



NEW HORIZON COLLEGE OF ENGINEERING

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



Open Elective Syllabus

Batch: 2023-2027
(6th & 7th Semester)
(160 Credits)

New Horizon College of Engineering, Bangalore

Autonomous College affiliated to VTU, Accredited by NAAC with 'A' Grade & NBA

VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students
- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation
- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities

Quality Policy

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

Values

- | | |
|--------------------|-------------------------|
| ❖ Academic Freedom | ❖ Professionalism |
| ❖ Innovation | ❖ Inclusiveness |
| ❖ Integrity | ❖ Social Responsibility |
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New Horizon College of Engineering

SIXTH SEMESTER OPEN ELECTIVES LIST FOR AY 2025-2026 (EVEN SEMESTER)

Batch: 2023-2027

Course Code	Course Name	BOS
25NHOP601	Data Analytics using R Programming	CSE
25NHOP602	Advanced Networking	CSE
25NHOP603	SAP	ME
25NHOP604	Product Life Cycle Management	ME
25NHOP605	Industry 4.0	ME
25NHOP606	Schneider - Industrial Automation	EEE
25NHOP607	CISCO - Routing & Switching - I	ECE
25NHOP609	Embedded Programming	ECE
25NHOP610	5G Mobile Communication	ECE
25NHOP611	VLSI Physical Design-I	ECE
25NHOP612	Juniper Network Operating System	ISE

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SEVENTH SEMESTER OPEN ELECTIVES LIST FOR AY 2026-2027 (ODD SEMESTER)

Batch: 2023-2027

Course Code	Course Name	BOS
25NHOP701	Data Analytics using R Programming	CSE
25NHOP702	Advanced Networking	CSE
25NHOP703	SAP	ME
25NHOP704	Product Life Cycle Management	ME
25NHOP705	Industry 4.0	ME
25NHOP706	Schneider - Industrial Automation	EEE
25NHOP707	CISCO - Routing & Switching - I	ECE
25NHOP708	CISCO - Routing & Switching - II	ECE
25NHOP709	Embedded Programming	ECE
25NHOP710	5G Mobile Communication	ECE
25NHOP711	VLSI Physical Design-I	ECE
25NHOP712	Juniper Network Operating System	ISE
25NHOP713	VLSI Physical Design-II	ECE

OPEN ELECTIVE

(6th & 7th SEMESTER SYLLABUS)

DATA ANALYTICS WITH R PROGRAMMING

Course Code	25NHOP601 / 25NHOP701	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP601.1	Comprehend with statistical tools to import and manage data to demonstrate proficiency.
25NHOP601.2	Apply comprehensive data exploration and visualization using suitable platform to interpret data effectively for informed decisions.
25NHOP601.3	Apply tools for data transformation to select appropriate data sources.
25NHOP601.4	Analyze to shape and combine data for meaningful insights and visualization.
25NHOP601.5	Evaluate the analytics features to summarize, model and customize the data.
25NHOP601.6	Design interactivity, formatting to dashboards and publishing content for effective data communication on cloud platforms.

Mapping of Course Outcomes to Program Outcomes:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
25NHOP601.1	3	3	3	3	3	-	-	-	-	-	-	3
25NHOP601.2	3	3	3	3	3	-	-	-	-	-	-	3
25NHOP601.3	3	3	3	3	3	-	-	-	-	-	-	3
25NHOP601.4	3	3	3	3	3	-	-	-	-	-	-	3
25NHOP601.5	3	3	3	3	3	-	-	-	-	-	-	3
25NHOP601.6	3	3	3	3	3	-	-	-	-	-	-	3

MODULE-1 STATISTICAL COMPUTING AND DATA TRANSFORMATION 25NHOP601.1 8 Hours

MR Tool: Installing, loading and updating R packages, creating objects, Data types, Data structures, Sorting vectors and data frames, Directory management commands, Direct data entry in R (for small data sets), Importing data from other software, Decision structures (if, if-else, if-else if-else), Repetitive structures (for and while loops), Other functions (break, next, warn, stop).

Data Wrangling and Cleaning: Transform continuous variables to categorical variables, handling missing values, Sub-setting data frames, Appending and merging data frames, Split data frames, Stack and unstack data frames.

Hands on:

1. Write a R program to get the first 10 Fibonacci numbers.
2. Write a R program to find the maximum and the minimum value of a given vector.
3. Write a R program to get all prime numbers up to a given number
4. Write a R program to get the unique elements of a given string and unique numbers of vector

MODULE-2 STATISTICAL DATA ANALYSIS 25NHOP601.2 8 Hours

Explanatory Data Analysis and Data Visualization: Creating tables of frequencies and proportions, Cross tabulations of categorical variables, Descriptive statistics for continuous variables, Graphs and charts in R.

Comparison & Association Tests in R: One Sample T Test, One-way analysis of variance (ANOVA), Chi-Square test of independence, Pearson's Correlation, Spearman's Rank-Order Correlation.

Predictive Regression Models: Linear Regression, Multiple Linear Regression, Binary Logistic Regression, Ordinal Logistic Regression.

Hands on:

1. Two Categorical Variables – Discover relationships within a dataset
2. Create Two Dimensional Tables from Multi-Dimensional Cross-Tabulations
3. Create a model for crop yield as a function of the type of fertilizer used. First use aov() to run the model, then use summary() to print the summary of the model.
4. Fit a simple linear regression model using the lm() function.

MODULE-3	CONNECT AND TRANSFORM DATA	25NHOP601.3, 25NHOP601.4	8 Hours
<p>Connect to Data Sources: Choose an appropriate data source, choose between live connection or extract, Connect to a data source.</p> <p>Prepare data for analysis: Assess data quality (completeness, consistency, accuracy), Perform cleaning operations, Organize data into folders, Use multiple data sources, Prepare data by using Data Interpreter, pivot and split, Create extract filters</p> <p>Perform data transformation: Choose which data transformation to perform based on a business scenario, Combine data by using unions and joins, Shape data by using aggregations, Perform filtering, Shape data by using pivots.</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. Experiment the steps to connect with a data source and choose between live connection and extract. 2. Program to Add Web Images Dynamically to Worksheets 3. Program to Organize and Customize Fields in the Data Pane 4. Perform Maps and Geographic Data Analysis 			
Case Study / Applications	<p>Healthcare diagnostics and treatment personalization: Healthcare diagnostics and treatment personalization involve tailoring medical approaches to individual patients based on their unique characteristics, including genetic makeup, medical history, lifestyle factors, and environmental influences. Perform case study on preparing data, analyse and do transformation as required.</p>		
MODULE-4	EXPLORE AND ANALYZE DATA	25NHOP601.5	8 Hours
<p>Create quick table calculations: Create calculated fields, Moving average, Percent of total, Running total, Percentile, Create custom table calculations.</p> <p>Create and use filters: Apply filters to dimensions and measures, Add filters to context, Create parameters to enable interactivity, Structure the data, Map data geographically, Summarize, model, and customize data by using the Analytics feature.</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. Perform quick table calculations including creating calculated fields, calculating moving averages, and computing percentages of the total. 2. Write a program to apply filters to dimensions and measures 3. Design a program to Map a data geographically 			
Case Study / Applications	<p>Fraud detection and prevention in finance: Fraud detection and prevention in finance are critical aspects of maintaining the integrity and security of financial systems. As technology evolves, so do the methods used by fraudsters, necessitating sophisticated approaches to identify and mitigate fraudulent activities. Perform case study on preparing data and analyse those data as required.</p>		
MODULE-5	CREATE CONTENT & PUBLISH ON CLOUD	25NHOP601.6	8 Hours
<p>Data Interpretation: Create charts, Create dashboards and stories, Add interactivity to dashboards, Format dashboards, Publish Content, Schedule data updates, Manage Published workbooks</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. Create a charts, dashboards and stories 2. Write a program to add interactivity and formatting to dashboards 			
Case Study / Applications	<p>E-commerce personalization and recommendation systems: E-commerce personalization and recommendation systems play a crucial role in enhancing the online shopping experience, increasing customer engagement, and driving sales. These systems leverage data analytics, machine learning algorithms, and user behavior analysis to deliver personalized product recommendations. Perform case study on preparing data, creating charts and publishing those data in cloud as required.</p>		

CIE Assessment Pattern (50 Marks - Hands On) -

RBT Levels		Marks Distribution			
		CIE 1	CIE 2	Certified Online Learning	Project Based/ Case Based Assessment
		25	25	15	10
L1	Remember	-	-	-	-
L2	Understand	5	5	5	-
L3	Apply	10	10	5	5
L4	Analyze	5	5	5	5
L5	Evaluate	5	5	-	-
L6	Create	-	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Reference Books:

- 1) High-Performance Data Mining and Big Data Analytics, Khosrow Hassibi, Create Space Independent Publishing Platform, 1st Edition, 2014
- 2) R for Data Science, Hadley Wickham and Garrett Gorlemund, First Edition, O'Reilly.
- 3) Mastering Tableau 2023: Implement advanced business intelligence techniques, analytics, and machine learning models with Tableau by Marleen Meier, Christina Stathopoulos, et al.

Web links and Video Lectures (e-Resources):

- <https://examupdates.in/big-data-analytics/>
- https://www.tutorialspoint.com/big_data_analytics/index.htm
- https://swayam.gov.in/nd2_arp19_ap60/preview

ADVANCED NETWORKING

Course Code	25NHOP602 / 25NHOP702	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	3	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP602.1	Apply subnetting and IP addressing techniques to design and configure IPv4-based enterprise network topologies.
25NHOP602.2	Implement and verify VLAN configurations and inter-VLAN routing using both routers and multilayer switches in a simulated environment.
25NHOP602.3	Apply static and dynamic routing configurations including RIP and OSPF to enable routing across multiple networks.
25NHOP602.4	Analyze OSPF behavior and troubleshoot issues related to DR/BDR elections, LSA types, neighbor adjacency, and OSPF packet exchanges.
25NHOP602.5	Evaluate advanced switching features including STP, EtherChannel, and VLAN management to enhance network reliability and efficiency.
25NHOP602.6	Apply IPv4 and IPv6 dynamic addressing techniques including DHCPv4, SLAAC, and DHCPv6 to automate host configuration in enterprise networks.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
25NHOP602.1	3	2	2	-	2	-	-	-	-	-	-	-
25NHOP602.2	3	2	3	-	2	-	-	-	-	-	-	-
25NHOP602.3	3	2	3	-	2	-	-	-	-	-	-	-
25NHOP602.4	2	3	3	3	3	-	-	-	-	-	-	-
25NHOP602.5	3	2	2	-	3	-	-	-	-	-	-	-
25NHOP602.6	3	3	3	2	3	-	-	-	2	2	1	1

MODULE-1	Networking Fundamentals	25NHOP602.1	8 Hours
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Introduction to Computer Networks: Components of a Computer Network, Types of Networks, Network Topologies, Networking Models, Real-World Applications of Computer Networks.

