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: 2022-2026
## (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
- ❖ Innovation
- ❖ Integrity
- ❖ Professionalism
- ❖ Inclusiveness
- ❖ Social Responsibility

# New Horizon College of Engineering

## SIXTH SEMESTER OPEN ELECTIVES LIST FOR AY 2024-2025 (EVEN SEMESTER)

**Batch: 2022-2026**

| Course Code | Course Name | BOS |
|---|---|---|
| 23NHOP601 | Data Analytics using R Programming | CSE |
| 23NHOP602 | Robotic Process Automation | CSE |
| 23NHOP603 | SAP | ME |
| 23NHOP604 | Product Life Cycle Management | ME |
| 23NHOP605 | Industry 4.0 | ME |
| 23NHOP606 | Schneider - Industrial Automation | EEE |
| 23NHOP607 | CISCO - Routing & Switching - 1 | ECE |
| 23NHOP609 | Programming of Industrial Robot | ECE |
| 23NHOP610 | 5G Mobile Communication | ECE |
| 23NHOP611 | VLSI Physical Design-I | ECE |
| 23NHOP612 | Juniper Network Operating System | ISE |

# New Horizon College of Engineering

## SEVENTH SEMESTER OPEN ELECTIVES LIST FOR AY 2025-2026 (ODD SEMESTER)

**Batch: 2022-2026**

| Course Code | Course Name | BOS |
|---|---|---|
| 23NHOP701 | Data Analytics using R Programming | CSE |
| 23NHOP702 | Robotic Process Automation | CSE |
| 23NHOP703 | SAP | ME |
| 23NHOP704 | Product Life Cycle Management | ME |
| 23NHOP705 | Industry 4.0 | ME |
| 23NHOP706 | Schneider - Industrial Automation | EEE |
| 23NHOP707 | CISCO - Routing & Switching - 1 | ECE |
| 23NHOP708 | CISCO - Routing & Switching -2 | ECE |
| 23NHOP710 | 5G Mobile Communication | ECE |
| 23NHOP711 | VLSI Physical Design-I | ECE |
| 23NHOP712 | Juniper Network Operating System | ISE |
| 23NHOP714 | VLSI Physical Design-II | ECE |
| 23NHOP715 | Advanced Networking | CSE |

# OPEN ELECTIVE

# (6th & 7th SEMESTER SYLLABUS)

## DATA ANALYTICS WITH R PROGRAMMING

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP601** | **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:

| | |
|---|---|
| 23NHOP601.1 | Comprehend with statistical tools to import and manage data to demonstrate proficiency. |
| 23NHOP601.2 | Apply comprehensive data exploration and visualization using suitable platform to interpret data effectively for informed decisions. |
| 23NHOP601.3 | Apply tools for data transformation to select appropriate data sources. |
| 23NHOP601.4 | Analyze to shape and combine data for meaningful insights and visualization. |
| 23NHOP601.5 | Evaluate the analytics features to summarize, model and customize the data. |
| 23NHOP601.6 | Design interactivity, formatting to dashboards and publishing content for effective data communication on cloud platforms. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP601.1 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 |
| 23NHOP601.2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 |
| 23NHOP601.3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 |
| 23NHOP601.4 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 |
| 23NHOP601.5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 |
| 23NHOP601.6 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 |

| | | | |
|---|---|---|---|
| **MODULE-1** | **STATISTICAL COMPUTING AND DATA TRANSFORMATION** | **23NHOP601.1** | **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** | **23NHOP601.2** | **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** | **23NHOP601.3, 23NHOP601.4** | **8 Hours** |
|---|---|---|---|

Connect to Data Sources: Choose an appropriate data source, choose between live connection or extract, Connect to a data source.

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

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.

**Hands on:**

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 | Healthcare diagnostics and treatment personalization<br>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. |
|---|---|

| **MODULE-4** | **EXPLORE AND ANALYZE DATA** | **23NHOP601.5** | **8 Hours** |
|---|---|---|---|

Create quick table calculations: Create calculated fields, Moving average, Percent of total, Running total, Percentile, Create custom table calculations.

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.

**Hands on:**

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 | Fraud detection and prevention in finance<br>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. |
|---|---|

| **MODULE-5** | **CREATE CONTENT & PUBLISH ON CLOUD** | **23NHOP601.6** | **8 Hours** |
|---|---|---|---|

Data Interpretation: Create charts, Create dashboards and stories, Add interactivity to dashboards, Format dashboards, Publish Content, Schedule data updates, Manage Published workbooks

**Hands on:**

1. Create a charts, dashboards and stories
2. Write a program to add interactivity and formatting to dashboards

| Case Study / | E-commerce personalization and recommendation systems |
|---|---|

| | |
|---|---|
| Applications | 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. |

**CIE Assessment Pattern (50 Marks – Hands On) –**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | 10 | - | - |
| L3 | Apply | 5 | 5 | 5 |
| L4 | Analyze | 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**

# ROBOTIC PROCESS AUTOMATION

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP602** | **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:

| | |
|---|---|
| 23NHOP602.1 | Identify the automation potential and realizing the value in RPA. |
| 23NHOP602.2 | Demonstrate good understanding RPA Platform Architecture and Components. |
| 23NHOP602.3 | Build simple task bots for automating the processes. |
| 23NHOP602.4 | Analyze the automating tasks through office automation packages. |
| 23NHOP602.5 | Evaluate independently developed solution for automating the tasks. |
| 23NHOP602.6 | Develop the RPA solutions for the real-time use cases. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP602.1 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| 23NHOP602.2 | - | 3 | - | - | - | - | - | - | - | - | - | - |
| 23NHOP602.3 | - | - | 3 | - | - | - | - | - | - | - | - | - |
| 23NHOP602.4 | - | - | - | 3 | - | - | - | - | - | - | - | - |
| 23NHOP602.5 | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 23NHOP602.6 | - | - | - | - | - | - | 2 | - | 1 | - | 1 | 2 |

| **MODULE-1** | **Robotic Process Automation - Overview** | **23NHOP602.1** | **8 Hours** |
|---|---|---|---|

**Introduction:** Definition of RPA, Evolution of Automation, Traditional Automation vs RPA, RPA Roles and Responsibilities, RPA used in Business, RPA Challenges and Best practices.

**RPA Requirements Elicitation and Flow Charting:** The role of the RPA Business Analyst, Interactions between the RPA Business Analyst, End Users, and RPA Developer, Process decomposition/flowcharting, Advanced cross functional flowcharting.

**RPA Business Process Design:** Processes and workloads that are candidates for RPA, Future state process design, Business value metrics and feasibility, RPA program management office.

**Hands on:**

1. How RPA is used in Business?
2. Create flowcharts for the following scenarios. Include at least one decision.
   a) Make a glass of lemonade
   b) Log in to Facebook
   c) Stop work on a computer and shut it down
   d) Take money out of the ATM
   e) File an expense report and the company pays it
3. Invoice processing Current state, Future state
4. Credit check current state, Future state

| | |
|---|---|
| Case Study / Applications | 1. Knowledge Check<br>2. Assignment - Case Study |
| Text Book | Automation Anywhere Material – Unit-1, Unit-2, Unit-3 |

