LIST OF SKILL BASED COURSES

(ODD SEMESTER OF 2022-23)

SB8001	**BUILDING INFORMATION MODELING**	**L T P C** **1 0 2 2**

PRE-REQUISITE

Basic knowledge about isometric structures and Engineering Graphics fundamentals are preferred

COURSE LEARNING OBJECTIVES

To enable learners to understand the concept of Building Information Modeling and application of the same in the life cycle of the project.

KEY JOB ROLES

- BIM Manager
- BIM coordinator
- Design Team Leader
- Design Engineer
- Design Manager

OVERVIEW

In this course, learners will be guided through each of the major project stages, from the strategic definition of the project right through to handover, operations and end of use. At each stage, the trainer will demonstrate how to balance technical requirements with project management skills, so the students are confident in implementing BIM methodology. The course covers the key skills and competencies required for implementing BIM-Building Information Modelling to AECO-Architecture, Engineering, Construction & Operation projects

UNIT I EVOLUTION OF ENGINEERING, INTRODUCTION TO BIM CONCEPTS AND DESIGN AUTHORING 3T+6P

Evolution of Engineering from 2D drawings to BIM Model, BIM Model of various projects like commercial & residential structures, Water Treatment Plant and Substation, Transportation
Isometric View – Introduction to Isometric Drawings, Creation of isometric views from different 2D views and vice versa: example problems, Limitation of Isometric views and concept of 3D-Modeling
Building Information Modeling – Introduction & Process
Design Authoring – Concepts and workflow, Fundamentals of Discipline Based Modeling, Introduction to stages of BIM Modeling process as per ISO 19650- Architectural, Structural, MEP (HVAC, Electrical, Plumbing), WIP stage of ISO 19650, Shared stage concept, Interdisciplinary based modeling, Federated model- Introduction. concepts and demonstrations, Concept, and workflow of design coordination
Engineering Analysis – Concept and types of analysis, Workflow of structural analysis, energy analysis, lighting Analysis, Process and workflow of Design Review in BIM.

UNIT II VISUALIZATION AND INTERFERENCE/CLASH CHECK 3T+6P

Views in BIM Model- plan, section, elevation, 3DVisualization Modes- Concept and viewing rendered, shaded, wore frame and hidden line mode, Walkthrough of the Model, Fly through the model
Layers & Properties, Concept of viewpoints, Sectioning and Visualization through Tablet and Mobile
Concept of BIM Kiosk & BIM Rooms, Visualization through Augment Reality (AR), Virtual Reality(VR) & Mixed Reality (MR)
Clash Check, Types of Clashes- Hard Clash & Soft Clash, Federated Model - Clash avoidance process, Clash Detection Process –Introduction, Clash Detection - Priority Matrix and Report

generation, Clash Detection – Rules, Report, Grouping, Clash Detection - Roles & Responsibilities, Clash Detection Process – Demo.

UNIT III DOCUMENTATION & CDE & LEVEL OF DEVELOPMENT 3T+6P

Documentation and CDE (Common Data Environment) -2D drawings generation from BIM Model, Computer Network types, Concept of Cloud Computing, Concept and Application of CDE: Traditional Information Sharing, Definition, Reference, and Concept, Setting up the workflow and process for CDE- File naming convention, Roles and Responsibilities, Request for Information and Review Process

Concept of LOD (Level of Development), preparation of LOD matrix and Progression matrix- Definition of LOD, Level of Detail and Information, LOD- Wall foundation, Precast Structural Inverted T-Beam, Domestic Water Piping, Plumbing Fixture, Packaged Generator Assembly, LOD- Chart, Matrix and Model Progression Matrix

UNIT IV 4D / FIELD BIM & ITS APPLICATIONS 3T+6P

Introduction to 4D / Field BIM: Concept of 4D, Introduction to construction sequence and project schedule, Project scheduling using Gantt Chart and its limitation, 4D BIM Modeling-Project demo and workflow, Synchronization of 4D BIM Model with project schedule, Reviewing project progress w.r.t planned dates and actual dates, Generation of Reports

Application of Field BIM/ 4D BIM: Understanding concept and usage of BIM in field for coordination- 3D Coordination and Visual Communication, Site utilization planning and Construction analysis, Application of wearables in coordination. 3D Control and planning

Other Applications of Field BIM/ 4D BIM: Concept and usages of BIM in field for safety, disaster and risk analysis, digital fabrication and scan to BIM, Existing Condition Modeling, Phase Planning, As-built/ Record Models

UNIT V 5D BIM, AIM & BEYOND BIM - EMERGING TRENDS 3T+6P

5D BIM: Introduction concepts of 5D BIM, Quantity take off with UoM, Concept of QTO with UoM, 5D BIM with UoM with cost, Quantity take off exercise, Demo of Quantity take off: Understanding QTO for Wall, Plaster & Tile, BIM Maturity LOD and General Practice of QTO, Cost Breakup structures, 5D BIM and cost control

AIM: Introduction to Asset Information Model (AIM), COBie structures and Asset Information Deliverables, Space Attributes and Asset Attributes- Examples with data, Asset requirement- Discipline wise Infrastructure System, Classification code and Information Exchange, Information Exchange with Facility Management

Beyond BIM: Emerging Trends- Concepts of Industrialisation, IoT, Big Data, Data Analytics and their applications in BIM: Industrialisation of Construction through BIM- DfMA, IoT in BIM, BIM and Big data, Data Analytics using AI & ML

Future scope of BIM Applications: Smart Infrastructure and the need for connected infrastructure, Digital twins- Concepts and benefits, National Digital Twin or a City level Digital Twin in a Smart City, Fundamental requirements for the success of a Digital Twin and its uses, Digital Twin applications in diverse industries.

TOTAL: 45 PERIODS

BIM model of various buildings like residential, commercial and industrial with all possible clashes shall be be provided by us

CASE STUDIES

- BIM model of multi-storey building structure
- BIM model of airports
- BIM model to study site utilization
- BIM model of material handling unit
- On site super imposition of BIM model

➢ 5D BIM- Implement strategy for a building

ATTAINMENT OF LEARNING OUTCOMES

STUDENT ASSESSMENT PLAN

A. The conceptualisation and comprehension level of learning outcomes intended through the course is measured through assessments conducted in multiple stages.

B. The understanding of concepts & principles, evolution of practices, codes & guidelines, emerging trends etc. are tested through assessment questions.

C. The skill outcome related to design, computation, workflow, report & work plan preparation, implementation etc. are assessed through assignments. Such assignment questions & answer keys will be shared to the college SPOC for enabling evaluation by respective faculties.

STUDENT ASSESSMENT 1:

Students will have to create a clash detection matrix and analyse the clash report for a given BIM model of residential building.

STUDENT ASSESSMENT 2:

Students will have to create a clash detection matrix and analyse the clash report for a given BIM model of industrial/Commercial building.

SOFTWARE EXPOSURE

In this course BIM models of various industries such as shipping, airports, residential & commercial structures, water & sewage treatment plant, substation etc. are shown which were developed using software such as Revit, Civil 3D, Tekla, Aveva etc.

These software companies provide free access to students & educators for academic &research purposes.

For these structures the federated model including the field BIM application is shown using the software Navisworks, Synchro & Fuzor.

COURSE OUTCOMES

On completion of the course, the students will be able to perform the following operations for any one of the given BIM models.

➢ LO.1: Create a workflow for a building with all required deliverables to be covered in the project output.

➢ LO.2: Create the clash detection matrix for the federated structural, architectural and specialist designer project model.

➢ LO.3: Coordinate different discipline models with clash checking to arrive at the final design solution, inclusive of the deliverables from the model at each stage.

SB8002 TRANSPORTATION INFRASTRUCTURE – AIRPORTS, METROS & SEAPORTS

L	T	P	C
1	0	2	2

PRE-REQUISITE

- Fundamentals of Highway and Railway engineering, Soil Mechanics, Structural analysis is preferable

COURSE OBJECTIVES:

- This course will present the concepts on the design aspects and knowledge on the construction methods of transportation infrastructure. It will provide exposure to the field and serve as base for future practitioners in the field of transportation engineering. The course facilitates the learners to involve in engineering works related to Airports, Metro & seaports planning, design, and construction.

KEY JOB ROLES

- Design engineer
- Site planning engineer
- Construction engineer

OVERVIEW

This course will provide the learner with an overview of major functions involved in the transportation infrastructure such as Metros, Airports & seaports. It will provide a roadmap for learners to understand the concepts involved in Civil, Structural, Architectural & MEP functions for Planning and Design Transportation infrastructure. These concepts are reinforced with demonstrations and real case studies/projects that have been successfully carried out in major cities in India and Abroad. It provides brief knowledge to the learner to steer through their career in the field of transportation engineering. The course also provides insights on the future modes of transportation, to supplement the learner to stay adept amidst the rapid advancement of technology in this field.
Learners are expected to gain knowledge on the design concepts of different structures and their constructability aspect related to transportation infrastructure.

UNIT I INTRODUCTION AND PLANNING OF MASS RAPID TRANSIT SYSTEM (MRTS) 3T+6P

Introduction - Overview of Metro, Transit Oriented Development, Necessity and Feasibility Study for MRTS Project, Sustainable and Smart Technologies, Recent Advancements & Future Technologies - Automated Guideway Transit Systems, Suspended Railway / Monorail, High Speed Rail, Semi High-speed Rail, Maglev Trains, Vactrain History, Development and Technology
Planning – Alignment Basic Interfacing Principles, Urban level planning constraints and restrictions, Planning of the Station, Integration of systems, HVAC Systems, Tunnel Ventilation System, Fire Protection System, Public Health Engineering, Electrical System, Fire Alarm System, Building Information Modelling (BIM) Walkthrough Contracts and Quality system - Introduction to Contracts, Overview of FIDIC standards, Introduction to Quality Systems.
Overview of Elevated metros – Alignment/ Span configuration of elevated structures, Superstructure, Substructure and foundation of elevated metro, Bridge articulation based on profile alignment
Overview of Station – Station overall layout, Station foundation, substructure and Pier arm
Construction Methods - Challenges in Metro Construction, Precast and cast in-situ construction, Precast yard and Mould development, Precast Erection and Launching methods, Overview of Obligatory Span overview, foundation construction methods

UNIT II ANALYSIS AND DESIGN OF ELEVATED AND UNDERGROUND STATIONS 3T+6P

Elevated station and Viaducts – Overview and components, Loads and load combination according to IRC/IRS Codes, Modelling, Analysis and Design of superstructure, Substructure and foundation of Viaduct, Idealization of Framed Station and Cantilever station, Design and analysis of platform slab, track slab and above ground structures, Spine beam method, Ductile detailing of structures, Introduction to Modelling Software - STAAD Pro and Midas Civil

Earth retaining structures – Types of Earth retaining structures, Diaphragm wall Analysis and design, Shoring Systems, Secant pile wall design, Guide walls, capping beams, supporting systems, Tunnels - Mined/Bored/NATM

Underground Stations – Configurations of underground station, Loads and load combination according to IRC/IRS Codes, SIDL for UG stations, Construction Methodology (Bottom-Up method/ Top Down method), Fire resistant criteria and Floatation check, 2D & 3D model generation, SOD restrictions & Element sizing for UG Stations, Design of all the components of UG station.

UNIT III INTRODUCTION AND TYPICAL MASTER PLANNING OF AN AIRPORT 3T+6P

Introduction - key features of a modern airport, Codes and aviation regulation organizations, Growth Requirements and Passenger Demand Capacity, Overview of existing and future Indian Airports

Outline of Master Planning process according to ICAO and FAA Planning and Design of Airside works – Topography and geotechnical investigation for green field airport and upgradation of existing airport, Survey of various elements/facilities, Layout plans, Configuration and orientation of runways, Design of Runway, Taxiway, Apron, Drainage System and Ducts

Planning of Terminal Building – Functions of Terminal building, Building Information Modelling (BIM) walkthrough, Facilities and services of terminal building: Passenger conveniences, Travellators, Departure and Arrival gates, MEP and HVAC Services etc.,

Planning of Landside works – Planning of Approach roads to Terminal building, Landside access for Arrival/Departure Planning, Multi- Level/Surface car parking/Waiting areas, Air Traffic Control Tower, Drainage Planning, arboriculture, Water harvesting cum storage/distribution, Fuel storage and supply, Power supply and Renewable Energy, Airport fire & Rescue station

UNIT IV CONSTRUCTION AND MAINTENANCE OF AIRPORT AIRSIDE WORKS 3T+6P

Pre-construction activities - Statutory Approvals, mobilization of key resources and Estimation of requirement of Plant and equipment - Earthmoving Plants, Dumpers and Compaction Equipment, Hoists and Tower Cranes

Construction of Runways and Taxiways - Airport Layout and Grading Plan, Execution and Estimation of various Layers of Flexible Pavements and Rigid Pavements, precast and cast in-situ drainage and duct, Navigational and Meteorological aids - Marking, Lighting, Instrument landing system and stations, etc., Maintenance, Evaluation and Rehabilitation of Runways and Taxiways - Evaluation of runways and taxiways, Causes & Typical Failures of Flexible and Rigid Pavements, Maintenance, Strengthening and Rehabilitation of Pavements, Discussion on pavement repairs

UNIT V OVERVIEW OF PORTS AND HARBOURS 3T+6P

Introduction and Evolution of Ports and Harbours, Classification of Ports, Overview of Indian Seaports

General Terms and Conventions – Waves and Tides, Tidal Variations, Return Period, Tranquility, Littoral Drift, Wave Transmission, Wave Reflection, Wave Overtopping, Wave Diffraction, Types of Ships, Parts of Ship, Ship Size Parameters, Ship Motions

Overview of Marine structures - Container and bulk terminal, Liquid terminals, Breakwaters, Shipyard facilities, port infrastructures and Bulk Terminals, Walkthrough of Typical Shipyard Cum Port

Operation and components of Ports – Vessel and cargo related Operations of Ports, Berthing Structures – Wharf, Quay, Pier, jetty, Storages - Container yards, Stack yards, Warehouse, Tankage

Site Investigation and Survey – Hydrographic, topographic, Meteorological, Oceanographic, Geological, Seismic, Resources data

Approach Facilities, Navigation Aids – Audible, Radio, Visual, Others, Design considerations and Functional requirements of typical structures, Breakwater Structures, Fenders, Dolphin, Shipyard structures - Slipways, Dry Docks, Floating Docks, and Ship Lifts, Shore protection and Reclamation works

TOTAL: 45 PERIODS

CASE STUDIES

- Case studies of top-down construction with permanent retaining system.
- Case study of an underground station
- Design and orientation of runways
- Design of Drainage and Rainwater harvesting
- Design of parking space

ATTAINMENT OF LEARNING OUTCOMES

STUDENT ASSESSMENT PLAN

A. The conceptualisation and comprehension level of learning outcomes intended through the course is measured through assessments conducted in multiple stages.
B. The understanding of concepts & principles, evolution of practices, codes & guidelines, emerging trends etc. are tested through assessment questions.
C. The skill outcome related to design, computation, workflow, report & work plan preparation, implementation etc. are assessed through assignments. Such assignment questions & answer keys will be shared to the college SPOC for enabling evaluation by respective faculties.