OSI & TCP/IP Models: The OSI Model, The TCP/IP Model, Protocols and Layer Mapping, Real-World Device and Layer Mapping.

Network Topology & Architecture: Physical vs Logical Topology, Cisco Three-Tier Enterprise Network Architecture, Spine and Leaf Architecture, Other Architectures.

IPv4 Addressing and Subnetting: IPv4 vs IPv6, Why Do We Need IP Addresses? IPv4 Addressing Structure, Types of IPv4 Addresses, Subnetting Techniques, Subnetting Method.

Ethernet & Switching Basics: Ethernet Frame Structure, MAC Address Table, Switches/ Bridges, Broadcast, Unicast, and Multicast, Switch vs Hubs, CSMA/CD.

Hands-on:

Installation and use of Pnet labs.

1. Switch Configuration
2. Switch Port Security
3. Design a Small office IP Network using IPV4 addressing and subnetting concepts

MODULE-2	Routing	25NHOP602.3 25NHOP602.4	8 Hours
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Static & Dynamic Routing Protocols: Static and Dynamic routing, RIP (Routing Information Protocol), RIP Timers, RIP Configuration, Policy Configuration, Verification, Link-State Routing Protocol OSPF, OSPF Metrics Cost, Router Types in OSPF, OSPF Neighbour Discovery and Adjacency, OSPF Packet Types, OSPF Neighbour Discovery and Adjacency, OSPF Packet Types, Designated Router (DR) and Backup DR (BDR), LSA Types (Link State Advertisements), OSPF Router ID (RID), OSPF Configuration, OSPF Troubleshooting Tips, OSPF Best Practices

Hands-on:					
<ol style="list-style-type: none"> 1. Configure Static Routing and Understand Limitations 2. Configure RIP v2 between R1 and R2, Forwarding & Topology Table 3. Configure and verify OSPF Area 10 dynamic routing on all routers. 					
MODULE-3	VLANS	25NHOP602.2	8 Hours		
VLANS: Switching Perspective, Creating VLANs, Port Types, VLAN Tagging -IEEE 802.1Q, Layer 3 VLANs: Routing Between VLANs, Router-on-a-Stick, Switched Virtual Interface (SVI), Switch Inter-VLAN Routing Example, Benefits of Layer 3 VLANs and SVIs, Real-World Use Cases.					
Hands-on:					
<ol style="list-style-type: none"> 1. Configure trunk port between SW1 and R1 using IEEE 802.1Q tagging. 2. Configure Router-on-a-Stick on R1 for inter-VLAN routing. 3. Inter-VLAN Routing on Layer 3 Switches 					
MODULE-4	Advanced Switching	25NHOP602.5	8 Hours		
Spanning Tree Protocols (STP, RSTP, MSTP, PVST, PVST+): STP Port Roles, STP Port States, STP Failure Types, Spanning Tree Enhancements & Safeguards, PortFast, BPDU Guard, BPDU Filter, Root Guard, Loop Guard, UDLD (Unidirectional Link Detection),					
VLAN management: VTP (VLAN Trunking Protocol), Verification. EtherChannel: Protocols, Cisco Configuration, Juniper Configuration (LACP), Load Balancing Methods,					
Hands-on:					
<ol style="list-style-type: none"> 1. Configure and Verify STP. 2. Configure and verify PAGP EtherChannel between the switches. 3. Configure and verify LACP EtherChannel between the switches. 					
MODULE-5	Dynamic Host Configuration	25NHOP602.6	8 Hours		
DHCPv4 Concepts: DHCP message types: DISCOVER, OFFER, REQUEST, ACK, SLAAC and DHCPv6 (IPv6 Addressing)					
Hands-on:					
<ol style="list-style-type: none"> 1. Configure and test the DHCPv4 server and client 2. Configure a DHCPv4 server for the network. 3. Capstone Project 					
Case Study	Campus Network – Centralized DHCPv4 Deployment				
CIE Assessment Pattern (50 Marks)					
RBT Levels		Marks Distribution			
		CIE 1	CIE 2	Certified Online Learning	Project Based/ Case Based Assessment
		25	25	15	10
L1	Remember	-	-	-	-
L2	Understand	10	10	-	-
L3	Apply	5	5	5	-
L4	Analyze	5	5	5	5
L5	Evaluate	5	5	5	5
L6	Create	-	-	-	-

SEE Assessment Pattern (50 Marks - Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:**Text Books:**

1. Data Communications and Networking. Forouzan, 5th Edition, McGraw Hill, Reprint-2017
2. Network Warrior - 2ND Edition, Gary A. Donahue, O'Reilly Media, Incl, 2011
3. CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand), 2016

Reference Books:

1. Computer Networking: A Top-Down Approach, James F. Kurose, Keith W. Ross, 8th Edition, Pearson, Reprint 2021
2. Routing TCP/IP Volume 1, Jeff Doyle, 2nd Edition, Cisco Press, Reprint – 2016

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=HD1WaIN-fvE>
- <https://www.youtube.com/watch?v=SW3QrbT11HQ>
- https://www.youtube.com/watch?v=Eo_eu-dN9NI
- <https://www.youtube.com/watch?v=CnSb8CyZuIQ>
- <https://www.youtube.com/watch?v=MEkka6sTh-A>

SAP												
Course Code	25NHOP603/ 25NHOP703						CIE Marks			50		
L:T:P:S	3:0:0:0						SEE Marks			50		
Hrs / Week	03						Total Marks			100		
Credits	03						Exam Hours			03		
Course outcomes:												
At the end of the course, the student will be able to:												
25NHOP603.1	Understand the concept of Automation, Manufacturing, Process Planning, Material Requirement Planning (MRP) and Master Production Schedule (MPS).											
25NHOP603.2	Create master data for new vendor and trading goods in Materials Management											
25NHOP603.3	Analyze the need for warehouse and transfer process.											
25NHOP603.4	Evaluate and create production order for the product groups.											
25NHOP603.5	Facilitate the flow of goods between producer and the purchaser for logistic operations											
25NHOP603.6	Create financial accounting process and generate financial statement											
Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
25NHOP603.1	3	2		2	2							
25NHOP603.2	2	2	3	2	3				2			
25NHOP603.3	2	2	3	2	3				2	2		
25NHOP603.4	2	2	3	2	3				2	2		
25NHOP603.5	3	3	3	2	3				2	2		
25NHOP603.6	2	3	2	3	3			1	2	2		
MODULE-1 MATERIALS MANAGEMENT (MM)												
									25NHOP603.1		8 Hours	
									25NHOP603.2			
Introduction to SAP, Enterprise Resource Planning (ERP), Material Requirement Planning (MRP or MRP-I), Material Resource Planning (MRP-II)												
Hands on: Execute Material Management module for Global Bike Incorporation using S/4 HANA.												
<ol style="list-style-type: none"> 1. Create new vendor, create 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 for BICYCLE STAND (BEST1***) 2. Creation of new vendor to review goods for BICYCLE CHAIN (BECN1***) 3. Creation of new vendor to review goods for BICYCLE LOCK (BELK1***) 												
Case Study / Applications				Procurement Cycle for a Bicycle Manufacturing Company (GBI)								
MODULE-2			WAREHOUSE MANAGEMENT (WM)						25NHOP603.3		8 Hours	
Automation, Capacity Planning (CC), Inventory Movement Cycle.												
Hands on: Execute Warehouse Management module for Global Bike Incorporation using S/4 HANA.												
Create purchase order, display material inventory, monitor stock overview (MMBE), receive the goods, display material inventory and value, run bin status report, create transfer order, confirm transfer order for following materials:												
<ol style="list-style-type: none"> 1. Knee pad KPAD1*** and Elbow pad EPAD1*** 2. Water bottles BOTL1*** and elbow pad EPAD1***) 3. Water bottles BOTL1*** and road helmets RHMT1***) 												
Case Study / Applications		Warehouse Optimization for Retail Distribution										
MODULE-3			SALES AND DISTRIBUTION (SD)						25NHOP603.4		8 Hours	
Sales & Distribution in ERP, Role of SD in Supply Chain Management, Sales order processing cycle												

Hands on: Execute Sales and distribution module for Global Bike Incorporation using S/4 HANA Create 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 for the following bicycle models:

1. Deluxe touring bicycle-black DXTR1*** and Professional Touring Bicycle-black PRTR1***
2. Deluxe touring bicycle-silver DXTR2*** and Professional Touring Bicycle-silver PRTR2***
3. Deluxe touring bicycle-red DXTR3*** and Professional Touring Bicycle-silver PRTR***

Case Study / Applications	Create End-to-End Order-to-Cash (O2C) Cycle for GBI Inc.		
MODULE-4	PRODUCTION PLANNING AND EXECUTION (PP)	25NHOP603.5	8 Hours

Computer Aided Process Planning (CAPP), Master Production Schedule (MPS), Plan-to-Produce Process Flow

Hands on: Execute production planning and control module for Global Bike Incorporation using S/4 HANA 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 for the following bicycle variants:

1. Deluxe touring bicycle BLACK color (DXTR1***), materials: TRWA1***, TRFR1***
2. Deluxe touring bicycle-silver DXTR2***, materials: PCKG1***PEDL1***
3. Deluxe touring bicycle-red DXTR3***, materials: CHAN1***, BRKT1***

Case Study / Applications	Production Planning for Seasonal Demand for GBI Inc		
MODULE-5	FINANCE AND CONTROL (FICO)	25NHOP603.6	8 Hours

Finance and Control (FICO), Integrated FICO Process Flow

Hands on: Execute FICO module for Global Bike Incorporation using S/4 HANA Create Enterprise Structure Configuration, Create Bank Account in General Ledger, Generate Accounts Payable (AP), Accounts Receivable (AR), Create Expense Account in General Ledger, Create Vendor Master Record, Post Transfer of Funds, Review transfer of funds, Display and Review Accounts Payable Balances, Post payment review, Run Financial statement for the following:

1. End-to-End Financial Cycle Simulation – GBI
2. Costing & Variance Analysis in Global Bike Inc. (GBI)
3. Asset Accounting for GBI

Case Study / Applications	Implement SAP FICO to a mid-sized bicycle manufacturing company		
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CIE Assessment Pattern (50 Marks – Hands On) –

RBT Levels		Marks Distribution			
		CIE 1	CIE 2	Certified Online Learning	Project Based/ Case Based Assessment
		25	25	15	10
L1	Remember	-	-	-	-
L2	Understand	-	-	-	-
L3	Apply	10	10	05	5
L4	Analyze	10	10	05	5
L5	Evaluate	05	05	05	-
L6	Create	-	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	15
L5	Evaluate	15
L6	Create	-

Reference Books:

1. Automation, Production Systems & Computer Integrated Manufacturing, M. P. Groover, Person India, 2018, 4th Edition.
2. A beginner's guide to SAP, Martin Munzel, Sydney McConnel, 2nd edition.

