting Data in Python • Basic Insights from Datasets	**10**
3	**Cleaning and Preparing the Data :** Need for Data Pre-processing, Data Transforms, and Rescale Data Standardize Data, Normalize Data, Basic data cleaning, Outlier Identification and Removal , How to Mark and Remove Missing Data , Statistical Imputation **Hand on:** • Identify and Handle Missing Values • Data Formatting • Data Normalization Sets • Binning • Indicator variables	**8**
4	**Summarizing the Data Frame:** Mean Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map CorrelationStatistics – ANOV **Hand on:** • Basic of Grouping • ANOVA , Correlation • More on Correlation	**8**
5	**Model Development:** Classification **,** Types of Classification,Regression , Confusion matrix , Performance metrics of the model **Hand on:** • Simple and Multiple Linear Regression • Model Evaluation Using Visualization • Polynomial Regression and Pipelines • R-squared and MSE for In-Sample Evaluation • Prediction and Decision Making	**9**

Assessment Pattern

CIE (50 Marks – Theory)

Bloom's Category	Tests	Assignments	Quizzes
Marks	**25**	**15**	**10**
Remember			5
Understand	5		5
Apply	15	7.5	
Analyze	5		
Evaluate		7.5	
Create			

SEE (50 Marks – Theory)

Bloom's Category	Tests (theory)
Remember	10
Understand	10
Apply	30
Analyze	
Evaluate	
Create	

APPENDIX-A
Outcome Based Education

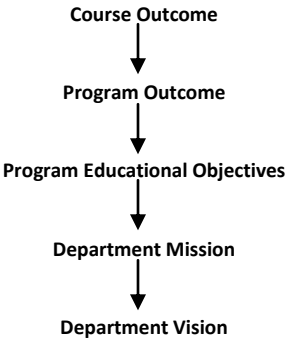
Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes. There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX-B
The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX-C
BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. **[eduglosarry.org]**