STUDENT ASSESSMENT 1:
Students will have to prepare a basic layout for metro station, considering the various structural elements of metro station and diaphragm wall for the given site specifications.

STUDENT ASSESSMENT 2:
Prepare a basic layout of runway including orientation using Wind Rose diagram and designing runway length.

SOFTWARE EXPOSURE
Learners are exposed to WALLAP (Diaphragm wall analysis software) for 5 % of course duration & STAAD Pro (Analysis software for Metro stations) for 10 % of the course duration.
The students can use free student version of STAAD Pro even post the completion of this course. Diaphragm wall analysis can also be done using the STAAD pro student version.

LEARNING OUTCOMES
Upon completion of this course the learner will be able to:

- LO.1: Create a Conceptual layout of both elevated and underground metro station
- LO.2: Design Diaphragm wall for the construction of Underground Metro station.
- LO.3: Assess the suitability of a given site for the construction of airport, metro and seaport
- LO.4: Comprehend the requirements of airport and the associated service requirements.

SB8003 DESIGN AND CONSTRUCTION OF STEEL BUILDINGS L T P C
1 0 2 2

PRE-REQUISITE

- Analytical skill on determinate & indeterminate structures and design knowledge of steel members
- Exposure to relevant codes and standards (Indian standard codes for Steel, wind and earthquake design)

COURSE LEARNING OBJECTIVES

The course aims to:

- Impart practical aspects of structural steel building design
- Introduce various aspects like selection and planning of structural system and its components, evaluation of actual loads, integration of architectural and services requirements
- Explore the structural modelling, analysis & design, fabrication, execution and inspection of a structural steel building

KEY JOB ROLES

- Design engineer
- Site planning engineer
- Construction engineer
- R&D Engineer
- Design Consultant

OVERVIEW

This course provides the practical aspects in design of a small to medium rise steel building starting from the selection of the appropriate structural system based on building functionality, to the design and detailing of its various components. This course covers the assessment of different loads in the building, application of the same in analysis and design software models, various vertical and lateral load-resisting systems
and the basis of its selection, integration of various services in the building, design and detailing of elements and connections, etc. This course also covers the different stages in design to execution of steel buildings briefly.

UNIT I ANALYSIS & DESIGN PHILOSOPHIES, CODES OF PRACTICE AND GENERAL DESIGN ASPECTS 3T+6P

Structural steel and its Mechanical Properties, Hot Rolled steel sections, Structural Steel sections and section classification.
Analysis and design of buildings as per Codes of Practice, design philosophies, Advantages of steel buildings in comparison with other types of structures
Inputs for the design of a steel building - Design Basis Report covering Site location, Site Specific aspects, building functionality, Construction planning, Geometric parameters of the building, Structural systems, Special geometries and its structural systems, Functional requirements necessary for the end user, Material specifications.
Methods of designing a steel building, Design life of a building, Exposure conditions and corrosion protection, Gravity and lateral load resisting elements and systems, Concrete and reinforcement, Block work, floors and Roofs, Structural steel, bolts, welds, fire proofing and Painting materials

UNIT II COMPUTATION OF VERTICAL, LATERAL & SPECIAL LOADS AND LOAD COMBINATIONS 3T+6P

Calculating the various loads acting on a steel building - Vertical & lateral loads - Effects of each loads separately and in combination – Dead, superimposed dead, live, temperature, MEP service loads - Lateral loads due to wind and seismic effects
Design of wind speed and pressure, Pressure and Force coefficient method, Deflection and drift limits, Drag, interference and dynamic effects Floor Vibration, Fire resistance, Analysis and design methods, Wind load calculation for an example steel building.

UNIT III SELECTION OF LOAD RESISTING SYSTEMS, STRUCTURAL MODELLING, ANALYSIS & DESIGN 3T+6P

Studying the layout plans of the structure – Codes and Reference drawings, Selection of load resisting systems - Load flow in each system -Satisfying stability & strength of the structure - Vertical and lateral load resisting systems, Integration of MEP services and its supporting structures in buildings

Overview of BIM and its importance in structural modelling

Computer aided modelling, analysis & design (STAAD Pro) - Geometric & structural parameters of the structure - Loading the structure - Interpretation of the results of the software – Analysis & design of a multistoried building from a project for comprehending the design from a practical standpoint.

A sample of Structural Design Basis report

UNIT IV DESIGN OF VARIOUS ELEMENTS & CONNECTIONS OF A STEEL BUILDING 3T+6P

Manual & software aided design – Beams, columns, floors, bracings, purlins/girts & facades, base plates & anchor bolts –different conditions of supports, exposure, and purpose of use - Design of connections between the members – Bolted and welded, moment and shear connections to be adopted in various locations of a building

Tension members in buildings – Types and grades of tension members, Design of mullions and transoms

Special connections for equipment and other services like staircases, roof, terrace, and other special elements. Project based on excel spreadsheet development.

UNIT V DESIGN OF AN INDUSTRIAL BUILDING & DETAILING, FABRICATION AND ERECTION ASPECTS 3T+6P

Design of an industrial building - Selection of sections as per requirements - Configuration of the elements and their connectivity - Functional requirements

Beam design Approach for buildings – Manual and software Design of beams- Cantilever beams and built-up beam, torsion in beams and back up beam concept, Service integration in beams, Simplified floor vibration analysis Column Design Approach for buildings -Manual and software design of column, Addressing failures and optimization in column design

Beam-Column design approach for buildings- Design of beam-columns, Base plate and anchor bolts, Planning and design approach of terrace floor, architecturally exposed steel.

Study of General Assembly drawings, Fabrication drawings and procedures - Fabrication processes - Transportation for structural Steel construction and erection - Sequence of erection - Inspection of a completed structure

Good Design, Detailing and construction Practices. Design summary of Example building

TOTAL: 45 PERIODS

CASE STUDIES

A commercial building with multiple storeys with varying load conditions for each storey.

The project work is design of the complete structure given in the case study, from the study of the structural DBR, till the final design output, resulting in a structure satisfying
the architectural & structural requirements.

ATTAINMENT OF LEARNING OUTCOMES

STUDENT ASSESSMENT PLAN

A. The conceptualisation and comprehension level of learning outcomes intended through the course is measured through assessments conducted in multiple stages.

B. The understanding of concepts & principles, evolution of practices, codes & guidelines, emerging trends etc. are tested through assessment questions.

C. The skill outcome related to design, computation, workflow, report & work plan preparation, implementation etc. are assessed through assignments. Such assignment questions & answer keys will be shared to the college SPOC for enabling evaluation by respective faculties.

STUDENT ASSESSMENT 1:
Preparation of a Design Basis Report for a medium rise steel building considering site specific parameters and loading due to functionality, computation of wind speed and pressure, seismic parameters, load combinations, grid planning and structural systems.

STUDENT ASSESSMENT 2:
Analysis and design of a medium rise building containing various structural & non-structural elements, contributing to the loads acting on the building, finally serving the intended functional requirements.

SOFTWARE EXPOSURE
Learners are exposed to STAAD Pro software for 35% of course duration for analysis and design of steel framed building structure including modelling, specifications, loads, and combination of loads.
The students can use free student version of this software post completion of the course.

LEARNING OUTCOMES
On completion of the course, the students will be able to-
Perform the following operations for the given architectural drawing

- LO.1: Design a low to medium industrial steel building using STAAD PRO Software
- LO.2: Examine site specific aspects of the structure like geotechnical investigations, project requirements
- LO.3: Develop Design basis requirements like building functionalities, durability and Materials
- LO.4: Compute loads (Dead, Superimposed, Live, Wind, Seismic) of various elements & services
- LO.5: Understand proper selection and design of vertical & lateral load resisting systems for the various loads acting on the building
- LO.6: Integrate non-structural elements like facades, service supports, etc., to the structure
- LO.7: Create an optimized design of the building, adhering to the codal requirements & functional aspects, using a modeling software.
- LO.8: Interpret structural drawings, fabrication & erection aspects

SB8004 **HIGH RISE BUILDING DESIGN** **L T P C**
1 0 2 2

PRE-REQUISITE

- ➢ Fundamentals of RCC elements design
- ➢ Basic exposure on analysis software
- ➢ Familiarity on IS codes, standards, and handbooks

COURSE LEARNING OBJECTIVES

- The course will present concepts and practical aspects of design & construction of reinforced concrete buildings particularly those about 10 storeys tall and less than 50 meters in height

KEY JOB ROLES

- ➢ Design Engineer
- ➢ Site Planning Engineer
- ➢ Construction Engineer
- ➢ R&D Engineer
- ➢ Design Consultant

OVERVIEW

The course provides key design techniques and practical application aspects from L&T's decades of expertise in designing structures. The course takes the learner through the typical process in designing reinforced concrete buildings particularly those about 10 storeys tall and less than 50 meters in height. This advanced course provides the experience of designing reinforced concrete buildings as it happens in any design office. The course covers schematic design of gravity and lateral load resisting systems in a reinforcedconcrete building, when to choose a particular system and how to size various components (slabs, beams, columns, shear walls). It also includes calculation of loads and analysis of structure, design and detailing of reinforcement in various components in a hands-on manner.

UNIT I INTRODUCTION AND CODES- DESIGN BASIS PARAMETERS AND REPORT 3T+6P

Indian & International Codes for Reinforced concrete Design, Design loads and detailing of reinforcement, Handbooks for reinforced concrete design, National Building Code 2016, Practical building examples, drawing sizes and scales, Reading Drawings – Architectural & Structural.
Introduction to DBR Parameters - Geometric Parameters, Occupancy Categories, Site location and associated parameters, Design life of structures, Material Specifications - Grade of concrete for vertical and floor elements – Grade of reinforcing steel, Exposure and cover requirements, Fire rating requirements, Load Combinations, Serviceability Requirements, Analysis tools, Design Basis Report, Concept explanation with example buildings.

UNIT II LOADS & SETTING THE STRUCTURAL SCHEME 3T+6P

Introduction, dead loads, superimposed dead loads, Live loads, Wind loads, Wind pressure coefficients, Determining global wind forces and wind velocity, storey forces and base shears. Earthquake loads, response spectrum to earthquake excitation, seismic design parameters - horizontal acceleration coefficient, Time period, Evaluation and application of seismic base shear, equivalent static method. Loads due to pressure – earth pressure, hydrostatic pressure. Loads from MEP Services and architectural considerations like façade loads.
Scheme Design, Concrete floor systems, Sizing and design of various slab systems, Dimensioning & designing of drop panels, Beams, Reinforced Concrete Columns - Location and Shape, Design Axial Load, Sizing, Lateral Load Systems, IS 1893- Requirements, Shear Walls – Location and thickness. Estimating relative stiffness of core walls.

UNIT III STRUCTURAL MODELS 3T+6P

Introduction to Analysis & Modelling, Modelling of Cantilever, Portal Frame, three bay Portal Frame, 3D structural models - Geometry, gravity loads, defining earthquake loads, defining wind loads, Modelling Shear walls, Practical Structural Model of building, Structural models of Floor System, Direct design method for Flat Slabs, Analysis of two-way slabs using moment coefficient method,

Application of moment coefficient method, Estimation of deflections
ETABS software demonstration for correct modelling and design of Vertical and Lateral loading systems like Shear Walls

UNIT IV DESIGN OF STRUCTURAL ELEMENTS 3T+6P

Design of structural elements - Design of Beams- flexural reinforcement, shear reinforcement-design of edge beam, Practical examples, Design of flat slabs- Flexural Reinforcement, shear reinforcement- Practical Examples-Design of mesh reinforcement, additional bottom reinforcement, additional top reinforcement, Design of 2-way continuous slabs.
Design of Reinforcements in Columns - Post processing of column forces from analysis, Design and arrangement of vertical reinforcement, Design of horizontal reinforcement, Design of stirrups, Cardinal rules in scheme design of buildings, Coordination with other Engineering disciplines
Design of shear walls – General considerations, Seismic response of RC structures, Vertical and Horizontal Reinforcement, Calculation of design forces, moment capacity of vertical distributed reinforcement,
Design of boundary elements and boundary zone. Sizing of elements based on Constructability aspects like formwork, concrete placement and compaction, rebar arrangement to satisfy economy and optimum utilization.

UNIT V DETAILING OF STRUCTURAL ELEMENTS- BILL OF QUANTITIES AND CONCLUSION 3T+6P

Development length of rebars, detailing of various structural elements - flat slabs, two-way continuous slabs, beams, columns and shear wall, detailing and documentation of practical example building.
Bill of quantities - Concrete and steel indices for RC buildings, Reinforcement consumption in RC members, BoQ of practical example building.

TOTAL: 45 PERIODS

CASE STUDIES

➢ Structural analysis, design and detailing of a multi-storey building with load calculation (dead, live, wind and seismic) as per Indian standard codes using ETABS as analysis t
➢ Bill of Quantities preparation of the multi storey building structure.

ATTAINMENT OF LEARNING OUTCOMES
STUDENT ASSESSMENT PLAN

A. The conceptualisation and comprehension level of learning outcomes intended through the course is measured through assessments conducted in multiple stages.
B. The understanding of concepts & principles, evolution of practices, codes & guidelines, emerging trends etc. are tested through assessment questions.
C. The skill outcome related to design, computation, workflow, report & work plan preparation, implementation etc. are assessed through assignments. Such assignment questions & answer keys will be shared to the college SPOC for enabling evaluation by respective faculties.

STUDENT ASSESSMENT 1:

Preparation of a Design Basis Report for a reinforced concrete building considering site specific parameters and loading due to functionality, computation of wind speed and pressure, seismic parameters, load combinations, grid planning and structural systems.

STUDENT ASSESSMENT 2:

Students will have to model a reinforced concrete building in ETABS by identifying regional seismic and wind load from appropriate code provisions and designing typical structural elements for the critical load combination.

SOFTWARE EXPOSURE

Learners are exposed to ETABS software for 40% of course duration for analysis and design of complete RCC building including modelling, specifications, loads and combination of loads. The students can use free student version of this software post completion of the course.

COURSE OUTCOMES

On completion of the course, the students will be able to-

➢ LO1.: Model a 14-storey building for given location and loading conditions such as wind, seismic and combined loads.