<table>
<tr><td>MODULE-2</td><td>RPA Programming</td><td>23NHOP602.2</td><td>8 Hours</td></tr>
<tr><td colspan="4">Programming Constructs: Input, Process, Output, Variables and Constants, Algorithms and Pseudocode, Programming Constructs – Sequence, Selection, Iteration.<br>Introduction to Automation Anywhere: Automation Anywhere architecture, How to register and set up, High level navigation and available Actions, How to build simple bots.<br>Automating Data Entry with Automation Anywhere: How to record and playback keystrokes, How to automate the process to fill out a form, How to process multiple rows of data using the Loop and Variable constructs.</td></tr>
<tr><td colspan="4">Hands on:<br>1. Create your first bot<br>2. Create a bot to send email.<br>3. Create a bot to open a website<br>4. Create a bot to close a website<br>5. Register a new user<br>6. Register multiple new users</td></tr>
<tr><td>Case Study / Applications</td><td colspan="3">Knowledge Check and Assignment – Case Study<br>Find a publicly available web site that allows registering for a service<br>Create a csv file (Create an Excel file and Save As .csv) with 6 rows of made-up data.</td></tr>
<tr><td>Text Book</td><td colspan="3">Automation Anywhere Material – Unit-4, Unit-5, Unit-6</td></tr>
<tr><td>MODULE-3</td><td>Data Extraction using RPA</td><td>23NHOP602.3, 23NHOP602.4</td><td>8 Hours</td></tr>
<tr><td colspan="4">Extracting Web Data to a CSV file with Automation Anywhere: How to extract data from a web table, How to save the data to a CSV file, How to write an iterative loop with a condition.<br>Working with Excel and Automation Anywhere: How to work with Excel files within Automation Anywhere, How to iterate through Excel files to automate calculations on multiple rows, Filter values and hide rows, How to password protect a spreadsheet.</td></tr>
<tr><td colspan="4">Hands on:<br>1. Build a bot to create a CSV file<br>a. Launch a web site<br>b. Capture a table<br>c. Iterate selectively through the table<br>d. Write the output to a CSV file<br>2. Web table extraction to CSV<br>3. HR-Bot for Bonus Calculation<br>4. Inventory Management Usecase<br>5. Measure Production Line Efficiency</td></tr>
<tr><td>Case Study / Applications</td><td colspan="3">Write bots that capture data in the tables from the following web sites<br>• https://medlineplus.gov/ency/patientinstructions/000886.htm<br>• https://whatscookingamerica.net/NutritionalChart.htm</td></tr>
<tr><td>Text Book</td><td colspan="3">Automation Anywhere Material – Unit-7, Unit-8</td></tr>
<tr><td>MODULE-4</td><td>More on Automation</td><td>23NHOP602.5</td><td>8 Hours</td></tr>
<tr><td colspan="4">End-to-end Processing with Automation Anywhere: The definition of “system of record”, The importance of data integrity in a system of record, Options and issues with integrating to systems of record,How to automate the process of creating and emailing an invoice.<br>Working with PDF Documents and Automation Anywhere: How to work with PDF files within Automation Anywhere, How to convert data from a PDF file to a text file, How to parse and extract information from a text file, How to put the output into a CSV file that is ready to be processed by an application.</td></tr>
</table>

**Hands on:**

1. Invoicing Process Flow Chart.
2. Generate an invoice and record/playback the session
3. Create a CSV file with multiple invoice records
4. Generate multiple invoices
5. Convert PDF to Text
6. Parsing and Extraction of string
7. Parsing Text and Saving to CSV

| | |
|---|---|
| Case Study / Applications | Sign up for www.invoicesimple.com and generate estimates<br>Create a csv file (Create an Excel file and Save As .csv) with 6 rows of made-up data Iterate through the table, Email the estimates to yourself and then Close the web site |
| Text Book | Automation Anywhere Material – Unit-9, Unit-10 |

| | | | |
|---|---|---|---|
| **MODULE-5** | **Emerging and Future Trends in RPA** | **23NHOP602.6** | **8 Hours** |

**Demystifying AI & ML:** Explain the significance of Artificial Intelligence (AI) and Machine Learning (ML), Explain the scope of Automation Anywhere's IQ Bot, Identify Automation Anywhere IQ Bot Use Cases, Describe the Automation Anywhere IQ Bot Workflow.

**Automation 360 Overview and Components:** Control Room, Bot Insight, IQ Bot, AA Platform Components – Automation Challenge, Automation Anywhere Documentation, Automation Anywhere University, Automation Anywhere Certifications,

**Hands on:**

1. AA Invocation + Integration with key platforms – case study
2. Automating business process with IQ Bot + RPA – case study
3. Sample Architecture
4. IQ Bot Use Cases
5. Coding best practices for creating bots

| | |
|---|---|
| Case Study / Applications | Bot development best practices |
| Text Book | Automation Anywhere Material – Unit-11, Unit-12 |

**CIE Assessment Pattern (50 Marks – Hands On)**

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

**SEE Assessment Pattern (50 Marks – Hands On)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 5 |
| L2 | Understand | 5 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | 10 |
| L6 | Create | 10 |

**Suggested Learning Resources:**

**Text Books:**

1) Automation Anywhere - Faculty training materials:
2) https://automationanywhere1.sharepoint.com/sites/AAU-EducationProducts/

**Reference Books:**

1) Robotic Process Automation with Automation Anywhere: Techniques to fuel business productivity and intelligent automation using RPA Paperback – Import, 24 November 2020 by Husan Mahey, ISBN: 978-1839215650

**Web links and Video Lectures (e-Resources):**

- https://academy.uipath.com/learning-plans/rpa-developer-foundation
- https://academy.uipath.com/learning-plans
- https://university.automationanywhere.com/certification/rpa-certification?sc=essentials#eScrlId
- https://university.automationanywhere.com/training/rpa-academic/automation-360-rpa-essentials-student-prep/

**Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Visit to any RPA industry
- Demonstration of bot development
- Video demonstration of latest RPA videos

## SAP

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP603** | **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:

| | |
|---|---|
| 23NHOP603.1 | Understand the concept of Automation, Manufacturing, Process Planning, Material Requirement Planning (MRP) and Master Production Schedule (MPS). |
| 23NHOP603.2 | Familiarize with SAP, ERP and GBI. |
| 23NHOP603.3 | Create master data for new vendor and trading goods in Materials Management. |
| 23NHOP603.4 | Analyze the need for warehouse and transfer process. |
| 23NHOP603.5 | Evaluate and create production order for the product groups. |
| 23NHOP603.6 | Facilitate the flow of goods between producer and the purchaser for logistic operations. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP603.1 | **3** | - | - | - | - | - | - | - | - | - | - | **2** |
| 23NHOP603.2 | **2** | - | - | - | - | - | - | - | - | - | - | **2** |
| 23NHOP603.3 | **2** | **2** | **2** | - | **2** | **1** | - | **2** | **2** | **2** | - | **2** |
| 23NHOP603.4 | **2** | **2** | **2** | - | **2** | **1** | - | **2** | **2** | **2** | - | **2** |
| 23NHOP603.5 | **2** | **2** | **2** | - | **2** | **1** | - | **2** | **2** | **2** | - | **2** |
| 23NHOP603.6 | **2** | **2** | **2** | - | **2** | **1** | - | **2** | **2** | **2** | - | **2** |

| **MODULE-1** | **INTRODUCTION TO AUTOMATION, CIM & SAP** | **23NHOP603.1 23NHOP603.2** | **8 Hours** |
|---|---|---|---|

Automation, Computer Integrated Manufacturing (CIM), Computer Aided Process Planning (CAPP), Material Requirement Planning (MRP or MRP-I), Material Resource Planning (MRP-II), Master Production Schedule (MPS), Capacity Planning (CC).

Introduction to SAP, Enterprise Resource Planning (ERP), S/4 HANA, History, Data Types, Drivers of Change, Organization Unit, Global Bikes Inc. (GBI).

**Hands on:**

1. S/4 HANA and GBI in SAP.

| Case Study / Applications | Industries using SAP. |
|---|---|

| **MODULE-2** | **MATERIALS MANAGEMENT (MM)** | **23NHOP603.3** | **8 Hours** |
|---|---|---|---|

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.

**Hands on:**

1. Creation of material to invoicing

| Case Study / Applications | Creation of material data and invoicing for different master data. |
|---|---|

| **MODULE-3** | **WAREHOUSE MANAGEMENT (WM)** | **23NHOP603.4** | **8 Hours** |
|---|---|---|---|

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.

**Hands on:**

1. Creation of purchase order and transfer order for given materials.

| Case Study / Applications | Creation of purchase order and transfer order for given material. |
|---|---|

| | | | |
|---|---|---|---|
| **MODULE-4** | **PRODUCTION PLANNING AND EXECUTION (PP)** | **23NHOP603.5** | **8 Hours** |

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.