Web links and Video Lectures (e-Resources):

- <https://helsinki.cob.csuchico.edu:8001/sap/bc/gui/sap/its/webgui/>
- <https://newhorizoncollegeofengineering.in/sap-lab/>

PRODUCT LIFE CYCLE MANAGEMENT												
Course Code	25NHOP604 / 25NHOP704						CIE Marks	50				
L:T:P:S	3:0:0:0						SEE Marks	50				
Hrs / Week	03						Total Marks	100				
Credits	03						Exam Hours	03				
Course outcomes: At the end of the course, the student will be able to:												
25NHOP604.1	Integrate PLM lifecycle stages and project management tools to plan and execute product development activities											
25NHOP604.2	Apply PLM concepts such as workflow management, collaboration, bookmark workspace planning for structured product data management.											
25NHOP604.3	Develop and manage the different types of BOM structures and perform Digital Mock-Up validation for collaborative product development.											
25NHOP604.4	Implement regulatory, environmental, and compliance requirements in digital product design and lifecycle management processes.											
25NHOP604.5	Assess digital manufacturing systems, variant management, and automation strategies to improve production planning and operational efficiency											
25NHOP604.6	Formulate PLM strategies aligned with corporate objectives and evaluate workflow optimization and change management effectiveness.											
Mapping of Course Outcomes to Program Outcomes:												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
25NHOP604.1	3	-	3	-	2	-	-	-	-	-	1	-
25NHOP604.2	3	-	-	-	3	-	-	-	-	-	-	-
25NHOP604.3	3	-	3	-	3	-	-	-	1	-	-	-
25NHOP604.4	2	-	3	-	-	-	-	-	1	-	-	-
25NHOP604.5	2	-	-	-	3	-	-	-	-	-	1	-
25NHOP604.6	2	-	-	-	3	-	-	-	-	-	1	-
MODULE-1 Introduction to Product Life Cycle Management (PLM) 25NHOP604.1 8 Hours												
PLM Life cycle Model, Gantt Chart, ENOVIA software, Project management schedule.												
Hands on: <ol style="list-style-type: none"> 1. Execution of the Project management schedule and time activity. 2. Execution of Creating a Change Request within project. 3. To execute Project Schedule and Gantt Chart Preparation with 3 phases with 3 Tasks for a suitable project. using ENOVIA software. 4. To execute Project Schedule and Gantt Chart Preparation with 4 Phases with 4 Tasks for a suitable project. using ENOVIA software. 												
Case Study	Case Study on Life Cycle phases of Product for project management using PLM software											
MODULE-2 PLM Concepts, Processes and Workflow 25NHOP604.2 8 Hours												
Environment Driving PLM, PLM Elements, Book marks and Workspace, Workspace Structure Planning, Engineering Vaulting, Product Reuse.												
Hands on: <ol style="list-style-type: none"> 1. Execution of Collaboration and Approval Workflow using ENOVIA. 2. Creation and configuration of a dedicated Bookmark Workspace in ENOVIA for structured product data management. 3. Execution of Bookmark Workspace Structure Planning. 												
Applications	Demo of drivers of PLM and the necessary elements using software											
MODULE-3 Digital Mock-Up and Prototype Development 25NHOP604.3, 25NHOP604.4 8 Hours												
Bill of Materials and its types, Process Consistency, Digital Mock-Up.												
Hands on: <ol style="list-style-type: none"> 1. Creation of CAD-linked EBOM from 3D assemblies using PLM Enovia 2. Execution of MBOM with manufacturing operations. 												

3. Creation of a Service BOM structure to manage spare parts and replacement components.
4. Execution on Digital Mock-Up Integration with BOM and Change Management

Case Study	Case Study on collaborate product development for a simple product using PLM software		
MODULE-4	Digital Manufacturing and Variant Management	25NHOP604.5	8 Hours

Digital Manufacturing, Steps in Digital Manufacturing, Production Planning, Variant Management.

Hands on:

1. Execution of PLC logic development for automating simulated assembly lines.
2. Apply variant management techniques to configure and link product variants with corresponding CAD assemblies.
3. To Create engineering structures for two product variants using PLM Enovia.

Case Study	Digital Manufacturing steps and development case study using PLM software		
MODULE-5	Developing a PLM Strategy and Conducting a PLM Assessment	25NHOP604.6	8 Hours

Impact of strategy, implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Workflow optimization.

Hands on:

1. Develop a PLM strategy document including vision, Roadmap, Implementation Timeline using PLM Enovia.
2. To execute Reducing Change Cycle Time through Workflow Optimization in PLM.
3. Execution of assessment PLM software supports corporate objectives in the area of Change Management

Case Study	PLM strategy and assessment using software
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CIE Assessment Pattern (50 Marks - Hands On) -

RBT Levels		Marks Distribution			
		CIE 1	CIE 2	Certified Online Learning	Project Based/ Case Based Assessment
		25	25	15	10
L1	Remember	-	-	-	-
L2	Understand	-	-	-	-
L3	Apply	15	10	5	5
L4	Analyze	10	10	5	5
L5	Evaluate	-	5	5	-
L6	Create	-	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	15
L3	Apply	20
L4	Analyze	15
L5	Evaluate	-
L6	Create	-

Reference Books:

1. Automation, Production Systems & Computer Integrated Manufacturing, M. P. Groover, Person India, 2018, 4th Edition.
2. A beginner's guide to SAP, Martin Munzel, Sydney McConnel, 2nd edition.

Web links and Video Lectures (e-Resources):

- <https://helsinki.cob.csuchico.edu:8001/sap/bc/gui/sap/its/webgui/>
- <https://newhorizoncollegeofengineering.in/sap-lab/>

INDUSTRY 4.0

Course Code	25NHOP605 / 25NHOP705	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP605.1	Analyze the characteristics of Odoo manufacturing execution system
25NHOP605.2	Create prototypes using additive manufacturing techniques
25NHOP605.3	Develop and execute basic robotic and palletizing programs for industrial automation systems.
25NHOP605.4	Apply the concept of cloud computing and digital twins in real time applications
25NHOP605.5	Analyze Industrial IoT architectures and implement sensor-based monitoring systems
25NHOP605.6	Understand the fundamental principles of Industry 4.0 and related fields

Mapping of Course Outcomes to Program Outcomes:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
25NHOP605.1	2	2	2	-	2	-	-	-	2	-	-	-
25NHOP605.2	2	2	2	2	2	-	-	-	2	-	-	-
25NHOP605.3	2	2	2	2	2	-	-	-	-	-	-	-
25NHOP605.4	3	2	2	2	3	-	-	-	-	-	-	-
25NHOP605.5	2	2	3	2	3	-	-	-	-	-	-	-
25NHOP605.6	2	2	3	2	3	-	-	-	2	-	-	-

MODULE-1 MANUFACTURING EXECUTION SYSTEM (MES) 25NHOP605.1 8 Hours

Industry revolution: Phases of development, Evolution of Industry 4.0, Core and support modules of MES and Tools for MES.

Hands on:

1. Configure inventory routing and track material flow within the Odoo warehouse environment.
2. Generate and analyse production performance reports and capacity dashboards within the Odoo platform.
3. Set up a simulated work centre to define production capacity, machine times, and worker allocations.

Case Study / Applications: Implementation of Odoo MES in a Precision Components Manufacturing Company.

MODULE-2 SMART MANUFACTURING AND ADDITIVE MANUFACTURING 25NHOP605.2 8 Hours

Overview and characteristics of smart factories, lean manufacturing systems, value streams in lean production system, necessity and implementation of lean manufacturing systems.

Hands on:

1. Design a functional assembly or shop-floor layout in SketchUp and export it for additive manufacturing.
2. Perform slicing and optimize print parameters (infill, supports, orientation) to minimize material usage.
3. Apply post-processing techniques for 3D printed parts to achieve specific functional tolerances.

Case Study / Applications: Case study on Design for Additive Manufacturing (DFAM) for an aerospace component.

MODULE-3 ROBOTICS AND AUTOMATION 25NHOP605.3 8 Hours

Degrees of freedom, joints and links, accuracy and precision, end effectors.

Hands on:

1. Execute advanced robotic programming sequences specifically designed for automated pick-and-place palletizing operations.