➢ LO2.: Prepare a Design Basis Report for a multi storey building considering site parameters, MEP services and functionality.

➢ LO3.: Compute loads including wind and Seismic and selection of vertical and lateral load resisting systems

SB8005 ROBOTICS SIMULATION FOR MANUFACTURING L T P C
1 0 2 2

COURSE DESCRIPTION:

Robotics is being used in many aspects of manufacturing to help increase productivity and efficiency while lowering production costs. Large number of Robots are deployed in manufacturing industry to collaborate with workers to perform repetitive, monotonous, or intricate tasks under the worker's guidance and control. In this course, students will get exposed to RoboAnalyzer® a 3D model-based software that can be used to teach and learn Robotics concepts. Virtual Robot Module, a part of RoboAnalyzer, has been developed as an application which has joint and Cartesian motion. It has also been made as a COM server, using which one can integrate VRM with MATLAB, MS Excel and other applications that have a COM interface. It also has been integrated with Robotics Toolbox for MATLAB.

COURSE OBJECTIVE:

Students to get aacquaintance with current industry demands, intensive competency needs and scope of the automated Machining in the current industry scenario. Analysis of work holding procedures through simulation software. Programming and setting parameters for desired solutions. Current industry demands, competency needs, job roles and scope of the automated Machining in the current industry and Execute programming solutions using lab exercises integrated into the platform as part of the tutorials.

Unit	**Assessment elements / Coverage**	**Aligned to Course Outcome**
Introduction to Robotics	- Quiz on Introduction to Robotics - Quiz on Anatomy of Robot - Quiz on Robot Configuration - Quiz on DOF, cartesian movement & Drive Systems and End Effectors - Quiz on Sensors in Robotics - Quiz on Industrial Applications of Robots	
Spatial Representation of Object	- Quiz on Relative Position and Orientation of an Object with respect to a reference - Quiz on Homogeneous representation of Position and orientation of an Object - Assignment - Relationship between visual and homogeneous representation of an object using HTM module in RoboAnalyzer - Assignment on Translation - Transformation, rotation transformations and DH Parameter. - LAB - Virtual models of Industrial robots	LO1. Model a 2 DOF planar robotic arm and trace given curved profile through specific intermediant points using cubic polynomial profile.

Robot Kinematics using RoboAnalyzer	- Quiz on Introduction to robot kinematics - Quiz on Forward Kinematics - Quiz on Inverse Kinematics - Quiz on Motion planning of Robots - Quiz on Joint and Cartesian motion - LAB - Assignment on forward and inverse kinematics - LAB - Understanding coordinate frames and transformations - LAB - Inverse and forward Dynamics of robots - LAB - Creating robot joint trajectories - LAB - Assignment on Motion planning in cartesian space - LAB - Case Study: Workspace analysis of a 6 axis Robot	LO2. Do mathematical modelling of the same (as in LO1) robotic arm with different arm length and trace the given profile in the LO1 using RoboAnalyzer**.**

Course Outcomes:

On completion of the course, the students will be able to-
LO1. Model a 2 DOF planar robotic arm and trace given curved profile through specific intermediant points using cubic polynomial profile.
LO2. Do mathematical modelling of the same (as in LO1) robotic arm with different arm length and trace the given profile in the LO1 using RoboAnalyzer.

Prerequisites:

- Engineering Mathematics,
- Kinematics and Mechanics

Student Assessment Plan:

The whole Assessment framework is built around our proprietary 'Measure & Reward' framework. Each part of the Assessment is Objective oriented and measurable. Additionally, it enables staged scoring on final simulation attributes, such that student is rewarded for stagewise progression as well overall attainment.

Internals + Theory assessment– 40 Marks

- Unit Testes – LMS Based (Online, MCQ)
- Every Sub-units /Unit will have a Quiz / overall Graded Quiz other than Lab exercise and Capstone Projects
- All Assessments are online based and self-graded
- Average of Unit wise Assessments

Final Practical Assessment – 60 Marks

- Experiment parameters and Questions are provided for Students
- Students have to Study the experiment and simulate it in the software and submit the Environment/Simulation Robot programming file through LMS
- Based on the simulation and the Result of the simulation assessment will be Qualified

Student Assessment Plan for term 1:

Students will be given various profiles similar to the profile given below and ask to program in RoboAnalyzer for tracing the given profile. Students will be asked to restrict the arm length to 0.7 m and 0.4 m. Students will be considered as qualified for term 1 for exactly tracing the given profile

Student Assessment Plan for term 2:

Students will be given a different arm length of both the arms with variation upto 20% from their term 1 assessment and ask to do a mathematical modeling for the new arm length and do the simulation for tracing the profile given in the term 1.

NOS alignment

Aligned with NSDC – SSC NOS Standards.

Sr. #	QP No.	NSQF	Qualification	NOS No.	Detail
1	ASC/Q8304	Level 6	Automotive Robotics and Automation	ASC/N8315	Simulation and integration of robot and automation system

SB8006 ELECTRIC SYSTEMS FOR E-MOBILITY (MECHANICAL) **L T P C**
1 0 2 2

COURSE DESCRIPTION:

The global market for electric vehicles (EVs) is growing continuously at a compounded annualized growth rate (CAGR) of 21.7 per cent. It is expected to grow from 8.1 million units to 39.21 million units by 2030. This exponential growth is being driven by various factors, including concerns for pollution.
In this course, students will get exposed to Electric vehicle & mobility and automation. Understand and demonstrate converter circuits. Build firm foundation in lithium-ion cell terminology and function and in battery-management-system. Get exposed and implement motors and motor control units. Learn & demonstrate the purpose of each component in an equivalent-circuit model of a lithium-ion battery cell, how to determine their parameter values from lab-test data, and how to use them to simulate cell behaviors under different load profiles.

COURSE OBJECTIVE:

Students to get exposed to Electric vehicle & mobility dynamics & Battery Management Systems. Understand and build strong foundation on advanced concepts of switched-mode converter circuits. Learn about motors and its control units & Implement the motor and accompanying rotary sensor into a motor control circuit in both hardware and software. Demonstrate equivalent circuit cell model simulation.

UNIT I INTRODUCTION TO ELECTRIC VEHICLES & AUTOMATION (3T+ 6P)

THEORY COMPONENT:

- Future of Mobility – [5 Videos, 3 Readings,2 Quizzes]
- Electrification : The Basic Technologies (Part 1) Electric Vehicles, batteries, EVs Made up of– [5 Videos, 2 Reading,2 Quizzes]
- Electrification : The Basic Technologies (Part 2) –Charging & Charging Infrastructure, EV & the power systems, Industry Perspective on Applications of Electrification [7 Videos, 6 Readings, 2 Quizzes]
- Electrification Impacts – [7 Videos, 2 Quizzes]
- Vehicle Automation – The Basic Technologies – [9 Videos, 1 Reading, 2 Quizzes]
- Automation – The Impacts – [6 Videos,1 Quiz]

PRACTICAL/LAB COMPONENT: NA

UNIT II CONVERTER CIRCUITS (3T+ 6P)

THEORY COMPONENT:

- Single-, Two, and Four-Quadrant Switches - [3 Videos,1 Readings ,2 Assignment]
- Basic issues of Power Semiconductors- [11 Videos,1 Readings & 2 Assignment]
- Introduction to DCM and Mode Boundary - [3 Videos, 1 Readings ,2 Assignment]
- Converter Topologies - [6 Videos, 1 Readings,1 Assignment]

PRACTICAL/ASSIGNMENT COMPONENT:

1. Understand why a diode works in some cases, while a transistor is needed in others
2. Understand when single-quadrant, two-quadrant, or four-quadrant switch realizations are needed
3. Complete Assignment to Understand the tradeoff between voltage breakdown, switching time, and forward voltage drop in a power semiconductor device
4. Complete Assignment to Model switching loss using equivalent circuits
5. Complete Assignment to Design gate drivers
6. Work on LTspice File: Synchronous Boost Converter, with associated driver, dead time generator, and PWM models
7. Work on assignment origin of discontinuous conduction modes
8. Will be able to Analyze a converter to find the CCM-DCM mode boundary
9. Will be able to Analyze a converter circuit to find its conversion ratio in DCM
10. Switching Loss Modeling and DCM Analysis
11. Conversion ration analysis of the Cuk Converter in DCM
12. Get exposed to solved study problems on DCM analysis
13. Understand the origins of basic converter topologies
14. Student will be able to Analyze converter circuits containing transformers
15. Apply transformer analysis techniques to the forward converter
16. Apply transformer analysis techniques to the flyback converter

UNIT III MOTOR AND MOTOR CONTROL CIRCUITS (3T+ 6P)

THEORY COMPONENT:

- AC motor Designs - [8 Videos, 2 Readings, 1 Quiz & 1 Assignment]
- AC motor Control – [7 Videos ,1 Reading & 1Quiz & 1 Assignment]
- DC motors – [8 Videos , 1 Readings & 1 Quiz & 1 Assignment]
- DC motor control and stepper motors - [5 Videos, 1 Readings,1 Quiz, 2 Lab]

PRACTICAL/LAB COMPONENT:

1. Motor Voltage and Current Measurement Lab Assignment

Course Project Quiz 1 - Build a DC Motor circuit, and use it to understand about motor Measurements

Course Project 2 Quiz - Build a rotary switch circuit, and use it to understand about switch timing

UNIT IV INTRODUCTION TO BATTERY MANAGEMENT SYSTEM (3T+ 6P)

THEORY COMPONENT:

- Battery Boot Camp - [8 Videos,13 Readings ,7 Quizzes]
- How lithium-ion cells works - [7 Videos,7 Readings & 7 Quizzes]
- BMS sensing and high-voltage control - [9 Videos, 9 Readings ,8 Quizzes]
- BMS design requirements 2-5 - [8 Videos, 8 Readings,8 Quizzes]
- How are cells made? How can they fail?- [5 Videos, 5 Readings,4 Quizzes]

PRACTICAL/LAB COMPONENT: NA

UNIT V : EQUIVALENT CIRCUIT CELL MODEL SIMULATION (3T+ 6P)

THEORY COMPONENT:

- Defining an equivalent-circuit model of a Li-ion cell - [9 Videos, 14 Readings, 9 Quizzes & 1 Overall Quizz]
- Identifying parameters of static model - [6 Videos, 7 Readings, 6 Quizzes & 1 Overall Quiz]
- Identifying parameters of dynamic model- [9 Videos, 9 Readings, 7 Quizzes & 1 Overall Quiz]
- Simulating battery packs in different configurations - [6 Videos, 6 Readings, 6 Quizzes & 1 Overall Quiz]
- Co-simulating battery and electric-vehicle load - [7 Videos, 7 Readings, 5 Quizzes & 1 Overall Quiz]

PRACTICAL/LAB COMPONENT:

1. Octave Code to determine static part of ECM – Jupyter notebook used in conjunction (20 Mins)
2. Identifying parameters of static model - Jupyter notebook used in conjunction (1 Hour)
3. Octave Code to determine dynamic part of an ECM (20 Mins)
4. Octave Code to simulate an ECM (20 Mins)
5. Octave code to look up model parameter value (20 Mins)
6. Octave code to compute OCV (20 Mins)
7. ECM to simulate constant voltage (30 Mins)
8. ECM to simulate constant power (30 Mins)
9. Octave code to simulate PCM's (30 Mins)
10. Octave code to simulate SCM's (30 Mins)
11. Octave code to co-simulate EV and Battery (1 Hour)
12. Tune a Thevenin model using Octave code to match laboratory data set (1 Hour)
13. Tune an Rint model using Octave code to match laboratory data set (1 Hour)
14. Manually tuning an ESC cell model – (10 Mins)

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Students will be able to,

- Get exposed to the concepts & need of Electric vehicles , Mobility & Automation
- How to implement the power semiconductor devices in a switching converter
- Understand the origins of the discontinuous conduction mode and be able to solve converters operating in DCM
- Demonstrate the basic dc-dc converter and dc-ac inverter circuits
- How to implement transformer isolation in a dc-dc converter, including the popular forward and flyback converter topologies

- How to specify the proper AC or DC motor for a machine design
- Integrate the motor to a machine, based on analysis of motor equations for voltage, current, torque and speed.
- Implement the motor and accompanying rotary sensor into a motor control circuit in both hardware and software.
- Add a motor and motor control circuit into a microprocessor based development kit.
- Create hardware and firmware to process motor feedback data to a microprocessor for further evaluation.

- List the major functions provided by a battery-management system and state their purpose
- Match battery terminology to a list of definitions - Identify the major components of a lithium-ion cell and their purpose
- Understand how a battery-management system "measures" current, temperature, and

isolation, and how it controls contactors
- Identify electronic components that can provide protection and specify a minimum set of protections needed
- Compute stored energy in a battery pack
- List the manufacturing steps of different types of lithium-ion cells and possible failure modes
- State the purpose for each component in an equivalent-circuit model
- Compute approximate parameter values for a circuit model using data from a simple Lab test
- Determine coulombic efficiency of a cell from lab-test data
- Use provided Octave/MATLAB script to compute open-circuit-voltage relationship for a cell from lab-test data
- Use provided Octave/MATLAB script to compute optimized values for dynamic parameters in model
- Simulate an electric vehicle to yield estimates of range and to specify drivetrain Components
- Simulate battery packs to understand and predict behaviours when there is cell-to-cell variation in parameter values

Mandatory Project work

1. Motor Voltage and Current Measurement Lab
   Course Project - Build a DC Motor circuit, and use it to understand about motor Measurements
   Course Project - Build a rotary switch circuit, and use it to understand about switch timing

2. Student to modify three sample Octave programs to create functions that can simulate temperature-dependent cells, battery packs built from PCMs, and battery packs built from SCMs

Test Project: -

Design of battery pack for 48V 1000W electric vehicle and determine coulomb efficiency and equivalent circuit parameters using Octave/MATLAB

List of Software Students are exposed to

- Jupyter Notebook

Duration of availability of Licensed Software to Students

- For the entire Semester (Could be extended if required for specific candidates)

List of consumables that will be given to per student

- License for accessing respective Courses
- Orientation on portal access
- Doubt clarification session based on need basis
- Automatic Graded Assessment reports
- Access to discussion forums to relevant courses/steams

Student Assessment Plan

- Every Sub-units will have a Quiz and every Unit will have an overall Graded Quiz other than Lab exercise and Capstone Projects
- Few Assignments are also provided for practice in addition to Quiz and Graded assessments
- All Assessments are online based and self-graded
- If a students does not score the required minimum of 80% , he will be asked to retake the tutorial and attempt the Quiz again.