**Hands on:**

1. Creation of material master to costing in SAP.

| | |
|---|---|
| Case Study / Applications | Creation of material master to costing for various goods. |

| | | | |
|---|---|---|---|
| **MODULE-5** | **SALES AND DISTRIBUTION (SD)** | **23NHOP603.6** | **8 Hours** |

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.

**Hands on:**

1. Creation of new customer to invoicing

| | |
|---|---|
| Case Study / Applications | Creation of new customer up to invoicing for different materials. |

**CIE Assessment Pattern (50 Marks – Hands On) –**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | 05 | - | - |
| L3 | Apply | 05 | 05 | 05 |
| L4 | Analyze | 05 | 05 | 05 |
| L5 | Evaluate | 05 | - | - |
| L6 | Create | 05 | 05 | - |

**SEE Assessment Pattern (50 Marks – Hands-On)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 05 |
| L2 | Understand | 05 |
| L3 | Apply | 10 |
| L4 | Analyze | 10 |
| L5 | Evaluate | 10 |
| L6 | Create | 10 |

**Reference Books:**


- **Automation, Production Systems & Computer Integrated Manufacturing, M. P. Groover, Person India, 2018, 4th Edition**.
- **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** | **23NHOP604** | **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:

| | |
|---|---|
| 23NHOP604.1 | Integrate the various stages of PLM into engineering product categories and portfolios that will evaluate into successful product development. |
| 23NHOP604.2 | Interpret the data with information and communicate the same for the supply chain and value supplier chain to ensure sustainable development. |
| 23NHOP604.3 | Examine life cycle management strategies and knowledge to develop new and/or appropriate engineering solutions in collaborations. |
| 23NHOP604.4 | Translate and implement the environmental and international regulatory frame works into product design, development and manufacturing requirements |
| 23NHOP604.5 | Assess system for corrective and preventive action to track production quantity and Quality issues through digital manufacturing. |
| 23NHOP604.6 | Incorporate preventive approaches concentrating on minimizing waste, hazard and risk associated with product design and development. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP604.1 | 3 | - | 3 | - | 2 | - | - | - | - | - | 1 | - |
| 23NHOP604.2 | 3 | - | - | - | 3 | - | - | - | - | - | - | - |
| 23NHOP604.3 | 3 | - | 3 | - | 3 | - | - | - | 1 | - | - | - |
| 23NHOP604.4 | 2 | - | 3 | - | | - | - | - | 1 | - | - | - |
| 23NHOP604.5 | 2 | - | - | - | 3 | - | - | - | - | - | 1 | - |
| 23NHOP604.6 | 2 | - | - | - | 3 | - | - | - | - | - | 1 | - |

| **MODULE-1** | **Introduction to Product Life Cycle Management (PLM):** | **23NHOP604.1** | **8 Hours** |
|---|---|---|---|

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.

**Hands on:**

1. Development of Project management schedule and time activity using PLM Enovia.

| | |
|---|---|
| Case Study | Case Study on Life Cycle phases of Product for project management using PLM software |

| **MODULE-2** | **PLM Concepts, Processes and Workflow:** | **23NHOP604.2** | **8 Hours** |
|---|---|---|---|

Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM. Collaborative Product Development: Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management

**Hands on:**

1. Software components, deliverable applications and system integration for product life cycle phases using PLM software.

| | |
|---|---|
| Applications | Demo of drivers of PLM and the necessary elements using software |

| **MODULE-3** | **Collaborative Product Development:** | **23NHOP604.3, 23NHOP604.4** | **8 Hours** |
|---|---|---|---|

Bill of Materials and Process Consistency, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral.

**Hands on:**

1. Collaborative product development from design, development and product portfolio building using PLM Enovia.

| | | | |
|---|---|---|---|
| Case Study | Case Study on collaborate product development for a simple product using PLM software | | |
| **MODULE-4** | **Digital Manufacturing:** | **23NHOP604.5** | **8 Hours** |

Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.

**Hands on:**

1. Digital product structural development for variant management 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:** | **23NHOP604.6** | **8 Hours** |

Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications.

**Hands on:**

1. Collaborative product development for creating meetings, discussions and developing agendas using PLM Enovia.

| | |
|---|---|
| Case Study | PLM strategy and assessment using software |

**CIE Assessment Pattern (50 Marks – Hands On) –**

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

**SEE Assessment Pattern (50 Marks – Hands-On)**

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

**Reference 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

**Web links and Video Lectures (e-Resources):**

- https://www.youtube.com/watch?v=xSYlbfJeYXQ
- https://www.youtube.com/watch?v=yd5NRIPXZ24

# INDUSTRY 4.0

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP605** | **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:

| | |
|---|---|
| 23NHOP605.1 | Understand the fundamental principles of Industry 4.0 and related fields |
| 23NHOP605.2 | Analyze the concepts of Industrial IoT |
| 23NHOP605.3 | Analyze the characteristics of Smart factories |
| 23NHOP605.4 | Implementation of MES Platform in Smart factories |
| 23NHOP605.5 | Analyze the different Industrial Data transmission systems |
| 23NHOP605.6 | Understand the concepts of on-site and off-site industry 4.0 technologies |
| | |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP605.1 | 2 | 2 | 2 | - | 2 | - | - | - | 2 | - | - | - |
| 23NHOP605.2 | 2 | 2 | 2 | - | 2 | - | - | - | 2 | - | - | - |
| 23NHOP605.3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - |
| 23NHOP605.4 | 3 | 2 | 2 | - | 2 | - | - | - | - | - | - | - |
| 23NHOP605.5 | 2 | 2 | 2 | - | 2 | - | - | - | - | - | - | - |
| 23NHOP605.6 | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | - | - | - |

| **MODULE-1** | **INTRODUCTION TO INDUSTRY 4.0** | **23NHOP605.1** | **8 Hours** |
|---|---|---|---|

Industry revolution: Phases of development, Evolution of Industry 4.0, Design requirements of Industry 4.0, Drivers of Industry 4.0, Applications of Industry 4.0, Impacts of Industry 4.0, Smart business perspective, Industry 5.0 and recent trends

**Hands on:**

1. Monitoring of shopfloor temperature and humidity using Node MCU
2. Modelling a line following robot/ AGV for a shopfloor

| | |
|---|---|
| Case Study / Applications | Case study on the impact of Industry 4.0 on a specific type of Industry |

| **MODULE-2** | **INDUSTRIAL INTERNET OF THINGS** | **23NHOP605.2** | **8 Hours** |
|---|---|---|---|

IIOT overview, IIOT vs Automation, challenges in IIoT, Applications of IIoT Industrial internet overview, Applications of industrial internet, advantages of industrial internet. Industrial sensing and automation: need of sensing for industry, industrial sensing, Smart sensor, Examples of industrial sensors,

**Hands on:**

1. Modelling a IOT based industrial gas monitoring system
2. Modelling a IOT based counter/sorting for assembly line

| **MODULE-3** | **SMART FACTORIES AND MANUFACTURING EXECUTION SYSTEM** | **23NHOP605.3, 23NHOP605.4** | **8 Hours** |
|---|---|---|---|

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

Manufacturing Execution Sytems: History and evolution of MES, Benefits of MES, Core and support modules of MES and Tools for MES,

**Hands on:**

1. Create manufactory orders using Odoo Manufacturing
2. Create purchase order, RFQ and sales order using Odoo

| | |
|---|---|
| Case Study / | Case study of a Toyota production systems |

| | | | |
|---|---|---|---|
| Applications | | | |
| **MODULE-4** | **INDUSTRIAL DATA TRANSMISSION** | **23NHOP605.5** | **8 Hours** |
| Introduction, PLC architecture, SCADA, WSAN. Fieldbus, profibus, HART, Interbus, Bitbus, CC-link, Modbus, Batibus, DigitalSTROM, Controller Area Network, DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and LoRaWAN, NB-IoT, IEEE 802.11AH | | | |
| **Hands on:**<br>1. Modelling and part preparation for additive manufacturing<br>2. Remote additive manufacturing technology using IOT | | | |
| **MODULE-5** | **TECHNOLOGIES OF INDUSTRY 4.0** | **23NHOP605.6** | **8 Hours** |
| Off-site technologies: cloud computing (overview, necessity of cloud computing, cloud computing services in IIOT, industrial cloud platform providers), fog computing (overview, advantages and applications), Edge Computing<br>On-site technologies: Additive manufacturing, Augmented Reality and Virtual Reality (History, categorization and applications), Big data (types, characteristics, sources, data acquisition and storage of data), Data analytics (necessity of data analytics and types of analytics. | | | |
| **Hands on:**<br>1. Create a temperature monitoring dashboard using IoT cloud with Node MCU<br>2. Data slicing and analysis using python<br>3. Demonstration of VR based industrial training | | | |
| Case Study / Applications | Case study on the various applications of AR/VR | | |