<ol style="list-style-type: none"> 2. Generate G-code instructional files into comprehensive 3D geometric models to analyze toolpath trajectories. 3. Execute comprehensive simulated exercises in Browserbotics to evaluate robot kinematics. 					
Case Study / Applications		Case study on Smart Shop-Floor Monitoring and Autonomous Material Handling System.			
MODULE-4	CLOUD COMPUTING AND DIGITAL TWINS	25NHOP605.4	8 Hours		
Digital Twin Lifecycle, Cloud computing, Edge computing, cloud computing services in IIOT					
Hands on:					
<ol style="list-style-type: none"> 1. Build a digital twin of a production line to simulate workflow using SIMULINK 2. Performing 3D simulation models using MATLAB/SIMULINK 3. Cloud service provider platforms and their real-life applications using ThingSpeak 					
Case Study / Applications		Case study on a digital twin for real-time monitoring of a robotic arm.			
MODULE-5	INDUSTRIAL INTERNET OF THINGS (IIoT)	25NHOP605.5 25NHOP605.6	8 Hours		
IIOT overview, smart sensors, cyber-physical systems, and establishing data pipelines for prediction and optimization.					
Hands on:					
<ol style="list-style-type: none"> 1. Execute temperature and humidity monitoring using Node MCU and DHT11 sensors in different locations. 2. Develop a live, interactive dashboard using ThingSpeak to visualize real-time temperature and humidity trends across the monitored environment. 3. Execution of IOT based industrial gas monitoring/sorting assembly line using Node MCU. 					
Case Study / Applications		Applying collected sensor data for predictive maintenance and workflow optimization in a simulated shop floor.			
CIE Assessment Pattern (50 Marks - Hands On) -					
RBT Levels		Marks Distribution			
		CIE 1	CIE2	Certified Online Learning	Project Based/ Case Based Assessment
		25	25	15	10
L1	Remember	-	-	-	-
L2	Understand	-	-	-	-
L3	Apply	15	10	5	5
L4	Analyze	10	10	5	5
L5	Evaluate	-	5	5	-
L6	Create	-	-	-	-
SEE Assessment Pattern (50 Marks - Hands-On)					
RBT Levels		Exam Marks Distribution (50)			
L1	Remember				
L2	Understand	15			
L3	Apply	20			
L4	Analyze	15			
L5	Evaluate				
L6	Create				
Online Certification course platforms:					
Coursera, edX, Udemy, LinkedIn Learning, Skillshare, freeCodeCamp, Google Skills, IBM Training, Microsoft Learn, Open Learn.					

Text Books:

1. Misra, Sudip, Chandana Roy, and Anandarup Mukherjee. Introduction to the industrial Internet of Things and industry 4.0. CRC Press, 2021. ISBN:9781032146751
2. Gilchrist, Alasdair. Industry 4.0: the industrial internet of things. Apress, 2016. ISBN:9781484220467
3. Elangovan, U. (2020). Product Lifecycle Management (PLM): A Digital Journey Using Industrial Internet of Things (IIoT) (1st ed.). CRC Press. ISBN:9781003001706

Reference Books:

1. Lasi, H., Fettke, P., Kemper, HG. et al. Industry 4.0. Bus Inf Syst Eng 6, 239–242 (2014). ISBN 1259901403344
2. Raj, Alok, et al. "Barriers to the adoption of industry 4.0 technologies in the manufacturing sector: An inter-country comparative perspective." International Journal of Production Economics 224 (2020): 107546.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/106105195>
- <https://nptel.ac.in/courses/106105166>
- <https://www.youtube.com/watch?v=kpW9JcWxKq0>

SCHNEIDER - INDUSTRIAL AUTOMATION												
Course Code	25NHOP606 / 25NHOP706								CIE Marks	50		
L:T:P:S	3:0:0:0								SEE Marks	50		
Hrs / Week	03								Total Marks	100		
Credits	03								Exam Hours	03		
Course outcomes:												
At the end of the course, the student will be able to:												
25NHOP606.1	Understand the need and basics of automation.											
25NHOP606.2	Investigate the types of protocols for PLC.											
25NHOP606.3	Develop a suitable logic for various real-time applications using ladder logic diagrams.											
25NHOP606.4	Design a PLC based solution for industrial problem by Sequential function charts.											
25NHOP606.5	Build blocks and mimic screen using HMI.											
25NHOP606.6	Develop real time applications for industry 4.0											
Mapping of Course Outcomes to Program Outcomes:												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
25NHOP606.1	3	3	3	3	3	-	-	-	-	-	-	-
25NHOP606.2	3	3	3	3	3	-	-	-	-	-	-	-
25NHOP606.3	3	3	3	3	3	-	-	-	-	-	-	-
25NHOP606.4	3	3	3	3	3	-	-	-	-	-	-	-
25NHOP606.5	3	3	3	3	3	-	-	-	-	-	-	-
25NHOP606.6	3	3	3	3	3	-	-	-	-	-	-	-
MODULE-1 BASICS OF AUTOMATION												
								25NHOP606.1	8 Hours			
Automation strategy-Evolution of instrumentation and control, role of automation in industries, benefits, types, levels of automation with examples-different systems for automation (PLC, SCADA, HMI, DCS, DRIVES) Challenges and considerations in automation.												
Hands on:												
1. Schneider M340 pedagogic bench for wiring of input and output elements.												
MODULE-2 PLC AND PROTOCOLS												
								25NHOP606.2	8 Hours			
PLC Introduction - Definition - Block diagram of PLC – Principle of operation – Modes of operating – PLC Scan - Hardwire control system compared with PLC system - Advantages and Disadvantages of PLCs.												
Hands on:												
1. Establish the PLC configuration and communication devices using vijeo designer.												
2. Design a ladder logic diagram for all logic gates in simulation mode.												
3. Design a ladder logic diagram for all logic gates in standard mode and show the output in hardware												
Case Study / Applications	Design a flame detection circuit for a toxic waste incinerator.											
MODULE-3 PROGRAMMING OF PLC												
								25NHOP606.3, 25NHOP606.4	8 Hours			
PLC Ladder Language- Functional Block Diagram (FBD)-Instruction List, Structured text, Sequential Function Chart (SFC), SFC Structure- SFC programming, Timer Instructions, PLC Counter Instructions.												
Hands on:												
1. Design a ladder logic diagram for Latching and Unlatching of a Motor using PLC.												
2. Design a ladder logic diagram for circulation of water in coolant pipes after the furnace is ON.												
3. Design a ladder logic diagram for counting the number of persons entering the conference room using counters.												
4. Design a wiring Tunnel wiring using ladder logic diagram and execute in hardware.												
Case Study /	Design the logic system for a small road cross signal.											

Applications			
MODULE-4	INDUSTRY APPLICATIONS	25NHOP606.4 25NHOP606.5	8 Hours

Sequential Operations- level control-Process control-manufacturing process-heating process.

Hands on:

1. Design ladder for Sequential operation of motor
2. Design a motor starter using ladder with ON/OFF indicators
3. Control a motor direction (Forward and reverse operation) using timer
4. Design a SFC for a drilling machine.

MODULE-5	HUMAN MACHINE INTERFACE AND INDUSTRY 4.0	25NHOP606.5 25NHOP606.6	8 Hours
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Evolution of HMI, Building HMI graphics, Communication with PLC, Fourth Industrial Revolution, Industry4.0

Hands on:

1. Draw and execute the control of lamp in the mimic screen.

CIE Assessment Pattern (50 Marks - Hands On) -

RBT Levels		Marks Distribution			
		CIE 1	CIE2	Certified Online Learning	Project Based/ Case Based Assessment
		25	25	15	10
L1	Remember	-	-	-	-
L2	Understand	-	-	-	-
L3	Apply	15	10	5	5
L4	Analyze	10	10	5	5
L5	Evaluate	-	5	5	-
L6	Create	-	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	15
L4	Analyze	15
L5	Evaluate	20
L6	Create	-

Reference Books:

- 1) Programmable Logic Controllers and Industrial Automation: An Introduction 2nd Edition, by Madhu Chandranda Mitra and Samarjt Sengupta, 2017
- 2) Programmable Logic Controllers, by [Frank D. Petruzella](#), 2016, McGraw-Hill Science Engineering; 4th edition, ISBN-10 : 0073303429

Web links and Video Lectures (e-Resources):

- <https://ial-coep.vlabs.ac.in/>
- <https://plc-coep.vlabs.ac.in/>
- <https://www.youtube.com/@vinodkumarvino1012>
- <https://newhorizoncollegeofengineering.in/industrial-automation/>

CISCO - ROUTING & SWITCHING - I

Course Code	25NHOP607 / 25NHOP707	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP607.1	Identify various network devices, topologies, and protocols.
25NHOP607.2	Construct IP addressing table and perform subnetting in IPv4 and IPv6 network.
25NHOP607.3	Analyse Dynamic Host Configuration Protocol (DHCP) operation for scalable networks.
25NHOP607.4	Configure and troubleshoot advanced operations of routers and implement Link State routing protocols (OSPF).
25NHOP607.5	Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol.
25NHOP607.6	Examine redundancy using Spanning tree protocols and Ether-Channel for network scalability

Mapping of Course Outcomes to Program Outcomes:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
25NHOP607.1	3	3	3	3	3	-	-	-	-	3	-	3
25NHOP607.2	3	3	3	3	3	-	-	-	-	3	-	3
25NHOP607.3	3	3	3	3	3	-	-	-	-	3	-	3
25NHOP607.4	3	3	3	3	3	2	2	2	3	3	-	3
25NHOP607.5	3	3	3	3	3	2	2	2	3	3	-	3
25NHOP607.6	3	3	3	3	3	2	2	2	3	3	-	3

MODULE-1	LAYERED ARCHITECTURE, NETWORK DEVICES AND TOPOLOGIES	25NHOP607.1	8 Hours
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Network Devices: Switches, Routers, NIC, Access Points, Modem. Topologies: Mesh Topology, Star Topology, Bus Topology, Ring Topology, Hybrid Topology. Layered Architecture: Layered Architecture and protocols

Hands on:

1. Basic Device Configuration: Configure Initial Switch/Router Settings, Configure Interfaces, Configure the Default Gateway, Ping and Traceroute Testing
2. Telnet Configuration and verify the access to the network device.
3. SSH Configuration and verify the secure access to the network device.

Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE -Introduction to Networks (ITN): 1.2, 1.3, 3.3, 3.5, 3.6, 10.1.6 https://www.cisco.com/c/en/us/support/docs/security-vpn/secure-shell-ssh/4145-ssh.html?dtid=ossdc000283 https://community.cisco.com/t5/networking-knowledge-base/configuring-telnet-console-and-aux-port-passwords/ta-p/3126628?dtid=ossdc000283
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MODULE-2	IPv4 ADDRESSING, IPv6 ADDRESSING, DHCPv4 CONFIGURATION & DHCPv6 CONFIGURATION	25NHOP607.2 25NHOP607.3	8 Hours
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IPv4 Addressing: IPv4 Address Structure, IPv4 Unicast, Broadcast, and Multicast, Types of IPv4 Addresses, Subnetting Concepts. DHCPv4: DHCP4 Concepts Configure a Cisco IOS DHCP4 Server; Example of Cisco Router as a DHCP4 Client. IPv6 Addressing: IPv6 Address Representation, IPv6 Address Types. SLAAC and DHCPv6: IPv6 Global Unicast Address Assignment, SLAAC, DHCPv6

Hands on:

1. DHCPv4 Configuration
2. DHCPv6 Configuration

Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE- Introduction to Networks (ITN): 11.1,11.2,11.3,11.4,11.5. COURSE Switching, Routing, & Wireless Essentials (SRWE): 7.1, 7.2, 7.2.2, 7.3.1, 8, 8.2.3, 8.3.2 https://www.cisco.com/c/en/us/support/docs/ip/routing-information-protocol-rip/13788-3.html?dtid=ossdc000283			
MODULE-3	ROUTING CONCEPTS & SINGLE-AREA OSPF CONCEPTS	25NHOP607.4	8 Hours	
Routing Concepts: Path Determination, Packet Forwarding, IP Routing Table, Dynamic Routing, Default Static Route. Single-Area OSPF Concepts: OSPF Features and Characteristics, OSPF Packets, OSPF Operation				
Hands on: 1. Configure IP Default Static Routes 2. Single-Area OSPFv2 Configuration				
Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE Switching, Routing, & Wireless Essentials (SRWE): 14.1, 14.2, 14.4 COURSE-Enterprise Networking, Security & Automation (ENSA): 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.3.1, 2.1, 2.2, 2.5, 15.5.4 https://www.cisco.com/c/en/us/support/docs/ip/open-shortest-path-first-ospf/7039-1.html?dtid=ossdc000283			
MODULE-4	VLANS	25NHOP607.5	8 Hours	
VLANS: Overview of VLANS, VLAN Trunks, VLAN identification with a Tag, VLAN Configuration, Dynamic Trunking Protocol, Inter VLAN routing				
Hands on: 1. VLAN Configuration 2. Inter-VLAN routing Configuration				
Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE Switching, Routing, & Wireless Essentials (SRWE): 3.1, 3.2.1, 3.2.4, 3.3, 3.5, 4.1, 4.2 https://www.cisco.com/c/en/us/support/docs/smb/switches/cisco-small-business-300-series-managed-switches/smb5653-configure-port-to-vlan-interface-settings-on-a-switch-throug.html?dtid=ossdc000283			
MODULE-5	SPANNING TREE PROTOCOL & ETHERCHANNEL	25NHOP607.6	8 Hours	
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.				
Hands on: 1. Spanning Tree Protocol Configuration 2. EtherChannel Configuration				
Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE Switching, Routing, & Wireless Essentials (SRWE): 5.1, 5.2, 5.3, 6.1, 6.2 https://www.cisco.com/c/en/us/support/docs/lan-switching/spanning-tree-protocol/5234-5.html?dtid=ossdc000283 https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst9500/software/release/16-10/configuration_guide/lyr2/b_1610_lyr2_9500_cg/configuring__etherchannels.html?dtid=ossdc000283			
CIE Assessment Pattern (50 Marks - Hands On) -				
RBT Levels		Marks Distribution		
		Test (s)	Certified Online Learning	Project Based/ Case Based Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	5
L3	Apply	15	10	5
L4	Analyze	10	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	30
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Reference Books:

- 1) CISCO Netacad (ONLINE ACCESS)
- 2) CCNA Routing and Switching - Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand), 2016
- 3) Data Communications and Networking. Forouzan, 5th Edition, McGraw Hill, Reprint-2017.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/106101209>
- <https://www.youtube.com/watch?v=TSNNDrEElPw>
- <https://contenthub.netacad.com/srwe-dl/5.1.8>
- <https://www.youtube.com/watch?v=Fmq1E1Qr2W4>
- <https://www.youtube.com/watch?v=dpoUjnfGbeo>
- https://youtu.be/9UT82H7USZc?si=okqCKI_jz9T6L7zeb
- https://youtu.be/6p4_ypAZbj0?si=iv81e-gqLB2GZKbZ

EMBEDDED PROGRAMMING												
Course Code	25NHOP609 / 25NHOP709						CIE Marks	50				
L:T:P:S	3:0:0:0						SEE Marks	50				
Hrs / Week	03						Total Marks	100				
Credits	03						Exam Hours	03				
Course outcomes:												
At the end of the course, the student will be able to:												
25NHOP609.1	Understand the QNX OS Architecture and its microkernel-based design											
25NHOP609.2	Develop QNX-RTOS based applications using QNX Momentics IDE.											
25NHOP609.3	Implement synchronization methods between process and threads.											
25NHOP609.4	Apply the QNX Inter-Process Communication with Hardware Programming and Interrupt handling.											
25NHOP609.5	Understand the timing architecture, High-Resolution Timers & Image files.											
25NHOP609.6	Configure Boot /OS Images for Embedded Systems.											
Mapping of Course Outcomes to Program Outcomes:												
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
25NHOP609.1	2	-	-	-	-	-	-	-	-	-	-	-
25NHOP609.2	3	2	-	-	3	-	-	-	-	-	3	-
25NHOP609.3	3	-	-	-	-	-	-	-	-	-	-	2
25NHOP609.4	3	2	-	-	-	-	-	-	-	-	-	2
25NHOP609.5	3	2	-	-	3	-	-	-	-	-	3	2
25NHOP609.6	3	2	-	-	3	-	-	-	-	-	3	2
MODULE-1 Architecture of QNX 25NHOP609.1 8 Hours												
Overview of QNX Architecture, Microkernel, Processes Manager and standards Processes and Threads model, Timing, Scheduling, Boot Sequence, Security.												
Hands on:												
<ol style="list-style-type: none"> 1. Create, cross-compile, and execute a QNX application on VMware or Raspberry Pi 4 using Momentics IDE. 2. Demonstrate successful execution and verify the running process using QNX system utilities such as pidin or ps. 3. Develop a QNX application that creates multiple child processes using POSIX process APIs. The parent process shall monitor the execution of each child, record their process IDs, and control their execution order using appropriate synchronization mechanisms. 												
Case Study / Applications	Case study of the QNX Neutrino Operating System											
MODULE-2 Processes and Threads Synchronization 25NHOP609.2 8 Hours												
Processes, Threads & Synchronization: Introduction, Processes: Creation and Detecting termination, Threads, Process Termination and Cleanup.												
Hands on:												
<ol style="list-style-type: none"> 1. Implement a QNX program to detect the termination of child processes using wait() / waitpid(). Demonstrate proper handling of normal and abnormal process termination, and ensure that no zombie processes remain in the system. 2. Design a multi-threaded QNX application to solve a synchronization problem using mutexes. Demonstrate safe access to shared resources, analyze race conditions, and evaluate the behavior of the system with and without mutex protection. 												

<ol style="list-style-type: none"> Implement a QNX program using condition variables to coordinate multiple threads. Demonstrate thread synchronization using condition wait and signal operations to manage execution order and shared resource availability. Develop a QNX program demonstrating atomic operations for thread synchronization. Analyze their effectiveness for simple shared data access and compare their usage with mutex-based synchronization 			
Case Study / Applications	Case study of Synchronization methods in QNX		
MODULE-3	QNX IPC	25NHOP609.3, 25NHOP609.4	8 Hours
<p>Introduction to QNX Inter-Process Communication: Message Passing, designing a Message Passing System (1): Pulses, Client Information Structure, How a Client Finds a Server, Multi-Part Messages. Comparing QNX IPC Methods: The Methods, How to Choose.</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> Implement a client-server application in QNX using message passing. The server shall receive requests from the client using <code>MsgReceive()</code>, process the request, and send a response using <code>MsgReply()</code>. The client shall communicate with the server using <code>MsgSend()</code> and handle the received response. Develop QNX programs to demonstrate inter-process communication using pulses and multipart messages. Illustrate event notification using pulses and structured data transfer using multipart messages. 			
MODULE-4	Message Passing and Interrupt Handling	25NHOP609.5	8 Hours
<p>Issues Related to Priorities, Designing a Message Passing System (2): Event Delivery Shared Memory, Hardware I/O, Programming PCI bus devices, Handling Interrupts.</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> Develop a QNX program to demonstrate inter-process communication using event delivery. Implement event notification between processes using QNX event mechanisms and verify event handling at the receiving process. Implement inter-process communication in QNX using shared memory. Create a shared memory region between processes and demonstrate safe data exchange with appropriate synchronization mechanisms. Develop a QNX program to demonstrate basic interrupt handling. Attach an interrupt handler, respond to an interrupt event, and perform minimal processing within the interrupt context. 			
MODULE-5	Timers and Resource Managers	25NHOP609.6	8 Hours
<p>Timers, Clocks and Timeouts: Introduction to Timers, High-Resolution Timers, Design Considerations, Kernel Timeouts. Build a QNX Neutrino Boot/OS Image: Introduction, Images & Build files, Images & Build files: Exercise option Resource Managers: Introduction, A Simple Resource Manager: Initialization and Handling <code>read()</code> and <code>write()</code>.</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> Develop a QNX program to demonstrate the use of timers. Create and configure a timer to generate periodic events and handle timer expirations using appropriate QNX timer mechanisms. Implement a basic QNX Resource Manager and initialize it successfully. Handle client <code>read()</code> and <code>write()</code> requests and demonstrate communication between user applications and the resource manager. Demonstrate the process of building a QNX system image. Modify the build configuration to include applications and drivers, generate the bootable image, and verify successful system startup. 			
Case Study / Applications	Case study on developing Resource Manager for RPI GPIO to toggle LED		

CIE Assessment Pattern (50 Marks - Hands On)

RBT Levels		Marks Distribution		
		Test(s)	Online Learning / Certification	Project based/Case Based Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	10	7.5	5
L4	Analyze	10	7.5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Hands On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	30
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Reference Books:

1. QNX Neutrino RTOS User's Guide, QNX Software Systems.
2. Michael Barr, Anthony Massa, "Programming for Embedded Systems", O'Reilly Media, 2nd edition, 2006.
3. Brian Amos, "Hands-On RTOS with Microcontrollers", Packt Publishing, 2020.
4. Abraham Silberschatz, Peter B.Galvin, Greg Gagne, "Operating System", 9th Edition, Wiley, 2018.