Unit 1 – Introduction to Electric Vehicles & Automation

- Quiz on Mobility Terms
- Quiz on Mobility – Past, Present & Future
- Quiz on EVs Made of?
- Quiz on Battery Technology
- Quiz on Stakeholders of Electrification

Overall Graded assessment on all the above topics

- Quiz on Sustainability & Equity
- Quiz on Impacts of Electrification
- Quiz on Autonomous Vehicles Components
- Quiz on Impacts of Automation

Unit 2 – Converter Circuits

- Assignment on why a diode works in some cases, while a transistor is needed in others
- Assignment on when single-quadrant, two-quadrant, or four-quadrant switch realizations are needed
- Homework Assignment on Switch Realisation
- Assignment on Simulation to trade off between voltage breakdown, switching time, and forward voltage drop in a power semiconductor device, Model switching loss using equivalent circuits & Design gate drivers
- Homework Assignment on the origin of discontinuous conduction modes
- Analyze a converter to find the CCM-DCM mode boundary
- Analyze a converter circuit to find its conversion ratio in DCM
- Demonstrate the origins of basic converter topologies
- Analyze converter circuits containing transformers
- Apply transformer analysis techniques to the forward converter
- Apply transformer analysis techniques to the flyback converter

Unit 3 – Motor & Motor Control Circuits

- Quiz on AC Motor Designs
- Quiz on AC Motor Control
- Quiz on DC Motors
- Quiz on DC Motors Control and Stepper Motors

- Motor Voltage and Current Measurement Lab Assignment

  Course Project Quiz 1 - Build a DC Motor circuit, and use it to understand about motor Measurements

  Course Project 2 Quiz - Build a rotary switch circuit, and use it to understand about switch timing

Unit 4 – Introduction to Battery Management System

- Pre-requisite Quiz on Battery Boot Camp
- Quiz on battery terminology
- Quiz on parts of electrochemical cell
- Quiz on electro chemical cell storage and release energy
- Quiz on materials to use in electrochemical cell

Overall assessment on all the above topics

- Quiz on lithium-ion cells
- Quiz on lithium-ion cells different from electrochemical cells
- Quiz on negative electrodes for lithium-ion cells
- Quiz on positive electrodes for lithium-ion cells
- Quiz on electrolytes and separators for lithium-ion cells
- Quiz on lithium to run out

Overall assessment on all the above topics

- Quiz on primary functions of a BMS
- Quiz on Modular design
- Quiz on Cell Voltage in a BMS
- Quiz on sense module temperature in a BMS
- Quiz on sense battery-pack current in a BMS
- Quiz on control contactors with a BMS
- Quiz on electrical isolation in a BMS

Overall assessment on all the above topics

- Quiz on BMS Protect the user and battery pack
- Quiz on BMS interface with other system components
- Quiz on BMS estimate SOC and SOH
- Quiz on Cell SOC and Battery-pack SOC
- Quiz on computing cell available energy and power
- Quiz on computing battery pack available energy and power
- Quiz on kinds of diagnostics must for a BMS report

Overall assessment on all the above topics

- Quiz on lithium-ion cell's electrodes fabricated
- Quiz on lithium-ion cell assembled
- Quiz on lithium-ion cell aging processes
- Quiz on abnormal cell aging processes and failure modes

Unit 5 - Equivalent Circuit Cell Model Simulation

- Quiz on Ope-circuit voltage (OCV) and State-of-charge (SOC)
- Quiz on How do we model voltage
- Quiz on Warburg impedance & its implementations
- Quiz on Convert a continuous-time model to discrete-time model
- Quiz on Model parameter values
- Quiz on Hysteresis in a lithium-ion cell and its modelling
- Quiz on equivalent-circuit model of a lithium-ion cell

Overall assessment on all the above topics

- Quiz on cell Characterization
- Quiz on open-circuit voltage determination
- Quiz on Cell's coulombic efficiency and total capacity
- Quiz on Cell's temperature dependent OCV
- **LAB** – Jupyter notebook - To be used in Conjunction with Octave code to determine static part of ECM

-Quiz on Octave code to determine static part of ECM
-**LAB** – Jupyter notebook - To be used in Conjunction with identifying parameters of static model and next steps

-Quiz on Determining dynamic-model parameters
-Quiz on cell data used to find dynamic-model parameter values
-**LAB** – Jupyter notebook to run for octave code to determine dynamic part of an ECM
-Quiz on octave code to determine dynamic part of an ECM
-**LAB** – Jupyter notebook to run for octave code to simulate an ECM
-Quiz on octave code to simulate an ECM
-**LAB** – Jupyter notebook to run for octave code to look up model parameter value
-Quiz on octave code to look up model parameter value
-**LAB** – Jupyter notebook to run for octave code to compute OCV
-Quiz on octave code to compute OCV

Overall assessment on all the above topics

-**LAB** – Jupyter notebook to run for ECM to simulate constant voltage

-Quiz on how to use ECM to simulate constant voltage
-**LAB** – Jupyter notebook to run for ECM to simulate constant power
-Quiz on how to use ECM to simulate constant power
-Quiz on Simulate battery packs
-**LAB** – Jupyter notebook to run for Octave code to simulate PCM's
-Quiz on Octave code to simulate PCM's
-**LAB** – Jupyter notebook to run for Octave code to simulate SCM's
-Quiz on Octave code to simulate SCM's

Overall assessment on all the above topics

- Quiz on develop a load/battery co-simulator
- Assignment on how to Infer the information needed to develop a load/battery co-simulator based on the example taught.
- Assignment on how to Analyze vehicle/battery co-simulation block diagram to understand the dependencies of simulation variables.

- Quiz on Modelling ideal vehicle dynamins
  Quiz on practical limits to model of vehicle dynamics
  Quiz on calculating electric-vehicle range

  -**LAB** – Jupyter notebook to run for Octave code to set up EV simulation
  -**LAB** – Jupyter notebook to run for Octave code to conduct EV simulation
  -Quiz on Octave code to set up EV simulation and conduct EV simulation
  - **LAB – Capstone Project to** modify three sample Octave programs to create functions that can simulate temperature-dependent cells, battery packs built from PCMs, and battery packs built from SCMs.
  - Assignment – Programming Assignment for manually tuning an ESC cell model

Documentary Evidence –

1. https://www.coursera.org/learn/people-technology-and-the-future-of-mobility
2. https://www.coursera.org/learn/converter-circuits
3. https://www.coursera.org/learn/motors-circuits-design
4. https://www.coursera.org/learn/battery-management-systems
5. https://www.coursera.org/learn/equivalent-circuit-cell-model-simulation

SB8007 MACHINE LEARNING WITH APPLICATION TO OBJECT RECOGNITION **L T P C 1 0 2 2**

COURSE OBJECTIVE

The objective of this course is to provide a view of data science, recognize why data science is gaining importance in today's business world to comprehend where data science can be applied across industry domains to understand major components of data science stack to learn how a data science project is implemented step-by-step in each business use-case

Pre-requisite courses:

Pre-requisite Knowledge	Courses Available on Springboard
Probability and Statistics	Probability and Statistics Probabilty distribution using Python Statistical Interence using Python
Python Programming Language	Programming Fundamentals using Python - Part 1
Linear Algebra	Basics of Linear Algebra
Regression Analysis	Regression Analysis
Deep Learning	Deep Learning for Developers
Exploratory Data Analysis	Exploratory data analysis

UNIT I INTRODUCTION TO AI AND DATA SCIENCE 7

Why AI? - What is AI? - AI in Practice - AI in Business - AI Platforms. Data Science: The Data Revolution - Components of Data Science - Data Science in Action – Conclusion.

UNIT II PYTHON FOR DATA SCIENCE 14

Why Python Libraries – NumPy - Introduction to NumPy - Operations on NumPy – Pandas – Introduction to Pandas – Introduction to Pandas Object – Working with datasets – Pandas Plots - Matplotlib – Introduction to Matplotlib – Types of Plots – Scikit-learn – Machine Learning using sklearn. [Practical hands-on exercises using NumPy, Pandas, Matplotlib]

UNIT III DATA VISUALIZATION USING PYTHON 6

Data visualization using Python: Data Visualization: Developing insights from data using Basic Plots using Matplotlib (Box, Scatter, Line, Bar, Pie, Histogram), Statistical analysis using Heatmap, Kernel Density plot using Seaborn, Network Graphs, Choropleth Map Using Ploty, Word Cloud. [Practical hands-on exercises for creating charts]

UNIT IV EXPLORE MACHINE LEARNING USING PYTHON 15

Introduction to Machine Learning - Regression – Classification – Clustering – Introduction to Artificial Neural Network. [Hands-on Exercises for Practicing Machine Learning Models Using Capstone Project]

UNIT V OBJECT DETECTION AND RECOGNITION USING DEEP LEARNING IN OPENCV 3

Basic Operations and Algorithms in OpenCV - Object Detection and Recognition Using Features - Deep Learning in OpenCV - Object Classification Using Deep Learning
Recognizing Text in an Image.

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES

- Continuous / Self-Assessment (MCQ)
- Capstone Project - Build a ML model using a sample image dataset, to detect or identify specific features in sample image such as mask on human face etc.,

SUGGESTED EVALUATION METHODS

- Video Proctored Exam
- Self-Assessment

COURSE OUTCOMES

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

CO1 : Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

CO2 : Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3 : Assess and select appropriate data analysis models for solving real-world problem.

CO4 : Demonstrate the importance of data visualization, design, and use of visual components.

CO5 : Demonstrate fundamental understanding of applications of machine learning for object recognition

REFERENCE(Course Material)

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_8840337130015322000_shared/overview (Introduction to AI)
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_12666306402263577000_shared/overview (Introduction to Data Science)
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0133306369806090249 4_shared/overview (Python for Data Science)
4. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126051913436938241 455_shared/overview (Data visualization using Python)
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126004007907491842 37_shared/overview (Explore Machine Learning)
6. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944396404162562 520_shared/overview (Object Detection and Recognition Using Deep Learning in OpenCV)

Mode of Training	Online (Self-Learning)
Course Evaluation	Online Assessment
Multiple Hybrid Branch of Students	Applicable for IT/CSE
Internship/Placement Opportunities	https://infytq.onwingspan.com/
NOS Alignment	Yes, Infosys Industry Standard
Train-the-Trainer	Faculty Enablement Program
Commercials	Free of Cost

SB8008	MACHINE LEARNING	L	T	P	C
		1	0	2	2

COURSE OBJECTIVE

The objective of this course is to provide a view of data science, machine learning, basic implementation using Python and how machine learning is applied in various domains in the industry

Pre-requisite courses:

Pre-requisite Knowledge	Courses Available on Springboard
Probability and Statistics	Probability and Statistics Probabilty distribution using Python Statistical Interence using Python
Python Programming Language	Programming Fundamentals using Python - Part 1
Linear Algebra	Basics of Linear Algebra
Regression Analysis	Regression Analysis

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 6

Why AI? - What is AI? - AI in Practice - AI in Business - AI Platforms.

UNIT II INTRODUCTION TO DATA SCIENCE 4

Data Science: The Data Revolution - Components of Data Science - Data Science in Action – Conclusion.

UNIT III PYTHON FOR DATA SCIENCE 14

Why Python Libraries – NumPy - Introduction to NumPy - Operations on NumPy – Pandas – Introduction to Pandas – Introduction to Pandas Object – Working with datasets – Pandas Plots - Matplotlib – Introduction to Matplotlib – Types of Plots – Scikit-learn – Machine Learning using sklearn. [Practical hands-on exercises using NumPy, Pandas, Matplotlib]

UNIT IV DATA VISUALIZATION USING PYTHON 6

Data visualization using Python: Data Visualization: Developing insights from data using Basic Plots using Matplotlib (Box, Scatter, Line, Bar, Pie, Histogram), Statistical analysis using Heatmap, Kernel Density plot using Seaborn, Network Graphs, Choropleth Map Using Ploty, Word Cloud. [Practical hands-on exercises for creating charts]

UNIT V EXPLORE MACHINE LEARNING USING PYTHON 15

Introduction to Machine Learning - Regression – Classification – Clustering – Introduction to Artificial Neural Network. [Hands-on Exercises for Practicing Machine Learning Models Using Capstone Project]

TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES

- Continuous / Self-Assessment (MCQ)
- Capstone Project – Build a ML model using a given numerical COVID'19 dataset, predict the number of confirmed cases for next ten days in different areas of the world

SUGGESTED EVALUATION METHODS

- Video Proctored Exam
- Self-Assessment

COURSE OUTCOMES

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

CO1 : Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

CO2 : Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3 : Assess and select appropriate data analysis models for solving real-world problem.

CO4 : Demonstrate the importance of data visualization, design, and use of visual components.

REFERENCE

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_8840337130015322000_shared/overview (Introduction to AI)
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_12666306402263577000_shared/overview (Introduction to Data Science)
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0133306369806090249 4_shared/overview (Python for Data Science)
4. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126051913436938241 455_shared/overview (Data visualization using Python)
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126004007907491842 37_shared/overview (Explore Machine Learning Using Python)

Mode of Delivery	Online (Self-Learning)
Software Configuration to be arranged in Institution Premises	○ Python and related libraries
Hardware Configuration to be arranged in Instituion Premises	○ Windows 10, 16GB RAM
Course Evaluation	Online Assessment
Multiple Hybrid Branch of Students	Applicable for Mechanical/Chemical
Internship/Placement Opportunities	https://infytq.onwingspan.com/
NOS Alignment	Yes- Infosys Industry Standard
Train-the-Trainer	Faculty Enablement Program
Commercials	Free of Cost

SB8009 ELECTRIC VEHICLE CHARGING SYSTEMS FOR EEE LT P C
1 0 2 2

COURSE DESCRIPTION:

The global market for electric vehicles (EVs) is growing continuously at a compounded annualized growth rate (CAGR) of 21.7 per cent. It is expected to grow from 8.1 million units to 39.21 million units by 2030. This exponential growth is being driven by various factors, including concerns for pollution.

In this course, students will get exposed to Electric vehicle, Predict aspects of mobility in the future. Comprehend the basics of battery technology. covers developing equivalent circuit model for the battery pack for performing various studies like OCV and ECM in simulation aspect. It also covers fault estimation in battery packs during short circuit and overload. The control system should kick in to protect the battery pack with design constrains.

COURSE OBJECTIVE:

Students to get exposed to Electric vehicle & mobility dynamics & Battery Management Systems. Demonstrate Battery State-of-charge (Estimation) & Battery State-of –Health (SOH) Estimation using lab exercises integrated in the platform as part of the tutorials. Design of various converter topologies which involves selection of components, switching pulses and switches using LTspice simulation tool, sensing of various battery parameters like SCO and SOH and developing EKF and SPKF using Octave Code.