**CIE Assessment Pattern (50 Marks – Hands On) –**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly 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 | 15 |
| L3 | Apply | 20 |
| L4 | Analyze | 15 |
| L5 | Evaluate | |
| L6 | Create | |

**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** | **23NHOP606** | **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:

| | |
|---|---|
| 23NHOP606.1 | Understand the need and basics of automation. |
| 23NHOP606.2 | Investigate the types of protocols for PLC. |
| 23NHOP606.3 | Develop a suitable logic for various real-time applications using ladder logic diagrams. |
| 23NHOP606.4 | Design a PLC based solution for industrial problem by Sequential function charts. |
| 23NHOP606.5 | Build blocks and mimic screen using HMI. |
| 23NHOP606.6 | Develop real time applications for industry 4.0 |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP606.1 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| 23NHOP606.2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| 23NHOP606.3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| 23NHOP606.4 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| 23NHOP606.5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| 23NHOP606.6 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |

| | | | |
|---|---|---|---|
| **MODULE-1** | **BASICS OF AUTOMATION** | **23NHOP606.1** | **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:** | **23NHOP606.2** | **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** | **23NHOP606.3, 23NHOP606.4** | **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 person entering the conference room using counters.
4. Design a wiring Tunnel wiring using ladder logic diagram and execute in hardware.

| | |
|---|---|
| Case Study / Applications | Design the logic system for a small road cross signal. |

| MODULE-4 | INDUSTRY APPLICATIONS | 23NHOP606.4<br>23NHOP606.5 | 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 | 23NHOP606.5<br>23NHOP606.6 | 8 Hours |
|---|---|---|---|

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 | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | - | - | - |
| L3 | Apply | 10 | 15 | 10 |
| L4 | Analyze | 5 | - | - |
| L5 | Evaluate | 10 | - | - |
| 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 Semgupta.12 July 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 - 1 | | | |
|---|---|---|---|
| **Course Code** | **23NHOP607** | **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:

| | |
|---|---|
| 23NHOP607.1 | Identify various network devices, topologies, and protocols. |
| 23NHOP607.2 | Construct IP addressing table and perform subnetting in IPv4 and IPv6 network. |
| 23NHOP607.3 | Analyse Dynamic Host Configuration Protocol (DHCP) operation for scalable networks. |
| 23NHOP607.4 | Configure and troubleshoot advanced operations of routers and implement Link State routing protocols (OSPF). |
| 23NHOP607.5 | Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol. |
| 23NHOP607.6 | Examine redundancy using Spanning tree protocols and Ether-Channel for network scalability |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP607.1 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | 3 |
| 23NHOP607.2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | 3 |
| 23NHOP607.3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | 3 |
| 23NHOP607.4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | - | 3 |
| 23NHOP607.5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | - | 3 |
| 23NHOP607.6 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | - | 3 |

| **MODULE-1** | **LAYERED ARCHITECTURE, NETWORK DEVICES AND TOPOLOGIES** | **23NHOP607.1** | **8 Hours** |
|---|---|---|---|

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<br>https://www.cisco.com/c/en/us/support/docs/security-vpn/secure-shell-ssh/4145-ssh.html?dtid=osscdc000283<br>https://community.cisco.com/t5/networking-knowledge-base/configuring-telnet-console-and-aux-port-passwords/ta-p/3126628?dtid=osscdc000283 |

| **MODULE-2** | **IPv4 ADDRESSING, IPv6 ADDRESSING, DHCPv4 CONFIGURATION & DHCPv6 CONFIGURATION** | **23NHOP607.2 23NHOP607.3** | **8 Hours** |
|---|---|---|---|

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=osscdc000283 | | |
| **MODULE-3** | **ROUTING CONCEPTS & SINGLE-AREA OSPF CONCEPTS** | **23NHOP607.4** | **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:**<br>1. Configure IP Default Static Routes<br>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=osscdc000283 | | |
| **MODULE-4** | **VLANS** | **23NHOP607.5** | **8 Hours** |
| VLANS: Overview of VLANs, VLAN Trunks, VLAN identification with a Tag, VLAN Configuration, Dynamic Trunking Protocol, Inter VLAN routing | | | |
| **Hands on:**<br>1. VLAN Configuration<br>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=osscdc000283 | | |
| **MODULE-5** | **SPANNING TREE PROTOCOL & ETHERCHANNEL** | **23NHOP607.6** | **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:**<br>1. Spanning Tree Protocol Configuration<br>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=osscdc000283 https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst9500/software/release/1610/configuration_guide/lyr2/b_1610_lyr2_9500_cg/configuring__etherchannels.html?dtid=osscdc000283 | | |

**CIE Assessment Pattern (50 Marks – Hands On) –**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly 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**

## PROGRAMMING OF INDUSTRIAL ROBOT

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP609** | **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:

| | |
|---|---|
| 23NHOP609.1 | Infer the various coordinate systems and degrees of freedom for a robot |
| 23NHOP609.2 | Illustrate the robotic coordinate systems by teaching the robot |
| 23NHOP609.3 | Examine the functionalities of robotic end effectors |
| 23NHOP609.4 | Develop various industrial applications using FANUC Robot ER-4iA |
| 23NHOP609.5 | Model various applications using Roboguide simulation too |
| 23NHOP609.6 | Experiment with FANUC Robot ER-4iA using teach pendant |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP609.1 | 3 | 3 | 1 | 1 | 3 | 1 | - | - | - | - | - | 1 |
| 23NHOP609.2 | 3 | 3 | 2 | 1 | 3 | - | - | - | - | - | - | 1 |
| 23NHOP609.3 | 3 | 3 | 2 | 1 | 3 | - | - | - | - | - | 2 | 1 |
| 23NHOP609.4 | - | 3 | 3 | 3 | 3 | - | - | - | - | - | 3 | 1 |
| 23NHOP609.5 | - | 3 | 3 | 3 | 3 | - | - | - | - | - | 3 | 1 |
| 23NHOP609.6 | - | 3 | 3 | 3 | 3 | - | - | - | - | - | 3 | 1 |

| **MODULE-1** | **BASICS OF ROBOTICS** | **23NHOP609.1** | **8 Hours** |
|---|---|---|---|

Basic Concepts – Definition – Three laws – Degrees of Freedom. Robot – Components of a robot, Classification of robots Articulated – Cartesian – Cylindrical – Polar – SCARA – Delta – Robot anatomy – Co-ordinate systems, Work envelope – Specifications – Pitch, yaw, roll, joint notations, speed of motion and pay load – Robot parts and their functions.

**Hands on:**

1. Explanation on degrees of freedom
2. Explanation on joints and axes

| **MODULE-2** | **ROBOT TEACHING** | **23NHOP609.2, 23NHOP609.6** | **8 Hours** |
|---|---|---|---|

**Teach pendant programming**: Various Teaching Methods, Task Programming, A Robot Program as a Path in Space, Motion Interpolation.

**Hands on:**

1. Explanation on tool Orienting
2. Selection & Creation of Teach program
3. Explanation on Joint, Linear & Circular motion
4. Program testing, editing & Touch up
5. Using and setting up of User frame
6. Using and setting up of Tool frame

| | |
|---|---|
| Case Study / Applications | Jogging of the axes of Robots, Tracing of various geometrical figures using FANUC Robot ER4iA, Roboguide software |

| **MODULE-3** | **ROBOT SENSORS, ACTUATORS, END EFFECTORS AND INSTRUCTION SET** | **23NHOP609.3, 23NHOP609.6** | **8 Hours** |
|---|---|---|---|

**Sensors and Actuators:**
Resistors, Capacitors, Inductors, Transducers, PIR sensors, Optical Transducers, Servomotor, Stepper Motors.