Web links and Video Lectures (e-Resources):

- <https://learning.qnx.com/qnx/courses/20207/modules/132649/elements/638218>

5G MOBILE COMMUNICATION												
Course Code	25NHOP610 / 25NHOP710						CIE Marks	50				
L:T:P:S	3:0:0:0						SEE Marks	50				
Hrs / Week	03						Total Marks	100				
Credits	03						Exam Hours	03				
Course outcomes:												
At the end of the course, the student will be able to:												
25NHOP610.1	Understand 5G spectrum requirement, its channel model and use cases.											
25NHOP610.2	Familiarize with 5G architecture options and physical layer concepts.											
25NHOP610.3	Examine the multicarrier techniques and new waveform options for 5G communication.											
25NHOP610.4	Appraise the current research avenues in 5G domain.											
25NHOP610.5	Illustrate the concept of network slicing and V2V Communication.											
25NHOP610.6	Interpret the Interference and Mobility management in 5G networks.											
Mapping of Course Outcomes to Program Outcomes:												
	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
25NHOP610.1	3	2	-	-	-	3	3	-	-	-	-	2
25NHOP610.2	3	3	3	3	3	-	-	-	3	3	-	3
25NHOP610.3	3	3	3	3	3	-	-	-	2	2	-	3
25NHOP610.4	3	3	3	3	3	2	2	2	3	3	-	3
25NHOP610.5	3	3	2	2	-	3	-	-	-	-	-	2
25NHOP610.6	3	3	2	-	-	-	-	-	-	-	-	-
MODULE-1												
5G RADIO SPECTRUM, CHANNEL MODEL AND USE CASES							25NHOP610.1, 25NHOP610.4			8 Hours		
5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies. The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modelling, Use cases and requirements, 5G system concept.												
Hands on:												
<ol style="list-style-type: none"> Write a MATLAB program to pass the Signal through a Rayleigh Channel. Write a MATLAB program to pass the Signal through a Rician Channel. Write a MATLAB program to generate the signal $S(n) = 2 * n * (0.8^n)$ corrupted by the noise $d(n)$ resulting the signal $X(n)$, $X(n) = S(n) + d(n)$. Write a MATLAB program to generate an exponential Sequence. $X(n) = (a)^n \quad \text{for} \quad (i) 0 \leq a \leq 1 \quad (ii) -1 \leq a \leq 0 \quad (iii) a \leq -1 \quad (iv) a > 1$ 												
MODULE-2												
RADIO INTERFACE ARCHITECTURE							25NHOP610.2			8 Hours		
5G architecture options, core network architecture, RAN architecture, 5G frame structure, physical layer procedures (MIMO, Power control, link adaptation, beam forming).												
Hands on:												
<ol style="list-style-type: none"> Demonstrate the downlink data transmission between UE and external data network (Ext-dn) using iperf command in OAI platform. Demonstrate the uplink data transmission between UE and external data network (Ext-dn) using iperf command in OAI platform. Write a MATLAB program to implement 2x2 MIMO. Write a MATLAB program to compute the array factor for a ULA steered towards a desired angle and prints the coherent combining SNR gain. 												
MODULE-3												
5G RADIO-ACCESS TECHNOLOGIES							25NHOP610.3, 25NHOP610.4			8 Hours		

Access design principles for multi-user communications, multi-carrier with filtering: a new waveform, non-orthogonal schemes for efficient multiple access.

Hands on:

1. Write a MATLAB program to generate NR-like OFDM baseband waveform and plot its PSD.
2. Write a MATLAB program to build a simple resource grid with PRB allocation and generate a waveform to display grid heatmap and spectrogram.
3. Write a MATLAB program to plot 3GPP TR 38.901 urban microcell (Umi) LOS and NLOS path loss curves versus distance.

MODULE-4	INTRODUCTION TO 5G NETWORK SLICING	25NHOP610.4, 25NHOP610.5	8 Hours
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Network Slicing, E2E Slicing, SDN and NFV Slicing

Hands on:

1. Write a MATLAB program for: 5G URLLC for Industrial Automation.
2. Write a MATLAB program that simulates network slicing in 5G, where different types of services (e.g., eMBB, URLLC, mMTC) share the same physical infrastructure but are logically separated based on their QoS requirements.
3. Write a MATLAB program for RB scheduler with URLLC pre-emption and proportional sharing for eMBB/mMTC to simulate arrival and backlog over time.

MODULE-5	MOBILITY AND HANDOFF MANAGEMENT IN 5G	25NHOP610.6	8 Hours
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Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G.

Hands on:

1. Write a MATLAB program for simple IOT data transmission.
2. Write a MATLAB program to estimate user throughput for Carrier aggregation with two components carriers (CA_2CC).
3. Demonstrate the creation of pcap file, reading of pcap file and packet truncation with variable snap length.
4. Demonstrate the packet capturing and analysis using WIRESHARK tool by filtering the TCP and UDP packets.

CIE Assessment Pattern (50 Marks - Hands On) -

RBT Levels		Marks Distribution		
		Test (s)	Certified Online Learning	Project Based/ Case Based Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	15	7.5	5
L4	Analyze	10	7.5	5
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Reference Books:

1. Afif Osseiran, Jose F Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
2. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", CRC Press, Taylor & Francis Group, First Edition, 2018.
3. Harri Holma, Antti Toskala, Takehiro Nakamura, "5G Technology 3GPP NEW RADIO", John Wiley & Sons First Edition, 2020.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=Q6YxHz_07zk
- <https://www.youtube.com/watch?v=UteidGTgPC0>
- <https://www.youtube.com/watch?v=0GLa85EU2TI>
- https://onlinecourses.nptel.ac.in/noc24_ee152/preview
- https://onlinecourses.nptel.ac.in/noc21_ee12/preview
- <https://www.youtube.com/watch?v=-OdhLEertk>
- <https://www.youtube.com/watch?v=UmbpussByIs>

VLSI PHYSICAL DESIGN - I

Course Code	25NHOP611 / 25NHOP711	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP611.1	Analyze the pre-requisites required for back-end VLSI design flow and its implementations.
25NHOP611.2	Gain sufficient practical knowledge on LINUX, GVIM editor usage and apply the scripting skills for the VLSI tools
25NHOP611.3	Understand VLSI synthesis and evaluate the functionality of RTL and netlist.
25NHOP611.4	Understand timing analysis at various process and environment.
25NHOP611.5	Apply the learnt concepts of STA to evaluate the delay of the circuits.
25NHOP611.6	Engage in independent learning and perform the timing and power report analysis.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
25NHOP611.1	3	3	3	3	2	-	-	-	1	1	-	2
25NHOP611.2	3	3	3	3	2	-	-	-	1	1	-	2
25NHOP611.3	3	3	3	3	2	-	-	-	1	1	-	2
25NHOP611.4	3	3	3	3	2	-	-	-	1	1	-	2
25NHOP611.5	3	3	3	3	2	-	-	-	1	1	-	2
25NHOP611.6	3	3	3	3	2	-	-	-	1	1	-	2

MODULE-1	GVIM EDITOR	25NHOP611.1, 25NHOP611.2	8 Hours
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GVIM Introduction, Features of GVIM, create new file, Open file in Read-Only mode, edit existing file, Basic modes, Insert, Append, Open new line, Substitute, Change, Replace, Join, VIM Navigating, Buffer, Swap files, Cut, copy, delete, paste actions, Undo and redo actions, Search settings, Search in current file, Search in multiple files, Search in help files, Working with multiple files, buffers, Markers, Macros, Diff, Recording, Remote file editing.

Hands on:

1. Write the Vim editor commands to copy and paste and execute
2. Write the Vim editor commands to execute search and replace a pattern for all lines and all occurrences (ignoring case) and execute
3. Write the Vim editor commands and execute set line numbers and to move to line number 6
4. Write the Vim editor commands to insert digraph and execute
5. Write the Vim editor commands to join two lines and execute

Note: All the commands given in the syllabus need to be executed.

MODULE-2	BASICS OF LINUX, TCL	25NHOP611.1, 25NHOP611.2	8 Hours
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Linux commands, File management, Directories, File Permission, Basic utilities. Pipes and filters, Processes, Communication, shell scripting, Advanced Linux: Regular expressions, File system Basics. Basic syntax of TCL, Commands, Operators, Loops, Arrays, Strings, Lists, Procedures, Packages, Files I/O, Regular expressions.