To Design 48v 36Ah LIFEPO4 battery pack for the dimension of 430mm(L) x 15mm(B) x 160mm(H) and develop the control circuit for sensing the individual array temperature with OV and UV protection with minimum harmonic content also calculate the SOC and SOH using Octave model

COURSE CURRICULUM

UNIT I INTRODUCTION TO ELECTRIC VEHICLES & AUTOMATION 3T+6P

Theory component:
- Future of Mobility – *[5 Videos, 3 Readings,2 Quizzes]*
- Electrification : The Basic Technologies (Part 1) Electric Vehicles, batteries, EVs Made up of– *[5 Videos, 2 Reading,2 Quizzes]*
- Electrification : The Basic Technologies (Part 2) –Charging & Charging Infrastructure, EV & the power systems, Industry Perspective on Applications of Electrification *[7 Videos, 6 Readings, 2 Quizzes]*
- Electrification Impacts – *[7 Videos, 2 Quizzes]*
- Vehicle Automation – The Basic Technologies – *[9 Videos, 1 Reading, 2 Quizzes]*
- Automation – The Impacts – *[6 Videos,1 Quiz]*

UNIT II EQUIVALENT CIRCUIT CELL MODEL SIMULATION 3T+6P

Theory component:

- Defining an equivalent-circuit model of a Li-ion cell - *[9 Videos, 14 Readings, 9 Quizzes & 1 Overall Quiz]*
- Identifying parameters of static model - *[6 Videos, 7 Readings, 6 Quizzes & 1 Overall Quiz]*
- Identifying parameters of dynamic model- *[9 Videos, 9 Readings, 7 Quizzes & 1 Overall Quiz]*
- Simulating battery packs in different configurations - *[6 Videos, 6 Readings, 6 Quizzes & 1 Overall Quiz]*
- Co-simulating battery and electric-vehicle load - *[7 Videos, 7 Readings, 5 Quizzes & 1 Overall Quiz]*

Practical/Lab component:

1. Octave Code to determine static part of ECM – Jupyter notebook used in conjunction
2. Identifying parameters of static model - Jupyter notebook used in conjunction
3. Octave Code to determine dynamic part of an ECM
4. Octave Code to simulate an ECM
5. Octave code to look up model parameter value
6. Octave code to compute OCV
7. ECM to simulate constant voltage
8. ECM to simulate constant power
9. Octave code to simulate PCM's
10. Octave code to simulate SCM's
11. Octave code to co-simulate EV and Battery
12. Tune a Thevenin model using Octave code to match laboratory data set
13. Tune an Rint model using Octave code to match laboratory data set
14. Manually tuning an ESC cell model

UNIT III INTRODUCTION TO BATTERY MANAGEMENT SYSTEM 3T+6P

Theory component:

- Battery Boot Camp - *[8 Videos,13 Readings ,7 4 Quizzes/Assessment]*
- How lithium-ion cells work - *[7 Videos,7 Readings & 7 Quizzes/Assessment]*
- BMS sensing and high-voltage control - *[9 Videos, 9 Readings ,8 Quizzes/Assessment]*
- BMS design requirements 2-5 - *[8 Videos, 8 Readings,8 Quizzes/Assessment]*
  (Exclude Week 5 Content in the course)

Practical/Lab component: NA

UNIT IV AC MOTOR CONTROL COMPONENTS, MOSFET & BATTERY SOC ESTIMATION 3T+6P

Theory component:

- AC Motor Control Components - *[1 Video] – WEEK 2: 5TH TOPIC*
- Power Semiconductor Switches (Ch.4.2) Power MOSFETs, MOSFET Gate Drivers, BJTs and IGBTs , More About Switching Loss, Wide Bandgap Power Semiconductors *– [1 Videos]*
- What is the importance of a good SOC estimator - *[8 Videos, 4 Readings, 7 Quizzes]*
- Linear Kalman filter as a state estimator - *[6 Videos, 6 Readings, 6 Quizzes]*
- Linear Kalman filter - *[7 Videos, 7 Readings, 7 Quizzes]*
- Cell SOC estimation using an extended Kalman filter - *[8 Videos, 8 Readings, 7 Quizzes]*
- Cell SOC estimation using a sigma-point kalman filter - *[7 Videos, 7 Readings, 6 Quizzes]*
- Improving computational efficiency using the bar-delta method - *[5 Videos, 5 Readings, 4 Quizzes]*

Practical/Lab component:

1. Voltage based SOC estimation - LAB Exercise & Software Used for Practical Exercise This Jupyter notebook implements voltage-based methods for SOC estimation. This notebook implements two voltage-based SOC-estimation methods. The first one simply looks up cell terminal voltage under load in an OCV from SOC table. The second attempts to compensate for the effects of cell equivalent-series resistance
2. Generating correlated random vector
3. Sample code implementing linear Kalman filter
4. Simple EKF with octave code
5. Preparing to implement EKF on an ECM
6. Octave implementation of EKF to estimate SOC
7. Simple SPKF with Octave code

8. Octave implementation of SPKF to estimate SOC
9. Octave implementation of a bar-delta filter

Capstone project

- Execute Capstone Project - Tuning an EKF for SOC Estimation
- Execute Capstone Project - Tuning an SPKF for SOC Estimation

UNIT V BATTERY STATE-OF –HEALTH (SOH) ESTIMATION & MITIGATION OF HARMONICS 3T+6P

Theory component:

- How does lithium-ion cell health degrade? - *[8 Videos, 3 Readings, 3 Quizzes]*
- Total-least-squares battery-cell capacity estimates - *[7 Videos, 7 Readings, 7 Quizzes]*
- How to write code for the different total-capacity estimators - *[6 Videos, 6 Readings, 6 Quizzes]*
- Introduction to Modeling and Control of Single-Phase Rectifiers and Inverters, Introduction to Grid-Tied Power Electronics, Low Hormonic Rectifiers, CCM and DCM Operation of the Boost Low-Harmonic Rectifier - *[8 Videos,3 Readings,3 Quizzes]*
- Control of the PFC Boost Rectifier, Input Voltage Feedforward Compensation, Loss-Free Resistor Model - *[10 Videos,5 Practice Exercises]*

Practical/Lab component:

1 Demonstrate estimate cell series resistance
2 Will be able to execute on finding the ordinary least squares solution as a benchmark
3 Execute ordinary-least-squares solution computationally efficient
4 Able to Find the solution to a weighted total-least-squares problem
5 Confidence intervals on least-squares solutions
6 Implement Simplifying the total-least-squares solution for cases having proportional uncertainties
7 Demonstrate Making simplifies solution computationally efficient
8 Finding solution to the AWTLS Problem
9 Write Octave code to estimate cell total capacity
10 Demonstrating Octave code HEV: Scenario 1
11 Demonstrating Octave code HEV: Scenario 2-3
12 Demonstrating Octave code BEV: Scenario 1
13 Demonstrating Octave code BEV: Scenario 2-3
14 Execute Robustness and Speed
15 Will be able to execute A Kalman filter approach to total capacity estimation
16 Access Matlab ; Demonstrate understanding of power factor and harmonics in the context of grid-tied power electronics. Assignment on Universal-Input Boost Low-Harmonic Rectifier
17 Assignment Quiz on DCM Flyback as PFC Rectifier, Demonstrate understanding of operating principles of low-harmonic, power factor correction rectifiers ; Demonstrate ability to model single phase low harmonic rectifiers

Execute the Capstone Project - Tuning xLS algorithms for total capacity estimation & explore a different way to determine the "x" and "y" data you use as input to the total-capacity estimation methods.

TOTAL : 45 PERIODS

Mandatory Project work

- Execute Capstone Project - Tuning an EKF for SOC Estimation
  Execute Capstone Project - Tuning an SPKF for SOC Estimation
- Execute the Capstone Project - Tuning xLS algorithms for total capacity estimation & explore a different way to determine the "x" and "y" data you use as input to the total-capacity estimation methods.

Test Project :-

Design 48v 36Ah LIFEPO4 battery pack for the dimension of 430mm(L) x 15mm(B) x 160mm(H) and develop the control circuit for sensing the individual array temperature with OV and UV protection with minimum harmonic content also calculate the SOC and SOH using Octave model

Student Assessment Plan

- *Every Sub-units will have a Quiz and every Unit will have an overall Graded Quiz other than Lab exercise and Capstone Projects*
- *All Assessments are online based and self-graded*
- *If a students does not score the required minimum of 80% , he will be asked to retake the tutorial and attempt the Quiz again.*

Unit 1 – Introduction to Electric Vehicles & Automation

- Quiz on Mobility Terms
- Quiz on Mobility – Past, Present & Future
- Quiz on EVs Made of?
- Quiz on Battery Technology
- Quiz on Stakeholders of Electrification

Overall Graded assessment on all the above topics

- Quiz on Sustainability & Equity
- Quiz on Impacts of Electrification
- Quiz on Autonomous Vehicles Components
- Quiz on Impacts of Automation

Unit 2 : – Equivalent Circuit Cell Model Simulation

- Quiz on Open-circuit voltage (OCV) and State-of-charge (SOC)
- Quiz on How do we model voltage
- Quiz on Warburg impedance & its implementations
- Quiz on Convert a continuous-time model to discrete-time model
- Quiz on Model parameter values
- Quiz on Hysteresis in a lithium-ion cell and its modelling
- Quiz on equivalent-circuit model of a lithium-ion cell

Overall assessment on all the above topics

- Quiz on cell Characterization
- Quiz on open-circuit voltage determination
- Quiz on Cell's coulombic efficiency and total capacity
- Quiz on Cell's temperature dependent OCV
- **LAB** – Jupyter notebook - To be used in Conjunction with Octave code to determine static part of ECM
- Quiz on Octave code to determine static part of ECM
- **LAB** – Jupyter notebook - To be used in Conjunction with identifying parameters of static model and next steps
- Quiz on Determining dynamic-model parameters
- Quiz on cell data used to find dynamic-model parameter values
- **LAB** – Jupyter notebook to run for octave code to determine dynamic part of an ECM
- Quiz on octave code to determine dynamic part of an ECM
- **LAB** – Jupyter notebook to run for octave code to simulate an ECM
- Quiz on octave code to simulate an ECM
- **LAB** – Jupyter notebook to run for octave code to look up model parameter value
- Quiz on octave code to look up model parameter value
- **LAB** – Jupyter notebook to run for octave code to compute OCV

-Quiz on octave code to compute OCV

Overall assessment on all the above topics

-**LAB** – Jupyter notebook to run for ECM to simulate constant voltage

-Quiz on how to use ECM to simulate constant voltage
-**LAB** – Jupyter notebook to run for ECM to simulate constant power
-Quiz on how to use ECM to simulate constant power
-Quiz on Simulate battery packs
-**LAB** – Jupyter notebook to run for Octave code to simulate PCM's

-Quiz on Octave code to simulate PCM's

-**LAB** – Jupyter notebook to run for Octave code to simulate SCM's
-Quiz on Octave code to simulate SCM's

Overall assessment on all the above topics

- Quiz on develop a load/battery co-simulator
- Assignment on how to Infer the information needed to develop a load/battery co-simulator based on the example taught.
- Assignment on how to Analyze vehicle/battery co-simulation block diagram to understand the dependencies of simulation variables.
- Quiz on Modelling ideal vehicle dynamins
  Quiz on practical limits to model of vehicle dynamics
  Quiz on calculating electric-vehicle range
  -**LAB** – Jupyter notebook to run for Octave code to set up EV simulation
  -**LAB** – Jupyter notebook to run for Octave code to conduct EV simulation
  -Quiz on Octave code to set up EV simulation and conduct EV simulation

  - **LAB – Capstone Project to** modify three sample Octave programs to create functions that can simulate temperature-dependent cells, battery packs built from PCMs, and battery packs built from SCMs.
  - Assignment – Programming Assignment for manually tuning an ESC cell model

Unit 3 – Introduction to Battery Management System

- Pre-requisite Quiz on Battery Boot Camp
- Quiz on battery terminology
- Quiz on parts of electrochemical cell
- Quiz on electro chemical cell storage and release energy
- Quiz on materials to use in electrochemical cell
- **Overall assessment on all the above topics**

- Quiz on lithium-ion cells
- Quiz on lithium-ion cells different from electrochemical cells
- Quiz on negative electrodes for lithium-ion cells
- Quiz on positive electrodes for lithium-ion cells
- Quiz on electrolytes and separators for lithium-ion cells
- Quiz on lithium to run out

Overall assessment on all the above topics

- Quiz on primary functions of a BMS
- Quiz on Modular design
- Quiz on Cell Voltage in a BMS
- Quiz on sense module temperature in a BMS
- Quiz on sense battery-pack current in a BMS
- Quiz on control contactors with a BMS

- Quiz on electrical isolation in a BMS

Overall assessment on all the above topics

- Quiz on BMS Protect the user and battery pack
- Quiz on BMS interface with other system components
- Quiz on BMS estimate SOC and SOH
- Quiz on Cell SOC and Battery-pack SOC
- Quiz on computing cell available energy and power
- Quiz on computing battery pack available energy and power
- Quiz on kinds of diagnostics must for a BMS report

Overall assessment on all the above topics

Unit 4 - AC Motor Control Components, MOSFET & Battery SOC Estimation

- Quiz on AC motor control
- Simulation of a Synchronous Boost Converter - Complete Assignment to Understand the tradeoff between voltage breakdown, switching time, and forward voltage drop in a power semiconductor device, Complete Assignment to Model switching loss using equivalent circuits
- Complete Assignment to Design gate drivers, Work on LTspice File: Synchronous Boost Converter, with associated driver, dead time generator, and PWM models

- Quiz on importance of a good SOC estimator
- Quiz on defining SOC
- Quiz on Estimating battery cell SOC
- **LAB** - This Jupyter notebook implements voltage-based methods for SOC estimation. This notebook implements two voltage-based SOC-estimation methods. The first one simply looks up cell terminal voltage under load in an OCV from SOC table. The second attempts to compensate for the effects of cell equivalent-series resistance

-Quiz on man and covariance
-Quiz on uncertainty of two unknown quantities
-Quiz on varying uncertain quantities
-**Overall assessment on all the above topics**

-Quiz on predict/correct mechanism of sequential probabilistic inference
-Quiz on Kalman-filter gain factor
-Quiz on six steps of generic probabilistic inference
-Quiz on three Kalman-filter prediction steps
-Quiz on three Kalman-filter correction steps
-Quiz on linear KF as a state estimator
-**Overall assessment on all the above topics**