**End effectors** – Grippers: Mechanical grippers, Hydraulic & Pneumatic grippers, Magnetic grippers, Vacuum grippers, RCC grippers – Two and three fingered grippers –External grippers – Selection considerations, Gripper force analysis.

**Instruction set** – Registers, Timers, Wait, Branching.

**Hands on:**
1.Practice on various I/O instructions
2.Practice on Timer/Wait and Branching Instructions
3.Practice on User Alarms

| | |
|---|---|
| Case Study / Applications | Investigate the principles of operations of end-effectors and explore the applications of various types of grippers |

| | | | |
|---|---|---|---|
| **MODULE-4** | **INDUSTRIAL APPLICATIONS OF ROBOTS** | **23NHOP609.4, 23NHOP609.6** | **8 Hours** |

Robot Application: Implementation of robots in industries Various steps, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application, Material handling Applications – PICK and PLACE & Palatalization, Robot cycle time analysis

**Hands on:**
1.Practice on Pick and Place application
2. Practice on Palatalization
3.Practice on real time applications

| | |
|---|---|
| Case Study / Applications | Scrutinize the Different types of Robotic applications in automation industry |

| | | | |
|---|---|---|---|
| **MODULE-5** | **ROBOT PROGRAMMING AND SIMULATION** | **23NHOP609.5, 23NHOP609.6** | **8 Hours** |

**Introduction to Robo Guide**: Create, program and simulate a robotic work cell- Integrated Virtual Teach Pendant looks and operates like a real Teach Pendant- Import CAD models of parts- Reach verification, collision detection, accurate cycle time and robot trajectory and other system.

**Hands on:**
1. Reach verification
2. Collision detection
3. Accurate cycle time
4. Robot trajectory
5. Other system

| | |
|---|---|
| Case Study / Applications | Create and Simulate Robot work cell and calculate the cycle time |

**CIE Assessment Pattern (50 Marks – Hands On) –**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | 4 | | |
| L2 | Understand | 4 | | 3 |
| L3 | Apply | 6 | 10 | 7 |
| L4 | Analyze | 8 | 5 | 5 |
| L5 | Evaluate | 3 | | |
| L6 | Create | - | | |

**SEE Assessment Pattern (50 Marks – Hands-On)**

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


Text Books:

1)Introduction to Robotics: mechanics and control, Craig J J, 3/E,Pearson Education, India,2008.

2) Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, "Technology Programming and Applications", McGraw Hill, 2012.

Reference Books:

1) Deb S.R, "Robotics Technology and flexible automation", Tata McGraw-Hill Education, 2nd Edition 2017.

2) Introduction to Robotics: S K Saha, Tata McGraw-Hill Education,2008

3) ROBOT GUIDE MANUAL, FANUC


**Web links and Video Lectures (e-Resources):**

- https://www.youtube.com/watch?v=htjRUL3neMg
- https://www.youtube.com/watch?v=lDty3bSVeG8
- https://www.youtube.com/watch?v=sr_q_crQBQE
- https://www.youtube.com/watch?v=rbki4HR41-4
- https://www.youtube.com/watch?v=u-GbcmK5RtE
- https://www.youtube.com/watch?v=oXQxM8fE3c0
- https://www.youtube.com/watch?v=QfbdVboVNUM

## 5G MOBILE COMMUNICATION

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP610** | **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:

| | |
|---|---|
| 23NHOP610.1 | Understand 5G spectrum requirement, its channel model and use cases |
| 23NHOP610.2 | Familiarize with 5G architecture options and physical layer concepts |
| 23NHOP610.3 | Examine the multicarrier techniques and new waveform options for 5G communication |
| 23NHOP610.4 | Appraise the current research avenues in 5G domain |
| 23NHOP610.5 | Illustrate the concept of network slicing and V2V Communication |
| 23NHOP610.6 | Interpret the Interference and Mobility management in 5G networks |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP610.1 | 3 | 2 | - | - | - | 3 | 3 | - | - | - | - | 2 |
| 23NHOP610.2 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| 23NHOP610.3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 2 | - | 3 |
| 23NHOP610.4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | - | 3 |
| 23NHOP610.5 | 3 | 3 | 2 | 2 | - | 3 | - | - | - | - | - | 2 |
| 23NHOP610.6 | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - |

| **MODULE-1** | **5G RADIO SPECTRUM** | **23NHOP610.1, 23NHOP610.4** | **8 Hours** |
|---|---|---|---|

5G RADIO SPECTRUM: 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies. 5G CHANNEL MODEL: The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling. 5G USE CASES AND SYSTEM CONCEPT: Use cases and requirements, 5G system concept.

**Hands on:**

1. Demonstrate the downlink data transmission between UE and external data network (Ext-dn) using iperf command in OAI platform.

| **MODULE-2** | **RADIO INTERFACE ARCHITECTURE** | **23NHOP610.2** | **8 Hours** |
|---|---|---|---|

RADIO INTERFACE ARCHITECTURE: 5G architecture options, core network architecture, RAN architecture. 5G PHYSICAL LAYER: Physical channels and signals, 5G frame structure, physical layer procedures (MIMO, Power control, link adaptation, beam forming).

**Hands on:**

1. Demonstrate the uplink data transmission between UE and external data network (Ext-dn) using iperf command in OAI platform.

| **MODULE-3** | **5G RADIO-ACCESS TECHNOLOGIES** | **23NHOP610.3, 23NHOP610.4** | **8 Hours** |
|---|---|---|---|

5G RADIO-ACCESS TECHNOLOGIES: 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 and simulate a MATLAB program to generate OFDM signal.

| **MODULE-4** | **INTRODUCTION TO 5G NETWORK SLICING** | **23NHOP610.4, 23NHOP610.5** | **8 Hours** |
|---|---|---|---|

INTRODUCTION TO 5G NETWORK SLICING: Network Slicing, E2E Slicing, SDN and NFV Slicing VEHICULAR COMMUNICATIONS: From V2V to AV2X, key standards, VC architectures, V2X Use cases

**Hands on:**

1. Demonstrate the packet capturing and analysis using WIRESHARK tool by filtering the TCP and UDP packets.

| MODULE-5 | MOBILITY AND HANDOFF MANAGEMENT IN 5G | 23NHOP610.6 | 8 Hours |
|---|---|---|---|

MOBILITY AND HANDOFF MANAGEMENT IN 5G: Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G.

**Hands on:**

1. Demonstrate the creation of pcap file, reading of pcap file and packet truncation with variable snap length.

**CIE Assessment Pattern (50 Marks – Hands On) –**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly 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 | 15 |
| L3 | Apply | 20 |
| L4 | Analyze | 15 |
| L5 | Evaluate | - |
| 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.classcentral.com/course/5g-training-qualcomm-63487
- https://www.free5gtraining.com/
- https://academy.qualcomm.com/course-catalog/5G-University-Program
- https://telcomaglobal.com/p/5g-online-courses-free
- https://www.edx.org/learn/5g

## VLSI PHYSICAL DESIGN -I

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP611** | **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:

| | |
|---|---|
| 23NHOP611.1 | Analyze the pre-requisites required for back-end VLSI design flow and its implementations. |
| 23NHOP611.2 | Gain sufficient practical knowledge on LINUX, GVIM editor usage and apply the scripting skills for the VLSI tools |
| 23NHOP611.3 | Understand VLSI synthesis and evaluate the functionality of RTL and netlist. |
| 23NHOP611.4 | Understand timing analysis at various process and environment. |
| 23NHOP611.5 | Apply the learnt concepts of STA to evaluate the delay of the circuits. |
| 23NHOP611.6 | Engage in independent learning and perform the timing and power report analysis. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP611.1 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 1 | - | 2 |
| 23NHOP611.2 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 1 | - | 2 |
| 23NHOP611.3 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 1 | - | 2 |
| 23NHOP611.4 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 1 | - | 2 |
| 23NHOP611.5 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 1 | - | 2 |
| 23NHOP611.6 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 1 | - | 2 |

| | | | |
|---|---|---|---|
| **MODULE-1** | **GVIM EDITOR** | **23NHOP611.1, 23NHOP611.2** | **8 Hours** |

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. Invoke the LINUX tool
2. GVIM Commands

| | | | |
|---|---|---|---|
| **MODULE-2** | **BASICS OF LINUX, TCL** | **23NHOP611.1, 23NHOP611.2** | **8 Hours** |

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. Shell scripting
2. TCL: Basic syntax, Commands, Operators

| | | | |
|---|---|---|---|
| **MODULE-3** | **LOGIC SYNTHESIS** | **23NHOP611.1, 23NHOP611.3** | **8 Hours** |

Introduction to Logic Synthesis, Goals of Synthesis, Synthesis Flow, Input and Output of Synthesis.