Hands on:

1. Write a shell script to swap two numbers.
2. Write a shell script to perform all arithmetic operations on two numbers.
3. Write a shell script to perform sum of n natural numbers.
4. Execute the following: i) Search a word in current file and highlight it ii) Append text after the cursor iii) Create a file and give all permissions to all iv) Record and display the numbers in ascending order
5. Make use of Linux commands, to do the following structure:

<p>Make one main directory as “VLSI design flow”, below this directory create two directories named “Front end design” and “Back end design”. Inside “Front end design”, make two files named as “simulation” and “synthesis”. Inside “Back end design”, make four files named as “Floor Planning”, “placement”, “CTS” and “Routing”.</p>			
MODULE-3	LOGIC SYNTHESIS	25NHOP611.1, 25NHOP611.3	8 Hours
<p>Introduction to Logic Synthesis, Goals of Synthesis, Synthesis Flow, Input and Output of Synthesis.</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. Examine and perform the following for the 8-bit up counter using Cadence tool. <ol style="list-style-type: none"> a) Synthesize the module b) Generate the netlist c) Analyze the power report and area report. d) Analyze the timing report and check for violations if any. 2. Examine and perform the following for the 16-bit up counter using Cadence tool. <ol style="list-style-type: none"> e) Synthesize the module f) Generate the netlist g) Analyze the power report and area report. h) Analyze the timing report and check for violations if any. 3. Examine and perform the following for the 4-bit Ring counter using Cadence tool. <ol style="list-style-type: none"> i) Synthesize the module j) Generate the netlist k) Analyze the power report and area report. l) Analyze the timing report and check for violations if any. 			
MODULE-4	INTRODUCTION TO STA	25NHOP611.4	8 Hours
<p>Nanometer Designs, What is Static Timing Analysis? Why Static Timing Analysis? Crosstalk and Noise, Design Flow, CMOS Digital Designs, FPGA Designs, Asynchronous Designs, STA at Different Design Phases, Limitations of Static Timing Analysis, Power Considerations.</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. Create a clock period for a waveform of 50% duty cycle for a time period of 2 ns. 2. For the given clock period $t_{clk} = 2$ ns, library set up time $t_{setup} = 0.2$ ns, $t_{cq} = 0.1$ ns. Find the combinational logic delay to avoid negative slack. 3. Examine and synthesize the 16-bit up counter operating at a frequency of 10MHz using Cadence tool. Analyze the timing report and check for set up and hold time. 			
MODULE-5	STA CONCEPTS	25NHOP611.5, 25NHOP611.6	8 Hours
<p>Standard Cells, Propagation Delay, slew of a Waveform, Skew between Signals, Timing Arcs and Unateness, Min and Max Timing Paths, Timing Modeling, Wireload Models, Crosstalk Glitch analysis, Configuring STA Environment, Setup and Hold Timing Check</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. Examine and perform the following for the 8-bit down counter using Cadence tool. <ol style="list-style-type: none"> a) Synthesize the module and generate the timing report b) Analyze Clock Skew c) Analyze Clock Latency d) Find Set up and Hold time 2. Examine and perform the following for the 4-bit Johnson counter using Cadence tool. <ol style="list-style-type: none"> a) Synthesize the module and generate the timing report b) Analyze Clock Skew c) Analyze Clock Latency d) Find Set up and Hold time 			

3. Examine and perform the following for the 8-bit up-down counter using Cadence tool.

- a) Synthesize the module and generate the timing report
- b) Analyze Clock Skew
- c) Analyze Clock Latency
- d) Find Setup time and Hold time

CIE Assessment Pattern (50 Marks - Hands On) -

RBT Levels		Marks Distribution		
		Test (s)	Certified Online Learning	Case Study/ Project based Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	15	15	10
L4	Analyze	10	-	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	30
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Reference Books:

- 1) Beginning Linux Programming, 4th Edition, N. Matthew, R. Stones, Wrox, Wiley India Edition.
- 2) Richard Peterson, "Linux: The Complete Reference", sixth edition, Mc-Graw Hill, 2008.
- 3) J. Bhasker, R. Chadha, "Static Timing Analysis for Nanometer Designs: A Practical Approach", Springer, 2009
- 4) Sridhar Gangadharan, Sanjay Churiwala, "Constraining Designs for Synthesis and Timing Analysis – A Practical Guide to Synopsis Design Constraints (SDC)", Springer, 2013
- 5) <https://www.iopb.res.in/vimbook-OPL.pdf>
- 6) <https://www.ee.columbia.edu/~shane/projects/sensornet/part1.pdf>
- 7) https://www.vlsi-backend-adventure.com/logic_synthesis.html

Web links and Video Lectures (e-Resources):

- <https://youtu.be/yK536VDAy-c>
- https://www.youtube.com/watch?v=6s6YbIa2k_g
- <https://www.coursera.org/learn/linux-fundamentals>
- <https://youtu.be/ion19sGOQEo>

JUNIPER NETWORK OPERATING SYSTEMS

Course Code	25NHOP612 / 25NHOP712	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP612.1	Compare the network models and the protocols at each layer
25NHOP612.2	Construct IP addressing table and perform subnetting in IPv4 and IPv6 network
25NHOP612.3	Analyze the network to implement LAN security to mitigate threats and attack
25NHOP612.4	Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol
25NHOP612.5	Examine the operation of Spanning tree protocols and EtherChannel for network scalability
25NHOP612.6	Analyze Dynamic Host Configuration Protocol (DHCP) operation for scalable networks

Mapping of Course Outcomes to Program Outcomes:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
25NHOP612.1	3	3	3	3	3	-	-	-	-	-	-	-
25NHOP612.2	3	3	3	3	3	-	-	-	-	-	-	2
25NHOP612.3	3	3	3	3	3	1	-	2	2	-	2	-
25NHOP612.4	3	3	3	3	3	-	3	-	-	-	-	-
25NHOP612.5	3	3	3	3	3	-	3	-	-	-	2	-
25NHOP612.6	3	3	3	3	3	-	3	-	-	-	-	2

MODULE-1	BASICS OF NETWORKING	25NHOP612.1 25NHOP612.3	8 Hours
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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.

Hands on:

1. Basic Switch and End Device Configuration: Introduction to Junos, Junos CLI operation mode, Junos CLI configuration mode, Basic Device Configuration, Save Configurations, Configure IP Addressing, Verify Connectivity.
2. SSH and Telnet Configuration
3. Switchport security Configuration

MODULE-2	INTERNET PROTOCOLS	25NHOP612.2	8 Hours
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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

Hands on:

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

MODULE-3	VIRTUAL LAN	25NHOP612.4	8 Hours
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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.

Hands on:

1. VLAN Configuration
2. Dynamic Trunking Protocol Configuration
3. Inter-VLAN routing Configuration

MODULE-4	SPANNING TREE and ETHER CHANNEL	25NHOP612.5	8 Hours
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Spanning Tree Protocol: Purpose of STP, STP Operations, Evolution of STP, RSTP, RSTP+, Portfast, BPDU Guard.
 Ether Channel: Ether Channel Operation, LACP, PAGP, Passive and Active mode in Ether Channel.

Hands on:

1. Spanning Tree Protocol Configuration
2. EtherChannel Configuration

MODULE-5	DHCPv4 & DHCPv6	25NHOP612.6	8 Hours
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DHCPv4:DHCP4 Concepts Configure a DHCP4 Server; Configure a DHCP4 Client, SLAAC
 DHCPv6: IPv6 Global Unicast Address Assignment, SLAAC, DHCPv6, Configure DHCPv6 Server.

Hands on:

1. DHCPv4 Configuration
2. DHCPv6 Configuration

CIE Assessment Pattern (50 Marks - Hands On)

RBT Levels		Marks Distribution		
		Test (s)	Online Learning / Certification	Case Study/ Project based Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	5
L3	Apply	15	10	5
L4	Analyze	10	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	30
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Reference Books:

1. Juniper Networks Routers: The Complete Reference (Osborne Complete Reference Series) by Matthew Kolon and Jeff Doyle, McGraw-Hill Education.
2. CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand), 2016.
3. Data Communications and Networking. Forouzan, 5th Edition, McGraw Hill, Reprint-2017

Web links and Video Lectures (e-Resources):

- <https://www.juniper.net/>
- <https://learningportal.juniper.net/>

CISCO - ROUTING & SWITCHING - II

Course Code	25NHOP708	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP708.1	Configure advanced operation of ACL and implement extended ACL for IPv4 and IPv6
25NHOP708.2	Configure Network address translation (NAT) for IPv4
25NHOP708.3	Configure a secured Wireless LAN setup using Routers and extend wireless connectivity using Access Points
25NHOP708.4	Examine the operations of WAN, WAN Authentication Protocols, and best practices for network security
25NHOP708.5	Examine the operation of virtual private network (VPN) and concepts of network automation and virtualization
25NHOP708.6	Evaluate the network configurations, identify the errors, and configure correctly for effective network communication for lifelong learning

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
25NHOP708.1	3	3	3	3	3	-	-	-	-	3	-	3
25NHOP708.2	3	3	3	3	3	-	2	-	-	3	-	3
25NHOP708.3	3	3	3	3	3	2	2	-	-	3	-	3
25NHOP708.4	3	3	3	3	3	2	2	2	2	3	2	3
25NHOP708.5	3	3	3	3	3	2	2	-	2	3	2	3
25NHOP708.6	3	3	3	3	3	2	2	2	2	3	2	3

MODULE-1 ACL CONCEPTS

25NHOP708.1
25NHOP708.6 **8 Hours**

ACL Concepts: Overview of ACL operation, Guidelines for ACL Creation, Comparison of Standard and Extended ACLs, Implementation of Extended ACLs, Troubleshoot Scenarios.

Hands on:

1. Configure Standard ACL
2. Configure Extended ipv4 ACL's and its comparison with standard ACL's

Case Study / Applications
NETACAD ONLINE COURSE-CCNAv7 COURSE Enterprise Networking, Security & Automation (ENSA): 4.1, 4.3, 4.4, 5.4,
<https://www.cisco.com/c/en/us/support/docs/security/ios-firewall/23602-confaccesslists.html#toc-hId-1286187984>

MODULE-2 NAT FOR IPV4 ADDRESSING SCHEMES

25NHOP708.2
25NHOP708.6 **8 Hours**

NAT for IPv4 addressing schemes: NAT Characteristics, Types of NAT, NAT Advantages and Disadvantages, Static NAT, Dynamic NAT, PAT, Troubleshoot Scenarios.