-Quiz on Kalman filter with a linearized cell model
-**LAB** – Generate Correlated random vectors (15 Mins)
-Quiz on Octave code to generate correlated random numbers
-**LAB** – Write Code implementing linear Kalman filter (15 mins)
-Quiz on Octave Code to implement KF for linearized cell model
-Quiz on numeric robustness of Kalman filter
-Quiz on automatically detecting bad measurements with a Kalman filter
-Quiz on initialize and tune a Kalman filter
-Quiz on Linear KF and next steps

- Quiz on Non-linear variations to Kalman filters
- Quiz on three extended Kalman –filter prediction steps
- Quiz on three extended-Kalman-filter correction steps
- **LAB** – Write Simple EKF Example workout (20 Mins)
- Quiz on Simple EKF with Octave code

- L**AB** – Preparing to implement EKF on an ECM (15 Mins)
- Quiz on Preparing to implement EKF on an ECM
- **LAB** – Octave implementation of EKF to estimate SOC (30 Mins)
- Quiz on Octave implementation of EKF to estimate SOC
- Quiz on cell SOC estimation using an EKF and next steps
- Quiz on Sigma point methods
- Quiz on uncertain variables using sigma points
- Quiz on six sigma – point –Kalman filter steps
- **LAB** – Simple SPKF example with Octave code (20 Mins)
- Quiz on Simple SPKF example with Octave code
- **LAB** – Octave implementation of SPKF to estimate SOC (30 Mins)
- Quiz on Octave implementation of SPKF to estimate SOC
- Quiz on Cell SOC estimation using a SPKF and next steps
- Quiz on estimating SOC for battery packs
- Quiz on bar filters using an ECM

- Quiz on delta filters using an ECM
- **LAB** – Octave implementation of a bar-delta filter (30 Mins)
- Quiz on desktop validation as a method of predicting performance
- **Capstone Project**

  Part 1 - Tuning an EKF for SOC Estimation
  Part 2- Tuning an SPKF for SOC Estimation

Unit 5 :- Battery State-of –Health (SOH) Estimation & Mitigation of harmonics – (10 Hours)

- Quiz on cell ages
- Quiz on Negative-electrode aging processes at particle surface
- Quiz on Negative-electrode aging processes in bulk and composite electrode
- Quiz on positive-electrode aging processes
- **LAB** - This Jupyter notebook implements ### Simple method to estimate cell series resistance. This notebook executes the simple method presented in lesson 4.1.6 to estimate cell series **resistance**
- Quiz on cell voltage to changes in equivalent series resistance (ESR) (10 Mins)
  Quiz on sensitivity of cell voltage to changes in cell total capacity

  Overall assessment on all the above topics

- Quiz on using ordinary least squares to estimate total capacity
- **LAB** – How to find the ordinary least squares solution as a benchmark (10 Mins)
- Quiz on ordinary least squares solution as a benchmark
- **LAB** – Demonstrating the ordinary-least-squares solution computationally efficient (10Mins)
- Quiz on ordinary-least-squares solution computationally efficient
- **LAB** – Finding the solution to an weighted total-least-squares problem (10 Mins)
- Quiz on setting up weighted total-least-squares solution
- **LAB** – Confidence intervals on least-squares solutions (10 Mins)
- Quiz on Confidence intervals on least-squares solutions
  Overall assessment on all the above topics

- **LAB** – Simplifying the total-least-squares solution for cases having proportional uncertainties (10 Mins)
- Quiz on the total-least-squares solution for cases having proportional uncertainties
- **LAB** – Making simplifies solution computationally efficient (10 Mins)
- Quiz on Making simplifies solution computationally efficient
- Quiz on Defining geometry for approximate full solution to weighted total least squares
- Quiz on finding appropriate cost function for approximate full solution to AWTLS problem
- **LAB** – Finding solution to the AWTLS Problem (10 Mins)

- Quiz on AWTLS Problem
- **LAB** – Adding fading memory (10 Mins)
  Overall assessment on all the above topics
- **LAB** – Write Octave code to estimate cell total capacity (10 Mins)
- Quiz on estimate cell total capacity
- **LAB** – Demonstrating Octave code HEV: Scenario 1 (10 Mins)
- Quiz on Octave code HEV: Scenario 1
- **LAB** – Demonstrating Octave code HEV: Scenario 2-3 (10 Mins)

- Quiz on Octave code HEV: Scenario 2-3
- **LAB** – Demonstrating Octave code BEV: Scenario 1 (10 Mins)
- Quiz on Octave code BEV: Scenario 1
- **LAB** – Demonstrating Octave code BEV: Scenario 2-3 (10 Mins)
- Quiz on Octave code BEV: Scenario 2-3
  Overall assessment on all the above topics

- Quiz on Deriving SPKF method for parameter estimation
- Quiz on Deriving EKF method for parameter estimation
- Quiz on estimate states and parameters at the same time. Steps to do
- **LAB** – Robustness and Speed (1 hour)
- **LAB** – A Kalman filter approach to total capacity estimation (10 Mins)

- **Capstone Project Evaluation** – Students have learned several different total-capacity estimation methods. Some of these methods work better than others in general, but any method is only as good as the data you give it. In this project, students will explore a different way to determine the "x" and "y" data you use as input to the total-capacity estimation methods. (3 hr. 30 Mins)

  1.Jupyter notebook for capstone project integrated
  2.Tuning xLS algorithms for total capacity estimation

- Quiz on Universal-Input Boost Low-Harmonic Rectifier
- Quiz on DCM Flyback as PFC Rectifier
- Quiz on Energy Storage Capacitor in a Flyback PFC
- Quiz on Boost PFC Rectifier Control Loops
- Quiz on Comparison of PFC Rectifiers

Test Project :-

Design 48v 36Ah LIFEPO4 battery pack for the dimension of 430mm(L) x 15mm(B) x 160mm(H) and develop the control circuit for sensing the individual array temperature with OV and UV protection with minimum harmonic content also calculate the SOC and SOH using Octave model

COURSE OUTCOMES:

Students will be able to,

- Arrange the Cell array for various power ratings
- Measure the Voltage, Current and temperature of individual cell array
- Estimate the fault current during short circuit and overload
- Develop the galvanizing isolation for high and low side MOSFET
- Estimation of SOC and SOH
- Estimation of SOC and SOH
- Develop protection circuit for fast charging
- Mitigation of harmonics in EV charging system

Course Links:

1. https://www.coursera.org/learn/people-technology-and-the-future-of-mobility
2. https://www.coursera.org/learn/equivalent-circuit-cell-model-simulation
3. https://www.coursera.org/learn/battery-management-systems
4. https://www.coursera.org/lecture/motors-circuits-design/5-ac-motor-control-components-Mws6I
5. https://www.coursera.org/lecture/converter-circuits/sect-4-2-2-1-power-mosfets-a1NBr
6. https://www.coursera.org/learn/battery-state-of-charge
7. https://www.coursera.org/learn/battery-state-of-health
8. https://www.coursera.org/learn/modeling-and-control-of-single-phase-rectifiers-and-inverters

SB8010 **SMART ENERGY GRID** **LT P C**
1 0 2 2

COURSE DESCRIPTION:

Since the early 21st century, opportunities to take advantage of improvements in electronic communication technology to resolve the limitations and costs of the electrical grid have become apparent. Technological limitations on metering no longer force peak power prices to be averaged out and passed on to all consumers equally. In parallel, growing concerns over environmental damage from fossil-fired power stations have led to a desire to use large amounts of renewable energy and Smart Grid plays a vital role in it.

In this course, students will get exposed to Smart grid Fundamentals, Architecting smart grid technologies, M2M & IOT Interface design and protocols for embedded systems. Students will also work on guided projects in Azure IoT Hubs.

COURSE OBJECTIVE:

Students will be able to understand and work on smart grid technologies and its potential in different types of power sectors such as power generation, transmission, and distribution.

They will get to Architect Smart IoT Devices, programming with IOT Boards, M2M & IoT Interface Design & Protocols for Embedded Systems because it's essential that an IoT Project that can monitor and manage the energy consumption of your Devices with a Smart Energy Meter and cloud , which tells you the amount of energy consumed by a particular device. Smart grid is one of the essential features of smart city. It provides a communication between the provider and consumer." And using Arduino for IoT based Smart Grid Systems:

COURSE CURRICULUM

UNIT I INTRODUCTION TO ELECTRIC POWER SYSTEMS & SMART GRID 3T+6P

Theory component:

- Basic Electricity – *[6 Videos, 2 Readings,6 Quizzes]*
- Generation, Transmission, & Distribution – *[4 Videos, 1 Reading,5 Quizzes]*
- System Design & Switching – *[3 Videos, 1 Reading, 4 Quizzes]*
- Renewable Energy & Smart Grid Technologies – *[4 Videos, 4 Readings & 4]*

Practical/Lab component: NA

UNIT II INTRODUCTION ARCHITECTING SMART IOT DEVICES 3T+6P

Theory component:

- Embedded Systems - *[7 Videos,14 Readings ,4 Quizzes]*
- Problems & Failures of Systems - *[6 Videos,20 Readings & 5 Quizzes]*
- System Life Cycle - *[6 Videos, 15 Readings ,4 Quizzes]*

Practical/Lab component: NA

UNIT III ARCHITECTING SMART IOT DEVICES 3T+6P

Theory component:

- Hardware & Software for EmS - *[7 Videos, 19 Readings, 5 Quizzes]*
- RTOS – *[6 Videos ,26 Readings & 5 Quizzes]*
- System finalisation– *[6 Videos ,28 Readings & 3 Quizzes]*
- Low Power - *[6 Videos, 3 Readings,1Quiz]*

Practical/Lab component: NA

UNIT IV INTRODUCTION AND PROGRAMMING WITH IOT BOARDS 3T+6P

Theory component:

- Introduction to IOT - *[2 Videos, 2 Quizzes]*
- Networking Technologies for IOT - *[2 Videos, 2 Quizzes]*
- IOT Programming with Arduino- *[6 Videos, 2 Quizzes]*
- IOT Programming with Raspberry Pi - *[5 Videos, 3 Quizzes]*
- IOT Programming with ARTIK Board - *[4 Videos, 3 Quizzes]*

Practical/Lab component: NA

UNIT V M2M & IOT INTERFACE DESIGN & PROTOCOLS FOR EMBEDDED SYSTEMS 3T+6P

Theory component:

- Intro Introduction to M2M & IoT- *[8 Videos, 1 Reading, 1 Quiz]*
- Cloud for IOT - *[2 Videos, 2 Quizzes]*
- Communications Protocols- *[5 Videos, 1 Quiz]*
- Other Cloud and IoT Elements - *[7 Videos, 1 Quiz]*

Practical/Lab component: NA

- *Assignment Quiz on M2M & IoT, Cloud Architectures, UML and Architecture Patterns (10 Mins)*
- *Pre-Project Preparation and AWS Account Acquisition (10 mins)*
- *Graded Project Assignment on Simple AWS IoT Connection (1 hr)*
- *Graded Project Assignment on Extended AWS IoT Connections (1 hr)*
- **TOTAL : 45 PERIODS**

Mandatory Project work

- *Pre-Project Preparation and AWS Account Acquisition (10 mins)*
- *Graded Assignment on Simple AWS IoT Connection (1 hr)*
- *Graded Assignment on Extended AWS IoT Connections (1 hr)*

Other Stand-alone Guided Projects: (4 Hours)

- *Create an IoT hub & IoT device in Azure and use a Raspberry Pi web simulator to send telemetry data to the IoT hub*
- *Configure Routing in Azure IoT Hub - Create an IoT hub and register a device in IoT hub, Configure message routing in Azure IoT Hub, Create an Azure Storage account to store the incoming sensor data.*
- *Build Device Messaging and Communication in Azure IoT Hub - Create and configure Azure IoT hub, demonstrate to send device-to-cloud and cloud-to-device messages & learn to use message routing with Azure IoT Hub.*
- *Processing IoT Hub data streams with Azure Stream Analytics - Create an IoT hub and register a device in IoT hub, Create stream analytics job with IoT hub as input and Azure storage as output, Will use raspberry pi online simulator to send streaming data to the IoT hub.*

Test Project:-

Develop an SQL database for the smart energy meter using AWS cloud or Configure Routing in Azure IoT Hub which will log the data of voltage, current, maximum demand and power factor

List of Software Students are exposed to

- Microsoft Azure
- Azure IoT Hub

Duration of availability of Licensed Software to Students

- For the entire Semester *(Could be extended if required for specific candidates)*

List of consumables that will be given to per student

- License for accessing respective Courses
- Orientation on portal access
- Doubt clarification session based on need basis
- Automatic Graded Assessment reports
- Access to discussion forums to relevant courses/steams

Student Assessment Plan

- *Every Sub-units will have a Quiz and every Unit will have an overall Graded Quiz other than Lab exercise and Peer Graded Assignments*
- *All Assessments are online based , auto-graded & Peer Graded*
- *If a students does not score the required minimum of 80% , he will be asked to retake the tutorial and attempt the Quiz again.*

Unit 1 – Introduction to Electric Power Systems & Smart Grid

- Quiz on Basic Electricity Concepts
- Quiz on Basic Electric properties
- Quiz on Simple Circuits
- Quiz on ohm's Law
- Quiz on AC Current
- Quiz on ohm's Law

Overall Graded assessment on all the above topics

- Quiz on Generation, Transmission, & Distribution
- Quiz on Generation
- Quiz on Transmission & Sub transmission

Overall Graded assessment on all the above topics

- Quiz on System Design & Switching : Circuit Breakers
- Quiz on Switches
- Quiz on Double-Busbar & Switching Sequence

Overall Graded assessment on all the above topics

- Quiz on Renewable Energy & Smart Grid Technologies: Smart Grid Risks
- Quiz on Smart Grid, utilities & Consumers
- Quiz on Smart Grid & the Environment
- Quiz on Renewable Energy

Overall Graded assessment on all the above topics

Unit 2 – Introduction Architecting Smart IOT Devices

- Quiz on Embedded System's markets
- Quiz on EmS Characteristics
- Quiz on parallel Executions
- Quiz on Electronic Time
- Quiz on Abuse
- Quiz on Embedded systems Failure
- Quiz on EmS Success rate
- Quiz on Build or Buy
- Quiz on EmS Complexity

- Quiz on Life Cycle Basics
- Quiz on Architectural Design
- Quiz on Model-based Design
- Quiz on SysML

Unit 3 - Architecting Smart IOT Devices

- Quiz on Processors
- Quiz on Boards
- Quiz on networks
- Quiz on Software Components
- Quiz on IoT Components
- Quiz on XXS to XXL
- Quiz on Real-Time Scheduling
- Quiz on Synchronisation and Communication

- Quiz on Device Drivers
- Quiz on Multithreading Design
- Assignment & Discussion prompt – Turn on your smartphone into a BB gateway
- Quiz on Development tools & Environments
- Quiz on Debugging Basics
- Quiz on Debugging specials and Code Tuning
- Quiz on Low Power

Unit 4– Introduction and Programming with IoT Boards

- Quiz on IoT
- Quiz on IoT use cases
- Quiz on Wired & Wireless networking technologies
- Quiz on Wireless Personal Area Networking technologies
- Quiz on Arduino
- Quiz on Arduino
- Quiz on Programming with Arduino
- Quiz on Raspberry Pi
- Quiz on Programming with Raspberry Pi - 1
- Quiz on Programming with Raspberry Pi - 2
- Quiz on ARTIK
- Quiz on Programming with ARTIK

Unit 5– M2M & IoT Interface Design & Protocols for Embedded Systems

- Quiz on M2M & IoT, Cloud Architectures, UML and Architecture patters
- Quiz on IoT Application Protocols, Cloud for IoT, AWS, AWS IoT
- Graded Project Assignment on Simple AWS IoT Connections
- Quiz on low-Level Protocols, M2M Protocols, LPWANs for IoT
- Graded Project Assignment on Extended AWS IoT Connections
- Quiz on AWS alternatives, IoT Security, Message Queuing, APIs, Microservices

Other Stand-alone Guided Projects Evaluation :

⇒ Create an IoT hub & IoT device in Azure and use a Raspberry Pi web simulator to send telemetry data to the IoT hub.