**Hands on:**

1. Synthesis Flow
2. Input and Output of Synthesis

| | | | |
|---|---|---|---|
| **MODULE-4** | **INTRODUCTION TO STA** | **23NHOP611.4** | **8 Hours** |

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.

**Hands on:**

1. Static Timing Analysis
2. STA at Different Design Phases

| MODULE-5 | STA CONCEPTS | 23NHOP611.5, 23NHOP611.6 | 8 Hours |
|---|---|---|---|

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

**Hands on:**

1. STA concepts
2. Setup and Hold Timing Check

**CIE Assessment Pattern (50 Marks – Hands On) –**

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

**SEE Assessment Pattern (50 Marks – Hands-On)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| 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** | **23NHOP612** | **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:

| | |
|---|---|
| 23NHOP612.1 | Compare the network models and the protocols at each layer |
| 23NHOP612.2 | Construct IP addressing table and perform subnetting in IPv4 and IPv6 network |
| 23NHOP612.3 | Analyze the network to implement LAN security to mitigate threats and attack |
| 23NHOP612.4 | Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol |
| 23NHOP612.5 | Examine the operation of Spanning tree protocols and EtherChannel for network scalability |
| 23NHOP612.6 | Analyze Dynamic Host Configuration Protocol (DHCP) operation for scalable networks |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP612.1 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| 23NHOP612.2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 2 |
| 23NHOP612.3 | 3 | 3 | 3 | 3 | 3 | 1 | - | 2 | 2 | - | 2 | - |
| 23NHOP612.4 | 3 | 3 | 3 | 3 | 3 | - | 3 | - | - | - | - | - |
| 23NHOP612.5 | 3 | 3 | 3 | 3 | 3 | - | 3 | - | - | - | 2 | - |
| 23NHOP612.6 | 3 | 3 | 3 | 3 | 3 | - | 3 | - | - | - | - | 2 |

| **MODULE-1** | **BASICS OF NETWORKING** | **23NHOP612.1 23NHOP612.3** | **8 Hours** |
|---|---|---|---|

**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** | **23NHOP612.2** | **8 Hours** |
|---|---|---|---|

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 | 23NHOP612.4 | 8 Hours |
|---|---|---|---|

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 | 23NHOP612.5 | 8 Hours |
|---|---|---|---|

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 | 23NHOP612.6 | 8 Hours |
|---|---|---|---|

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 | Weekly 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/

## DATABASE ADMINISTRATION USING DB2

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP613** | **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:

| | |
|---|---|
| 23NHOP613.1 | Understand Linux /Unix commands and Database functionality and its usage. |
| 23NHOP613.2 | Apply the SQL commands to display a desired result set for real time scenario |
| 23NHOP613.3 | Examine the different data recovery concepts using different methods. |
| 23NHOP613.4 | Evaluate the Data integrity and security using different techniques. |
| 23NHOP613.5 | Illustrate the logs and its data recovery methods |
| 23NHOP613.6 | Develop a solution or model for a real-time problem or application as a group using DB2 concepts |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP613.1 | 2 | - | - | - | - | - | - | - | - | - | - | 2 |
| 23NHOP613.2 | 3 | - | - | - | - | - | - | - | - | - | - | 2 |
| 23NHOP613.3 | 3 | 3 | 3 | - | 2 | - | - | - | - | - | - | 2 |
| 23NHOP613.4 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | 2 |
| 23NHOP613.5 | 3 | - | - | - | 2 | - | - | - | - | - | - | 2 |
| 23NHOP613.6 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 2 | 2 | 2 | 2 |

| **MODULE-1** | **Linux Commands** | **23NHOP613.1** | **8 Hours** |
|---|---|---|---|

Introduction Liunx/Unix-Linux/Unix file system-Essential Linux/Unix Commands: Directory commands- File Commands-File Content Commands-Users Commands-Filters Commands-Utility and Networking Commands.

**Hands on:**

1. Display all the users who have logged into system currently using WHO Command and print present working directory.
2. Practice the following commands: mkdir, rmdir, cd, touch, ls.
3. Practice the following commands; grep, chmod, mv, cp, rm.

| **MODULE-2** | **Basics of DB2** | **23NHOP613.1, 23NHOP613.2** | **8 Hours** |
|---|---|---|---|

Introduction of DB2- Data types- Querying Data- Data Definition Language Commands-Constraints- Data manipulation Commands-Filtering Data- Schemas

**Hands on:**

1. Find all the employee whose salary is more than the average salary of all employees.
2. Write a query to fetch more than one row of values into table.
3. Write a query to update a single column and multiple columns of an existing table.
4. Write a query to remove the duplicate value or row from result set of queries.

| | |
|---|---|
| Case Study / Applications | Find all the airlines where the total salary of all pilots in that airline is more than the average of total salary of all pilots in the database. |

| **MODULE-3** | **DB2 -Advance SQL** | **23NHOP613.2, 23NHOP613.3** | **8 Hours** |
|---|---|---|---|

Introduction to Subquery or nested query- Subqueries- Aggregate functions- Set Operations- window functions- Common Table Expressions (CTE).

**Hands on:**

1. Write a SQL query to find those employees whose salary matches the lowest salary of any of the departments. Return first name, last name and department ID
2. Write a SQL query to find those employees who earn more than the average salary. Return employee ID, first name, last name.
3. Write a SQL query to find all those employees who work in the Finance department. Return department ID, name (first), job ID and department name.
4. Write a SQL query to check whether there are any employees with salaries exceeding 3700. Return first name, last name and department ID

| | |
|---|---|
| Case Study / Applications | 1.Write a SQL query to find those employees who get second-highest salary. Return all the fields of the employees.<br>2. Write a SQL query to find those employees who earn more than the average salary and work in the same department as an employee whose first name contains the letter 'J'. Return employee ID, first name and salary. |

| | | | |
|---|---|---|---|
| **MODULE-4** | **Joins and Locks** | **23NHOP613.2, 23NHOP613.3 23NHOP613.4** | **8 Hours** |

Introduction to Joins and Locks- Joins-Views- Locks- Lock Size-Grant- Revoke-Triggers.

**Hands on:**

1. Write a query to join two tables (Orders, Customer) on the customer_id column so that we can see the customer's name and city for each order using Hash Join.
2. Write a query to display or return the employee with no title.
3. Write a query using tables (Books, Book_author, Authors details) to return the book title and the numbers of authors of each book using View.

| | |
|---|---|
| Case Study / Applications | Calculate how much time each employee worked every time they worked on the project from only start time and end time. |

| | | | |
|---|---|---|---|
| **MODULE-5** | **Operation and Recovery** | **23NHOP613.5 23NHOP613.6** | **8 Hours** |

INDEXING – monitoring and controlling DB2 and its connection – managing the log – recovering from different DB2 – reading log records- performance tuning

**Hands on:**

1. Write a query using Index statement.

**CIE Assessment Pattern (50 Marks – Hands On) –**

| RBT Levels | | Marks Distribution | | |
|---|---|---|---|---|
| | | Test (s) | Online Learning / Certification | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | | - | - |
| L2 | Understand | 5 | - | - |
| L3 | Apply | 10 | 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** | **10** |
| **L3** | **Apply** | **20** |
| **L4** | **Analyze** | **20** |
| **L5** | **Evaluate** | **-** |
| **L6** | **Create** | **-** |

**Reference Books:**


1) IBM DB2 SQL for Beginners: A Tutorial by Examples Kindle Edition by Djoni Darmawikarta ,2014.
2) DB2 11 for z/OS Developer Training and Reference Guide Paperback – 2020 by Robert Wingate.
3) "DB2 11 for z/OS Application Programming and SQL Guide", 2021, IBM Corp.
4) "DB2 11 for z/OS Administration Guide", 2021, IBM Corp.