Hands on:

1. Configure Static NAT
2. Configure Dynamic NAT

Case Study / Applications
NETACAD ONLINE COURSE-CCNAv7 COURSE Enterprise Networking, Security & Automation (ENSA): 6.1, 6.2, 6.3, 6.4, 6.5, 6.6.
<https://www.cisco.com/c/en/us/support/docs/ip/network-address-translation-nat/13772-12.html?dtid=ossdc000283>

MODULE-3	WLAN CONCEPTS	25NHOP708.3	8 Hours	
WLAN Concepts: Introduction to Wireless, Components of WLANs, WLAN Operation, Channel Management, Secure WLANs				
Hands on:				
<ol style="list-style-type: none"> 1. Remote Site WLAN Configuration 2. Configure a Basic WLAN on the WLC 				
Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE Switching, Routing, & Wireless Essentials (SRWE): 12.1, 12.2, 12.3, 12.7, 13.1, 13.2 https://www.cisco.com/c/en/us/products/wireless/wireless-lan.html?dtid=osscdc000283			
MODULE-4	WAN CONCEPTS	25NHOP708.4	8 Hours	
WAN Concepts: Purpose of WANs, WAN Operations, Network Security Concepts: Threat Actors, Malware, Common Network Attacks, IP Vulnerabilities and Threats, TCP and UDP Vulnerabilities, IP Services, Network Security Best Practices				
Hands on:				
<ol style="list-style-type: none"> 1. Configuration of WAN Point to Point Protocol (PPP) using Password Authentication Protocol (PAP). 2. Configuration of WAN Point to Point Protocol (PPP) using Challenge Handshake Authentication Protocol (CHAP). 				
Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE Enterprise Networking, Security & Automation (ENSA): 7.1, 7.2, 3.2, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, https://www.cisco.com/c/en/us/products/switches/what-is-a-wan-wide-area-network.html?dtid=osscdc000283			
MODULE-5	VIRTUAL PRIVATE NETWORK	25NHOP708.5	8 Hours	
Virtual Private Network: VPN and IPsec Concepts: VPN Technology, Types of VPNs Network Automation and Virtualization: Virtualization, Software-Defined Network, Data Formats, APIs, REST, Configuration Management Tools.				
Hands on:				
<ol style="list-style-type: none"> 1. Configuration of VPN using GRE 				
Case Study / Applications	NETACAD ONLINE COURSE-CCNAv7 COURSE Enterprise Networking, Security & Automation (ENSA): 8.1, 8.2, 8.3, 13.2, 13.4, 14.2, 14.3, 14.4, 14.5 https://www.cisco.com/c/en/us/products/security/vpn-endpoint-security-clients/what-is-vpn.html?dtid=osscdc000283			
CIE Assessment Pattern (50 Marks - Hands On) -				
RBT Levels		Marks Distribution		
		Test (s)	Certified Online Learning	Project Based/ Case Based Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	10	10	-
L4	Analyze	10	5	5
L5	Evaluate	5	-	5
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Reference Books:

- 1) Data Communications and Networking. Forouzan, 5th Edition, McGraw Hill, Reprint-2017.
- 2) CISCO NETACAD Course-2 : CCNAv7-Switching, Routing and Wireless Essentials (ONLINE ACCESS)

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=NqibHK5f930>
- <https://www.youtube.com/watch?v=FTUV0t6JaDA>
- <https://www.youtube.com/watch?v=sWokhQb2KJc&t=143s>
- https://youtu.be/srytxSvo0F4?si=9upxfS1k_xCn7q07
- <https://youtu.be/nY7HqwitUbK?si=PIwuiPMgQ3e7rSi>
- <https://youtu.be/jdw5lzpNT1w?si=ZIsY7M2PWiyDW8qs>
- <https://youtu.be/N9cGvH-kcjc?si=1V6ea67KQIAQcwPa>
- <https://youtu.be/jt4rMgZvDc0?si=hKMxxDsuxtfOxTwL>

VLSI PHYSICAL DESIGN - II

Course Code	25NHOP713	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

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

25NHOP713.1	Analyze back-end design flow in VLSI Technology and its implementations.
25NHOP713.2	Gain sufficient theoretical knowledge on Partitioning, Floor-planning, Placement and Routing for carrying out Physical Design.
25NHOP713.3	Apply the procedure of Floor planning and placement in physical design.
25NHOP713.4	Examine routing and design rule check for a given physical design.
25NHOP713.5	Evaluate clock tree synthesis and power management of the circuit.
25NHOP713.6	Engage in independent learning and perform the physical design of selected VLSI circuit.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
25NHOP713.1	3	3	-	-	-	-	-	-	-	-	-	-
25NHOP713.2	3	-	-	-	3	-	-	-	3	-	3	3
25NHOP713.3	3	3	-	-	3	-	-	-	3	-	3	3
25NHOP713.4	3	3	-	3	3	-	-	-	-	-	-	-
25NHOP713.5	3	3	2	2	3	-	-	-	3	-	3	3
25NHOP713.6	3	3	2	2	3	-	-	-	3	-	3	3

MODULE-1	PHYSICAL DESIGN	25NHOP713.1	8 Hours
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CAD Tools System partitioning, Estimating ASIC size. Introduction to PD flow, Inputs of PD – Library files, Netlist, SDC (Synopsis Design Constraints), LEF (Library Exchange File), Output of PD – GDSII, Area, Power, Timing reports.

Hands on:

- Examine the ASIC size of 40k gate ASIC in a 0.3um gate array, three level metal process with 166 I/O pads. This ASIC minimum feature size is 0.35um.
- Examine and perform the following for the 16 -bit up counter at the specified frequency using Cadence tool.
- Write the commands to generate the SDC file.
- Synthesize the module and generate the timing report
- Examine and synthesize the 16 -bit down counter at the specified frequency using Cadence tool. Analyze the timing report to check the slack.
- Perform the synthesis of the 8-bit counter. Generate the simulation output. Run the tcl file to generate the synthesis output and read the power, area and timing report.

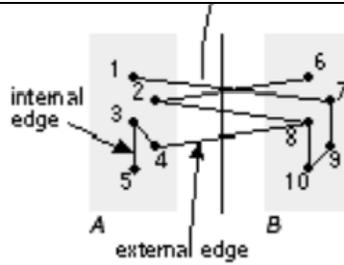
MODULE-2	PARTITIONING AND FLOOR-PLANNING	25NHOP713.2, 25NHOP713.3	8 Hours
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Goals and objectives, Constructive Partitioning, Iterative Partitioning Improvement, KL, FM and Look Ahead algorithms

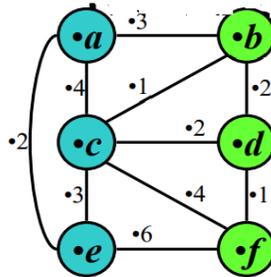
Floor-planning: Goals and objectives, Floor Plan-Die size estimation, Aspect Ratio, Core Utilization, Macros and Types –Soft macros, Hard macros, Firm macros, Pin Assignment

Hands on:

- Illustrate the KL algorithm and calculate the gain for the below network graph.



2. Create a chip for floor-planning for the following specification: Utilization -70%, Aspect ratio-1, Appropriate Channel Spacing between core boundary to IO boundary.
3. Analyze for gain using KL algorithm for the given network graph and measure the number of external edges. (Assume a,c,e belongs to one partition and b,d,f belongs to other partition).



MODULE-3	FLOOR PLANNING AND PLACEMENT	25NHOP713.3, 25NHOP713.6	8 Hours
<p>Floor Planning: Measurement of delay in Floor planning, I/O and Power planning and Clock planning. Placement: Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods. Type of Placement – Standard cell placement, Building block placement Cell types – Well tap cells, End cap cells, Decap cells, Filler cells, Spare cells</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. Analyze and perform the following in the floorplan, connect global net connects, add power rings, add power strips. 2. During the placement stage, place standard cell, analyze and generate timing, area and power report and complete clock tree synthesis. 3. Add the following to the design: <ol style="list-style-type: none"> a) End cap b) Well tap cells 			
MODULE-4	ROUTING	25NHOP713.4, 25NHOP713.6	8 Hours
<p>Routing: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Back-annotation. Detailed Routing: Goals and objectives, Measurement of Channel Density, Left-Edge Algorithm, Area-Routing Algorithms, Multilevel routing, Timing –Driven detailed routing, Final routing steps, Special Routing</p>			
<p>Hands on:</p> <ol style="list-style-type: none"> 1. During the placement stage place Route. Perform routing by using Timing-driven and SI-driven routing algorithms. 2. Analyze set up report using optimization. 3. Analyze hold report using optimization. 			
MODULE-5	POWER PLAN	25NHOP713.5, 25NHOP713.6	8 Hours
<p>Power plan – Rings, Stripes, Rails, Core power management, I/O cell power management, IR drop – types of IR drop Skew, Latency, Jitter, CTS</p>			

Hands on:

1. Illustrate and perform the power planning for the 8-bit up-down counter.
 - a) Connect Global Net connects
 - b) Add power rings
 - c) Add power strings
2. Illustrate and perform the power planning for the 8-bit up-down counter.
 - a) Special route
 - b) Generate set up and hold time reports after power planning.
3. Generate GDS- II file

CIE Assessment Pattern (50 Marks - Hands On) -

RBT Levels		Marks Distribution		
		Test (s)	Certified Online Learning	Case Study/ Project based Assessment
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	15	15	10
L4	Analyze	10	-	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks - Hands-On)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	30
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Reference Books:

- 1) Michael John Sebastian Smith, "Application - Specific Integrated Circuits" AddisonWesley Professional; 2005
- 2) VLSI physical design automation: theory and practice by Sadiq M Sait and Habib Yusuf, McGraw-Hill Book Co.
- 3) VLSI Physical Design: From Graph Partitioning to Timing Closure Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu 2011, Springer.
- 4) J. Bhasker, R Chadha, "Static Timing Analysis for Nanometer Designs: A Practical Approach", Springer, 2009
- 5) https://vlsi-backend-adventure.com/ir_analysis.html
- 6) Cadence or Synopsis or Mentor-Graphics User Guide
- 7) <https://nptel.ac.in/courses/106/105/106105161>

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_cs12/preview
- <https://youtu.be/Z1Cxbn5LOYg>
- <https://youtu.be/iKGxOVbwi40>
- <https://youtu.be/YcwY1PH31qg>
- <https://youtu.be/AW6OwZxY7VY>

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 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 B

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 Outcome:



APPENDIX B

The Graduate Attributes of NBA

- P01 Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems in Computer Engineering.
- P02 Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems in Computer Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.
- P03 Design / Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes of Computer Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
- P04 Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments in Computer Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- P05 Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities in Computer Engineering with an understanding of the limitations.
- P06 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 in Computer Engineering.
- P07 Environment and Sustainability:** Understand the impact of the professional Engineering solutions of Computer Engineering in societal and Environmental contexts, demonstrate the knowledge of, and need for sustainable development.
- P08 Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the Engineering practice.
- P09 Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- P010 Communication Skills:** Communicate effectively on complex Engineering activities with the Engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- P011 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.
- P012 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.