⇒ Configure Routing in Azure IoT Hub - Create an IoT hub and register a device in IoT hub, Configure message routing in Azure IoT Hub, Create an Azure Storage account to store the incoming sensor data.

⇒ Build Device Messaging and Communication in Azure IoT Hub - Create and configure Azure IoT hub, demonstrate to send device-to-cloud and cloud-to-device messages & learn to use message routing with Azure IoT Hub.

⇒ Processing IoT Hub data streams with Azure Stream Analytics - Create an IoT hub and register a device in IoT hub, Create stream analytics job with IoT hub as input and Azure storage as output, Will use raspberry pi online simulator to send streaming data to the IoT hub.

Test Projects :-

Develop an SQL database for the smart energy meter using AWS cloud or Configure Routing in Azure IoT Hub which will log the data of voltage, current, maximum demand and power factor

Project Sample Structure

Documentary Evidence –

1. https://www.coursera.org/learn/electric-power-systems
2. https://www.coursera.org/learn/iot-devices
3. https://www.coursera.org/learn/iot-architecture
4. https://www.coursera.org/learn/introduction-iot-boards
5. https://www.coursera.org/learn/m2m-iot-interface-design-embedded-systems

Coursera Guided Projects –

1. https://www.coursera.org/learn/getting-started-with-azure-iot-hub
2. https://www.coursera.org/learn/configure-routing-in-azure-iot-hub
3. https://www.coursera.org/learn/build-device-messaging-and-communication-in-azure-iot-hub
4. https://www.coursera.org/learn/processing-iot-hub-data-streams-with-azure-stream-analytics

COURSE OUTCOMES:

Students will be able to,

- Explain the difference between parallel and series of circuits.
- Analyze a basic DC circuit by calculating sum resistances.
- Determine whether a transformer is step-up or step-down.
- Identify the segments of the electrical power system.
- Explain the difference between generation, transmission and distribution in an electrical system
- Recognize the common the distribution voltages
- Identify common electrical power components
- Identify and define what a circuit breaker is.
- Differentiate between low, medium and high circuit breakers.
- Evaluate the difference between switches and circuit breakers.
- Identify reasons that fossil fuels are unsustainable
- Differentiate the parts of a smart grid and identify the benefits of each part
- Identify reasons that renewable energy sources are sustainable.
- Evaluating the embedded system market
- Outlining the characteristic of real time embedded systems
- Discuss the response of embedded system in the case of simultaneous events
- Discuss the notion of time and how it will be used in the embedded system
- Metaphoric overview of the methods and means to make a project operational
- Outline the problems associated with existing embedded systems and system hacking
- Analyze different types of failure and its effect on the embedded system performance
- Evaluate the system complexity and ways to deal with it
- Analyze basics of embedded system lifecycle and challenges associated with it
- Outline the need of architectural design and its applicability at system or drivers level
- Exemplify the importance of model based designs and ways to do it
- Distinguish between UMl and SysML for model based approach and tools to support it
- Evaluating the embedded components used for application specific design
- Able to decide whether components are ready to use or they need some configuration
- Evaluate the consquences of component changes to design or software
- Discuss the Intellectual property and licensing implications
- Apply architectural work at application
- Evaluate the characteristics while choosing a processor
- Criteria available to select printed circuit boards for IoT
- Explore the networking technologies used in embedded systems today focusing specially on IoT
- Explore software components for embedded system
- Evaluate the IoT market
- Evaluate the characteristics of different operating systems for embedded applications
- Outlining the different types of scheduling policies of real time operating systems
- Describing the synchronization and communication features of operating systems required for multitasking aspects
- Exploring the rules for multithreading design
- Outline the challenges in embedded software development
- Evaluate the debugging techniques and code tuning for performance
- Analyze the types of testing to validate the device functioning
- Discover the importance of the security of hardware and software
- Outline the required tools and debugger for embedded system development
- Analyze the methods of simulation to validate the device functioning
- Discover the ways of elimination of threats
- Conceptualize the meaning of low power in embedded system
- Outline the requirements of power and energy optimization
- To understand the basic elements of IoT, which is the general architecture and technologies involved.
- To find IoT use cases and explain how IoT devices work.

- To understand the key networking technologies used in IoT.
- To understand wireless personal area networks.
- To understand what Arduino is and its hardware and software components.
- To understand how to use Arduino board and how to program it.
- To understand what Raspberry Pi is and its hardware and software components.
- To understand how to use Raspberry Pi board and how to program it.
- To understand what ARTIK board is and its hardware and software components.
- To understand how to use ARTIK board and how to program it.
- Define and assess importance of M2M and IoT to modern development
- Understand, compare, contrast cloud architecture elements
- Be able to use UML and Use Cases in software design
- Apply IoT design to AWS-connected coding examples
- Recognize sources for architectural design and patterns support
- Apply IoT design to AWS-connected coding examples
- Review, compare, contrast common IoT application protocols
- Recognize key elements of cloud support for IoT devices and systems
- Review AWS services, costs, and certification
- Review specific elements of AWS IoT-related services
- Apply IoT design to AWS-connected coding examples
- Review, compare, contrast common low-level communication protocols
- Review, compare, contrast M2M wired and wireless protocols
- Review, compare, contrast low-power WANs for IoT use
- Apply IoT design to AWS-connected coding examples
- Consider alternatives to AWS for IoT support
- Understand security concerns and tools for IoT systems
- Consider and compare message queuing tools and patterns
- Consider API design and best practices for IoT systems
- Review the application of microservice architecture to IoT systems

Other Stand-alone Guided Projects: (4 Hours)

- Create an IoT hub & IoT device in Azure and use a Raspberry Pi web simulator to send telemetry data to the IoT hub
- Configure Routing in Azure IoT Hub - Create an IoT hub and register a device in IoT hub, Configure message routing in Azure IoT Hub, Create an Azure Storage account to store the incoming sensor data.
- Build Device Messaging and Communication in Azure IoT Hub - Create and configure Azure IoT hub, demonstrate to send device-to-cloud and cloud-to-device messages & learn to use message routing with Azure IoT Hub.
- Processing IoT Hub data streams with Azure Stream Analytics - Create an IoT hub and register a device in IoT hub, Create stream analytics job with IoT hub as input and Azure storage as output, Will use raspberry pi online simulator to send streaming data to the IoT hub

Test Project:- Develop an SQL database for the smart energy meter using AWS cloud or Configure Routing in Azure IoT Hub which will log the data of voltage, current, maximum demand and power factor

Course Links:

1. https://www.coursera.org/learn/electric-power-systems
2. https://www.coursera.org/learn/iot-devices
3. https://www.coursera.org/learn/iot-architecture
4. https://www.coursera.org/learn/introduction-iot-boards
5. https://www.coursera.org/learn/m2m-iot-interface-design-embedded-systems

Stand-alone Guided projects links:

1. https://www.coursera.org/learn/getting-started-with-azure-iot-hub
2. https://www.coursera.org/learn/configure-routing-in-azure-iot-hub
3. https://www.coursera.org/learn/build-device-messaging-and-communication-in-azure-iot-hub
4. https://www.coursera.org/learn/processing-iot-hub-data-streams-with-azure-stream-analytics

SB8011 **INDUSTRY 4.0** **L T P C**
1 0 2 2

Table of Contents:

In response to the EOI we now intend to submit a proposal for onboarding us as a training partner of TNSDC under the Naan Mudhalvan program.

Part - 1: Course Overview:

Course Title: Industry 4.0

Course Description:

With Industry 4.0 bringing revolutionary changes to various industries, businesses are looking to adopt technologies like Data Analytics, the Industrial Internet of Things (IIoT), and Augmented Reality (AR/VR) to improve their manufacturing competitiveness. Therefore, it is crucial to stay abreast of the changes happening in the industry. This program educates and trains students on the fundamentals of Industry 4.0, the underlying technologies, digital transformation, change management, and improvement strategies.

Course Objective:

1. To train and equip individuals with the basic technologies behind Digital Transformation.
2. To Analyze and utilize the building blocks of Industry 4.0.
3. To Utilize and create the key technologies involved in Industry 4.0, change management, and implementation strategies.

Course Outcomes:

On completion of the course, a group of students (4 Nos) will be able to

LO1: Identify the location of their institute and calculate the energy consumption and utilization of the identified place.
LO2: Design a dashboard for real-time monitoring of electricity consumption and utilization of the identified place using node MCU.
LO3: Connect appropriate sensors with all resources to be monitored and communicate the real-time data to the central server.
LO4: Calculate the wastage due to poor utilization of the resources and prepare the wastage report for the identified place.
LO5: Prepare a plan and schedule for preventing wastages based on the real-time data monitored.
LO6: Prepare an ROI report for the energy saved.

Course Hours and Mode of Delivery:

Online Theory No. of Hours	Online Practical/Hands-on No. of Hours	On Campus Theory No. of Hours	On Campus Practical No. of Hours
15	30	8	8

Student Assessment 1:

Students will have to identify a place with electrical utilities, select sensors, electric power or other industrial parameters, incorporate them in the electrical utilities, send sensor data to the cloud server through node MCU, and create a dashboard to visualize the real-time data received from sensors.

Student Assessment 2:

Students will have to measure the energy consumed by various electrical utilities for the identified place in terms of money spent, prepare a waste reduction plan for reducing energy wastage based on the data received, and implement energy-saving measures. Prepare an ROI report based on the waste reduced.

Part - 2: Course Curriculum

Unit 1: **3T+6P**

Introduction to Industry 4.0, Digital Transformation & Smart Manufacturing, and Building Blocks of Industry 4.0

Theory component:

Overview of Industry 4.0 and Evolution in Various Industries - Opportunities for Digital Transformation - Traditional Vs Smart Manufacturing - Key Concepts and Drivers for Digital transformation - Industrial Revolutions (1.0 to 4.0) - Additive Manufacturing - Augmented Reality/Virtual Reality - Autonomous Robots - Big Data and Analytics - The Cloud - Horizontal and Vertical System Integration - The Industrial Internet of Things (IIoT) - Digital Twin - Cybersecurity

Practical component:

Identify various wastes enterprise level in manufacturing organizations and make the list of it and analyze the source of it and list its root causes.

Unit 2: **3T+6P**

Opportunities in Industry 4.0, Transformation & Change Management and Key Uses of Smart Manufactu ring

Theory component:

Risk of Data security - IT Infrastructure - Legacy machines - Operational Excellence - Competitive Edge - Increased Work Safety - Flexible Production - Customer Satisfaction - Transforming Customer Experience, Operational Processes, and Business models - Change Management and its Theories - Vision and Strategies - Role of Leadership in Digital Transformation - Adoption Issues and Implementation Challenges - AR for Maintenance and Training - Predictive Maintenance - Virtual Training - Cobots in Manufacturing - Real-Time Dashboards and Alerts

Practical component:

Propose a solution to eliminate each waste with industry 4.0 technologies learned and do process mapping.

Unit 3: **3T+6P**

Implementing Industry 4.0 for Smart Manufacturing, Introduction to Smart Factories, Its Use Cases and Examples

Theory component:

Typical Industrial Set-up - Implementing Industry 4.0 - Industry Wise Pain Points and Challenges - Key Performance Indicators in Industries - Connected Manufacturing Solutions: Use Cases and Examples - Connected Supply Chain: Use Cases and Examples - Manufacturing Analytics: Concepts, Examples and Use Cases

Practical component:

1. Creation of Key Performance Indicator (KPI) Dashboard for an Automotive Manufacturing company.
2. Understand the key KPIs and their calculations.
3. Perform Vertical Integration.
4. Perform conditional monitoring of process and quality parameters.
5. Create a working KPI dashboard based on production data.
6. Create a manufacturing dashboard using Industrial IoT tools.

Unit 4: **3T+6P**

Impact of Industry 4.0 on Environment & Sustainability and Overview of Digital Twins

Theory component:

Environmental Management in Industry 4.0 - Technologies for Environmental Management - Challenges in Implementing Industry 4.0 for Environment and Sustainability - Introduction to Digital Twins and Their Functions - Role of Digital Twins in Smart Manufacturing - Digital Twins Built on IoT Platform - Implementation of Digital Twins - Applications of Digital Twins in Automotive Industry - Future Trends

Practical component:

Hands-on project demo using IOT platform that mimics the real world scenario.

Unit 5: **3T+6P**

Smart Machines and Digital Industry Transformation

Theory component: Introduction to Smart Machines - Evolution of Smart Machines - Building Blocks of Smart Machines - Sensors and Signal Processing - Controllers in Smart Machines - Smart Machines and Future Technology - Product Life Cycle Management - Material Requirement Planning - Manufacturing Process Management - Manufacturing Execution System - Enterprise Resource Planning

Practical component:

1. ROI case study
2. Prepare an ROI report based on the Cost of Technology

Mandatory Project Work:

Mentioned in Addendum - 1

Detailed Unit Wise plan:

Mentioned in Addendum - 2

List of Software Students are exposed to

1. Micro Python programming
2. Things board
3. Wokwi
4. Google Sheets

Duration of availability of Licenced Software to Students

The software that we use is open source hence it is available anytime

List of Hardware Students are exposed to

1. ESP 32 (Virtually simulated)
2. HCSR-04 (virtually simulated)

List of consumables that will be given per student

1. LMS access is given to all the students
2. All pre-recorded lecture videos will be given to the student

Part - 3:

Student Assessment Plan

- Every unit is delivered over a couple of weeks and every week has assessments attached to it. (Addendum - 2)
- The Assessments are a combination of Self-graded and Manually graded questions.
- Both Skill-Lync and college faculties will be involved in grading the assessments. (Addendum 1 and 2)

Mid-term/Unit Assessment 1:
Shared in Addendum - 2

Mid-term/Unit Assessment 2:
Shared in Addendum - 2

End/Exit Assessment:

Shared in Addendum - 1

Student Assessment 1:
Students will have to identify a place with electrical utilities, select sensors, electric power or other industrial parameters, incorporate them in the electrical utilities, send sensor data to the cloud server through node MCU, and create a dashboard to visualize the real-time data received from sensors.