**Web links and Video Lectures (e-Resources):**

- **https://www.techagilist.com/mainframe/db2/hash-join-use-in-db2-queries/**
- **https://www.techagilist.com/mainframe/db2/outer-join-step-by-step-walkthrough-with-examples/**
- **https://www.techagilist.com/mainframe/db2/inner-join-step-by-step-walkthrough-with-examples/**
- **https://www.db2tutorial.com/db2-view/db2-create-view/**
- **https://www.dnsstuff.com/db2-performance-tuning-tips**

## CISCO - ROUTING & SWITCHING - 2

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP708** | **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:

| | |
|---|---|
| 23NHOP708.1 | Configure advanced operation of ACL and implement extended ACL for IPv4 and IPv6 |
| 23NHOP708.2 | Configure Network address translation (NAT) for IPv4 |
| 23NHOP708.3 | Configure a secured Wireless LAN setup using Routers and extend wireless connectivity using Access Points |
| 23NHOP708.4 | Examine the operations of WAN, WAN Authentication Protocols, and best practices for network security |
| 23NHOP708.5 | Examine the operation of virtual private network (VPN) and concepts of network automation and virtualization |
| 23NHOP708.6 | 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:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP708.1 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | - | 3 |
| 23NHOP708.2 | 3 | 3 | 3 | 3 | 3 | - | 2 | - | - | 3 | - | 3 |
| 23NHOP708.3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | - | 3 | - | 3 |
| 23NHOP708.4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| 23NHOP708.5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | 2 | 3 | 2 | 3 |
| 23NHOP708.6 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |

| **MODULE-1** | **ACL CONCEPTS** | **23NHOP708.1 23NHOP708.6** | **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** | **23NHOP708.2 23NHOP708.6** | **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.<br><br>https://www.cisco.com/c/en/us/support/docs/ip/network-address-translation-nat/13772-12.html?dtid=osscdc000283 |

| MODULE-3 | WLAN CONCEPTS | 23NHOP708.3 | 8 Hours |
|---|---|---|---|
| WLAN Concepts: Introduction to Wireless, Components of WLANs, WLAN Operation, Channel Management, Secure WLANs | | | |
| **Hands on:**<br>1. Remote Site WLAN Configuration<br>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<br><br>https://www.cisco.com/c/en/us/products/wireless/wireless-lan.html?dtid=osscdc000283 | | |
| **MODULE-4** | **WAN CONCEPTS** | **23NHOP708.4** | **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:**<br>1. Configuration of WAN Point to Point Protocol (PPP) using Password Authentication Protocol (PAP).<br>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,<br><br>https://www.cisco.com/c/en/us/products/switches/what-is-a-wan-wide-area-network.html?dtid=osscdc000283 | | |
| **MODULE-5** | **VIRTUAL PRIVATE NETWORK** | **23NHOP708.5** | **8 Hours** |
| Virtual Private Network: VPN and IPsec Concepts: VPN Technology, Types of VPNs<br>Network Automation and Virtualization: Virtualization, Software-Defined Network, Data Formats, APIs, REST, Configuration Management Tools. | | | |
| **Hands on:**<br>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<br><br>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) | Online Learning / Certification | Weekly Assessment |
| | | 25 | 15 | 10 |
| L1 | Remember | - | - | - |
| L2 | Understand | - | - | 5 |
| L3 | Apply | 10 | 10 | 5 |
| L4 | Analyze | 10 | 5 | - |
| L5 | Evaluate | 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/jdw5IzpNT1w?si=ZIsY7M2PWiyDW8qs**
- **https://youtu.be/N9cGvH-kcjc?si=1V6ea67KQlAQcwPa**
- **https://youtu.be/jt4rMgZvDc0?si=hKMxxDsuxtfOxTwL**

## VLSI PHYSICAL DESIGN -II

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP714** | **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:

| | |
|---|---|
| 23NHOP714.1 | Analyze back-end design flow in VLSI Technology and its implementations. |
| 23NHOP714.2 | Gain sufficient theoretical knowledge on Partitioning, Floor-planning, Placement and Routing for carrying out Physical Design. |
| 23NHOP714.3 | Apply the procedure of Floor planning and placement in physical design. |
| 23NHOP714.4 | Examine routing and design rule check for a given physical design. |
| 23NHOP714.5 | Evaluate clock tree synthesis and power management of the circuit. |
| 23NHOP714.6 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP714.1 | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| 23NHOP714.2 | 3 | - | - | - | 3 | - | - | - | 3 | - | - | 3 |
| 23NHOP714.3 | 3 | 3 | - | - | 3 | - | - | - | 3 | - | - | 3 |
| 23NHOP714.4 | 3 | 3 | - | 3 | 3 | - | - | - | - | - | - | - |
| 23NHOP714.5 | 3 | 3 | 2 | 2 | 3 | - | - | - | 3 | - | - | 3 |
| 23NHOP714.6 | 3 | 3 | 2 | 2 | 3 | - | - | - | 3 | - | - | 3 |

| **MODULE-1** | **PHYSICAL DESIGN** | **23NHOP714.1** | **8 Hours** |
|---|---|---|---|

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:**

1. Invoke OASYS tool
2. Read timing library
3. Read technology LEF and LEF (HVT, LVT and SVT)
4. Read RTL program
5. Synthesize the module
6. Write Gate level netlist
7. Write the constraint

| **MODULE-2** | **PARTITIONING AND FLOOR-PLANNING** | **23NHOP714.2, 23NHOP714.3** | **8 Hours** |
|---|---|---|---|

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:**

1. Report timing, area and power after Synthesis
2. Read the Mentor-graphics data base
3. Import the design
4. Specify Core utilization and Aspect Ratio

| MODULE-3 | FLOOR PLANNING AND PLACEMENT | 23NHOP714.3, 23NHOP714.6 | 8 Hours |
|---|---|---|---|

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

**Hands on:**

1. PAD grouping
2. Input /Output PAD placement
3. Placing MACROS

| MODULE-4 | ROUTING | 23NHOP714.4, 23NHOP714.6 | 8 Hours |
|---|---|---|---|

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

**Hands on:**

1. Routing

| MODULE-5 | POWER PLAN | 23NHOP714.5, 23NHOP714.6 | 8 Hours |
|---|---|---|---|

Power plan – Rings, Stripes, Rails, Core power management, I/O cell power management, IR drop – types of IR drop Skew, Latency, Jitter, CTS

**Hands on:**

1. Power Planning
2. Creating false path and multi-cycle path

**CIE Assessment Pattern (50 Marks – Hands On) –**

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

**SEE Assessment Pattern (50 Marks – Hands-On)**

| RBT Levels | | Exam Marks Distribution (50) |
|---|---|---|
| L1 | Remember | 10 |
| L2 | Understand | 10 |
| L3 | Apply | 20 |
| L4 | Analyze | 10 |
| 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 practiceby Sadiq M Sait and HabibYusuf, McGraw-Hill Book Co.
3) VLSI Physical Design: From Graph Partitioning to Timing Closure Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu2011, 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**

## ADVANCED NETWORKING

| | | | |
|---|---|---|---|
| **Course Code** | **23NHOP715** | **CIE Marks** | **50** |
| **L:T:P:S** | **2:0:1:0** | **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:

| | |
|---|---|
| 23NHOP715.1 | Apply appropriate networking tools (CLI and GUI-based) for diagnostics, simulation, and performance monitoring in real-world environments. |
| 23NHOP715.2 | Analyze routing protocols and path selection mechanisms including BGP and EIGRP to troubleshoot and optimize inter-domain and intra-domain routing. |
| 23NHOP715.3 | Apply ACLs and NAT configurations on Cisco and Juniper devices to control and translate traffic securely across network boundaries. |
| 23NHOP715.4 | Analyze stateful and stateless firewall architectures to design secure zones and control traffic flow in enterprise networks. |
| 23NHOP715.5 | Evaluate secure VPN configurations (IPsec and Remote Access VPNs) for data confidentiality and integrity across untrusted networks. |
| 23NHOP715.6 | Analyze Quality of Service (QoS) policies and packet captures using Wireshark to interpret and optimize network traffic behavior for critical applications. |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23NHOP715.1 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| 23NHOP715.2 | 3 | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| 23NHOP715.3 | 3 | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| 23NHOP715.4 | 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 2 | 3 |
| 23NHOP715.5 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 |
| 23NHOP715.6 | 3 | 3 | 3 | 2 | 3 | - | - | - | 2 | 2 | 1 | 1 | 3 | 3 |

| **MODULE-1** | **Networking Tools** | **23NHOP715.1, 23NHOP715.6** | **8 Hours** |
|---|---|---|---|

**Introduction:** Tool Categories, Tool Selection Criteria,

**Software Tools:** WiFi Analyzer, Wireshark, Port Scanner, iPerf / iPerf3, TFTP Server/Client, IP Scanner, Putty / SecureCRT / KiTTY, Cisco Packet Tracer, GNS3 / EVE-NG, NetFlow / sFlow Analyzers, Network Monitoring Systems, DNS & HTTP Debug Tools, Log & Event Monitoring

**CLI Tools:** ping, traceroute / tracert, ipconfig / ifconfig / ip, nslookup / dig /digwebinterface, telnet & ssh (Port Testing), netstat, arp, ip (Linux Modern Replacement for ifconfig), tcpdump (Linux), hostname, whoami, uptime)

**Laboratory Component:**

1. Installation and use of Pnet labs.
2. Configure QoS Policies for VoIP and Critical Traffic (Wireshark)
3. Analyse Packet Captures with Wireshark

| Text Book | Text book 1: 26, |
|---|---|

| **MODULE-2** | **Routing** | **23NHOP715.2, 23NHOP715.6** | **8 Hours** |
|---|---|---|---|

**Introduction:** Path Determination, Packet Forwarding, Basic Router Configuration Review, IP Routing Table, Static and Dynamic Routing.

**Border Gateway Protocol (BGP):** Basic BGP Configuration, iBGP vs eBGP, BGP Metric: Path Attributes, Influencing BGP Path Selection, Local Preference, AS Path Prepending, MED (Multi-Exit Discriminator), Show & Debug Commands,

**EIGRP:** Securing Routing Networks: Threats to Routing Infrastructure, Techniques to Secure Routing Protocols, Verification & Monitoring.

**Laboratory Component:**

1. Configure Static Routing and Understand Limitations
2. Configure Static Routing and Understand Limitations
3. Configure Basic BGP Peering and Troubleshooting

| Text Book | Text Book 2: 9, 10 | | |
|---|---|---|---|
| **MODULE-3** | **Access Control and Address Translation in Enterprise Networks** | **23NHOP715.3** | **8 Hours** |

**Access Control Lists (ACLs):** Types of ACLs, ACL Rules and Logic, In/Out Direction Clarification, Use Cases, Verification Commands – Cisco, Juniper.
**NAT:** Types of NAT, Cisco NAT Configuration Examples, Juniper NAT Configuration (SRX or Junos OS), Source NAT (PAT – Overload), Static NAT, NAT and Security Considerations

**Laboratory Component:**

1. Implement Standard and Extended ACLs to control network traffic.
2. Implement Static NAT, Dynamic NAT, and PAT (NAT Overload) to enable internal private IPs to access external/public networks.

| Text Book | Text Book 2: 23, 26, | | |
|---|---|---|---|
| **MODULE-4** | **Firewall Technologies and Configuration for Network Security** | **23NHOP715.4** | **8 Hours** |

Firewalls: Why Firewalls Are Essential, Types of Firewalls, Stateless vs Stateful Firewalls, Firewall Zones and Traffic Flow, Basic Cisco Firewall (IOS-based) Configuration, Juniper Firewall Filter (Stateless Packet Filtering), Firewall Best Practices

**Laboratory Component:**

1. Configure a Cisco ASA firewall to control traffic between internal and external zones.
2. Implement a stateless firewall filter on a Juniper router to block specific traffic types

| Text Book | Text Book 1: 32.4, Text Book 2: 25, | | |
|---|---|---|---|
| **MODULE-5** | **Virtual Private Networks** | **23NHOP715.5** | **8 Hours** |

**Virtual Private Networks (VPNs):** Types of VPNs, VPN Tunnelling, Site-to-Site VPN – IPsec Overview, Remote Access VPN, TLS/SSL Handshake.

**Laboratory Component:**

1. Establish a secure IPsec tunnel between two branch offices using Cisco routers.
2. Configure a remote access VPN for users to securely connect to the corporate network.
3. Capstone Project

| Text Book | **Text Book 2: 12** |
|---|---|

**CIE Assessment Pattern (50 Marks)**

| RBT Levels | | Test (s) | Assignments |
|---|---|---|---|
| | | **25** | **25** |
| **L1** | **Remember** | - | **-** |
| **L2** | **Understand** | 5 | **5** |
| **L3** | **Apply** | 5 | **10** |
| **L4** | **Analyze** | 10 | **10** |
| **L5** | **Evaluate** | 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 Warrier -2ND Edition , Gary A. Donahue , O'Reilly Media, Incl, 2011**

**Reference Books:**

1. CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand),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**

# APPENDIX A

## Outcome Based Education

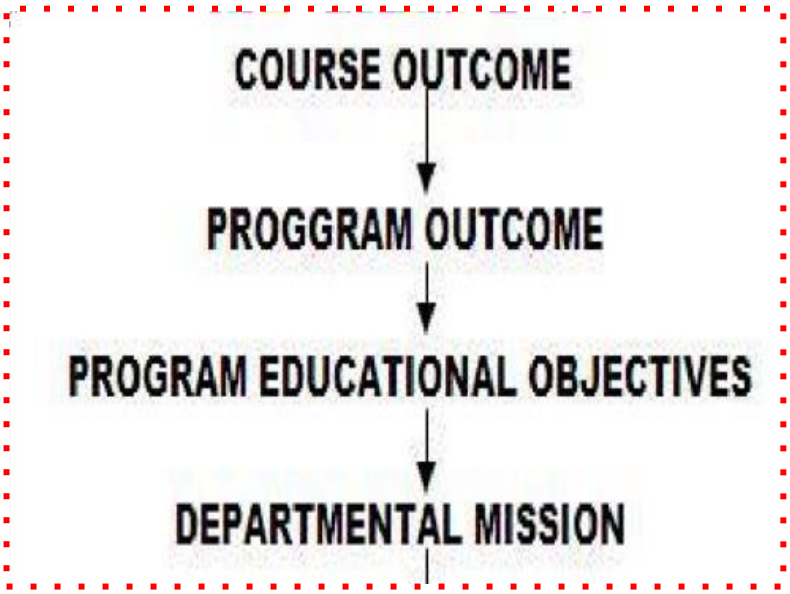
Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead, classes, opportunities, 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 theircareer and in particular, what the graduates are expected to perform and achieve during thefirst few years after graduation. [nbaindia.org]

**Program Outcomes:** **What the student would demonstrate upon graduation. Graduateattributes 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

**PO1** **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems in Computer Engineering.

**PO2** **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.

**PO3** **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.

**PO4** **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.

**PO5** **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.

**PO6** **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.

**PO7** **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.

**PO8** **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, andnorms of the Engineering practice.

**PO9** **Individual and Team Work:** Function effectively as an individual, and as a member orleader in diverse teams, and in multidisciplinary settings.

**PO10** **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.

**PO11** **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.

**PO12** **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 ofhuman cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and otherevaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.