Student Assessment 2:
Students will have to measure the energy consumed by various electrical utilities for the identified place in terms of money spent, prepare a waste reduction plan for reducing energy wastage based on the data received, and implement energy-saving measures. Prepare an ROI report based on the waste reduced.

Addendum - 1: Project works for Industry 4.0

Mandatory Project works:

Project 1

Project Title: Use of I4.0 for operational improvements

Project description: The project aims to study the impact of implementing Industry 4.0 technologies to eliminate each potential waste identified by the manufacturing organization

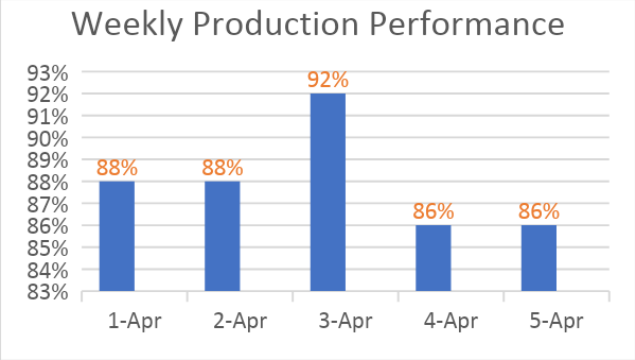
Project Outcomes: The students are able to Identify 7 wastes in manufacturing and propose IOT technologies for data collection and analysis to prioritize to eliminate potential causes.

Software Used: Microsoft Excel

Project Deliverables:

1. A Detailed list of seven wastes in manufacturing
2. A detailed description of each waste with diagram
3. List of technologies re-searched per waste along with a minimum of one case study
4. List of vendors who provide the technology solution
5. Vendor comparison report
6. ROI report based on the cost of technology and the waste in manufacturing

Project solution dashboard



Project 2

Project Title: A project on creating a Key Performance Indicator (KPI) dashboard for an Automotive Manufacturing Company

Project description: The project aims to analyze the key performance indicator of the manufacturing processes and propose the solution to improve the same and cost involved in it and also prepare ROI report.

Project Outcomes: The students can measure the objectives of the manufacturing processes and plot the KPI performance of the organization.

Software Used: Microsoft Excel

Project Deliverables:

1. Calculating key KPIs
2. Performing Vertical Integration
3. Condition monitoring of process and quality parameters
4. Creating a working KPI dashboard on MS Excel with production data

Project Solution Template:

Project 3

Project Title: A project on creating real-time process monitoring of temperature and humidity manufacturing industry using an Open source IoT platform.

Project description: The project aims to monitor real-time temperature and humidity monitoring dashboards using the Thingsboard IoT platform.

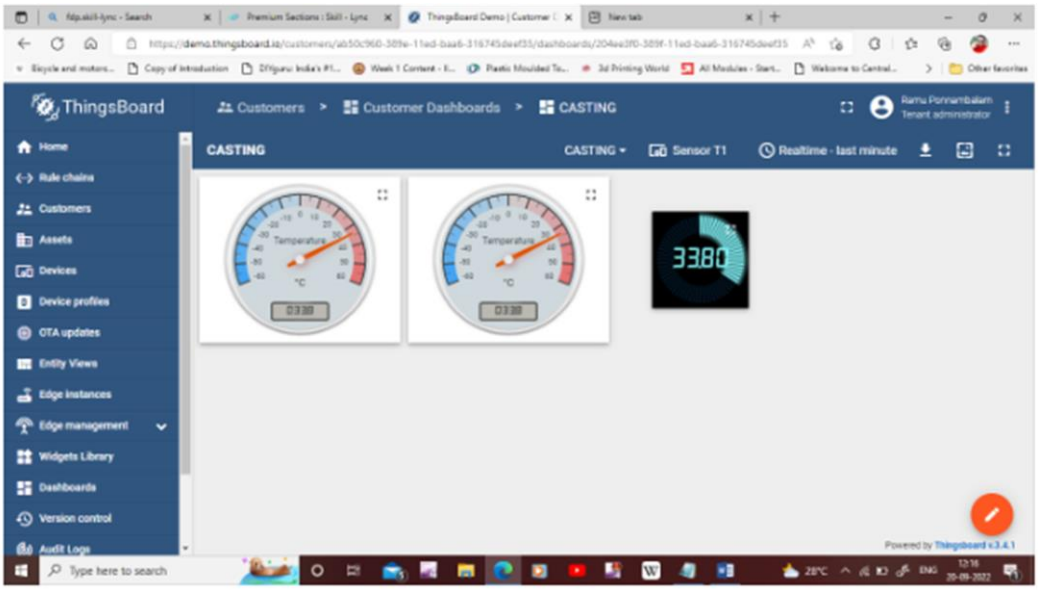
Project Outcomes: The students can able to the identification of the right devices like sensors and use connect them with the things board MQTT platform for real-time monitoring of the manufacturing processes

Software used: Thingsboard

Project Deliverables:

1. Analyze different IoT protocols and things board open source platform
2. Selection of sensors and configure the same
3. Create the dashboard
4. Real-time monitoring of the manufacturing process with data.

Project Solution Template:



Project 4

Project Title: Use of Industry 4.0 for Monitoring Vehicle Fuel level from a central fleet management group

Project description: The project aims to real-time monitoring of the Vehicle fuel level dashboard using open source ***WOKWI*** IoT platform.

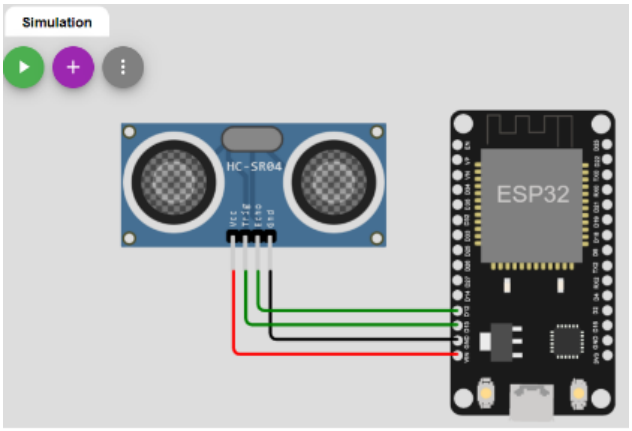
Project Outcomes: The basic principle involved in level monitoring using ultrasonic sensor Interfacing sensors to NodeMCU (ESP32) hardware. The need for MQTT publishing services and the overall implementation with python programming

Software Used: WOKWI

Project Deliverables:

1. Enable connection and configuration of ESP32 (NodeMCU) board
2. Real-time fuel level monitoring with one case study
3. Simulation and verification with a reference value.

Project Solution Template



Python Program Example

```
from hcsr04 import HCSR04

from machine import Pin, I2C

import network

import time

from machine import Pin

import dht

import ujson

from umqtt.simple import MQTTClient

# MQTT Server Parameters

MQTT_CLIENT_ID = &amp;quot; Measurement of Object Distance&amp;quot;
```

Addendum - 2: Unit Content with Assessments, Challenges, Midterms, and Exit Assessments:

apping of Outcomes with Assessments:

Unit - 1:

Week #	Day#	Title	Table of Contents	Video Title to Watch	Video Duration	Unit Assessment	Outcome
1	Day 1	Overview of Industry 4.0	Introduction to Industry 4.0 and Evolution in Various Industries	Introduction to Industry 4.0 - Part 1	0:20:00	1. Search for 5 companies, that implemented smart manufacturing in their manufacturing plant, collect the below details 2. What benefits did these companies achieve? 3. Why smart manufacturing is a future? 4. Why MSME fails to adopt disruptive change early?	1. Practical knowledge about the companies that have implemented smart manufacturing. 2. Analyze the advantages and disadvantages of digital transformation 3. The literature on smart manufacturing will give the students a better idea about how it is better than traditional manufacturing and smart manufacturing 4. Deals with disruption and how its resistance can prove to be costly for the company.
	Day 2			Introduction to Industry 4.0 - Part 1	0:20:00		
	Day 3			Evolution in Various Industries	0:20:00		
2	Day 4	Introduction to Digital Transformation & Smart Manufacturing	Explore how disruption happens Finding new opportunities for digital transformation Traditional Vs Smart Manufacturing Key concepts of digital transformation Drivers for Digital transformation	New Opportunities in Digital Transformation	0:14:31	1. List the 5 vendors available for each industry 4.0 block in the market. (Compare each technology solution across 5 vendors, Comparison should have features, cost, and scalability details, What challenges these vendors are facing to convince customers) 2. Explain development tools and resources to be used to develop each building block of industry 4.0. details required as below for each. (List of software tools, List of hardware, List of cloud technologies, Network technologies (physical or Virtual network)) 3. Research & explain one case study for each building block of Industry 4.0, each case study should contain the below details (Company name, Problem identified, Results achieved in numbers (%, etc))	1. Practical industrial knowledge about the Technologies and their current market rates. 2. Reiteration of the I4.0 technologies and detailed information regarding the implementations and requirements of each. 3. Available case studies will give a more detailed picture of the Industry 4.0 technologies and the relevant problems solved, providing an objective-oriented idea to the students.
	Day 5			Traditional Vs Smart Manufacturing	0:21:41		
	Day 6			Key Concepts of Digital Transformation	0:27:08		
	Day 7			Drivers for Digital Transformation	0:13:19		
3	Day 8	Building Blocks for Industry 4.0	Industrial Revolutions (1.0 to 4.0) Additive Manufacturing Augmented Reality/Virtual Reality Autonomous Robots Big Data and	Industrial Revolutions (1.0 to 4.0) and Additive Manufacturing	0:18:59	1. Draw an architecture diagram for the below requirement "A company would like to connect their manufacturing line in IIoT on the cloud, they have 3 lines, manufacturing line is having conveyor with product followed through two heating oven after finishing, the company wants to monitor the temp of oven and control oven if temp. Exceed 150C, and also alert users with data if any deviation, also they would like to monitor run time and downtime of line, products are moving on the conveyor, please propose a proper gateway, along with sensors with make and model. Also cloud platform.	1. The student will learn the It infrastructure in the syllabus and through the architecture diagram he/she will get a chance to create the same and in that process will analyze IT infrastructure and will apply the technical concepts in this assignment. 2. The student will learn, In the unlikely event of hacking in the company, How an efficient IT infrastructure can survive. The practical situation will provide a much better idea regarding this to the student. 3. The Covid 19 being a volatile
	Day 9			Augmented Reality/Virtual Reality and Autonomous Robots	0:29:00		

	Day 10		Analytics The Cloud Horizontal and Vertical System Integration The Industrial Internet of Things Digital Twin Cybersecurity	Big Data Analytics, the Cloud, and Horizontal & Vertical System Integration	0:22:36	Draw complete architecture with sensors, gateways & communication protocol, and a simple user dashboard. 2. Refer to General Data Protection Regulation (GDPR). Which type of data is vulnerable and why? Also, explain how you will act on the below Incident. A hacker hacks the company's IT infra network via a Phishing email, on this phishing email, one of the employees clicked and opened the door for the hacker. Now your IIoT network is in the same VLAN as the IT network, so you have 24 hours till a hacker breaches the IIoT network. Please list your actions and why you will take those actions during this cyber attack. 3. In this Covid pandemic to ensure social distancing in offices and on the shop floor, please recommend technologies with explanations and along with case studies.	the situation demands flexibility and quick thinking and disruptive technologies to be implemented. This Challenge will provide the students with such an opportunity to explore unconventional ideas.
	Day 11			Industrial IoT, Digital Twin, Cybersecurity	0:12:52		

Unit - 2:

Week #	Day#	Title	Table of Contents	Video Title to Watch	Video	Unit Assessment	Outcomes:
4	Day 12	Challenges & Opportunities in Industry 4.0	A Gap in Technical Skills Risk of Data security IT Infrastructure Legacy machines Change management Operational excellence Competisales edge Increased work safety Flexible production Customer satisfaction	IT Infrastructure, Data Security and Legacy Machines	0:27:06	1. One of the 2-wheeler manufacturing companies would like to transform the customer experience to increase their sales. They are looking for a solution so that customers can experience This 2-wheeler before they buy it, and also after selling they would like to ensure and update their customers about any upcoming part failure or low performance. Please recommend a solution with technology, it should include a detailed analysis of which sensors, and which technology you are proposing. One of the companies has a manufacturing plant of 120 machines, presently they are entering machine stoppages in regular paper log books per machine, which include total downtime, with the reason for downtime, here downtime refers to when the machine stops. And after the shift end supervisor collects all these data and summarizes them in one master paper log book. Then later this data is being entered by a data entry operator in excel. And then later production manager does analysis in excel. This whole process takes 1-2 days. This means the report is available after 2 days of production, which does not make sense to take action in a real-time shift and also much paperwork. Please recommend digitization solutions to reduce these days, and to act in real-time	1. The preventive maintenance and condition monitoring in the syllabus are kept in mind while designing this challenge. This challenge demands students to think and come up with a practical idea to solve a relevant industrial problem. The need for digital transformation and how it transforms the operational processes. The roadmap for the digital journey can be visualized through this challenge and could be analyzed with a practical example.
	Day 13			Operational Excellence, Flexible Production and Customer Satisfaction	0:22:43		

						in shifts to take action. Please draw architecture, and also screen dashboard if any.	
5	Day 14	Transformation & Change Management, Adoption issues and implementation challenges	Transforming Customer Experience Transforming operational processes Transforming business models Change management Key theories of change management Vision & strategies Role of leadership in digital transformation Adoption issues and implementation challenges Understanding your organization's readiness for digital transformation Roadmap to make the digital journey successful and sustaining it	Transforming Customer Experience, Operational Processes and Business Models	0:16:34	1, One of the companies is in urgent need of an operator skill set, they have recruited 70 operators, but the company cannot afford 1 month training lead time because they have got huge volume customer order to deliver and they need to deploy this new manpower in shopfloor in 1 week, please recommend technology solution to make this possible along with how this solution will work, Explain 3 case studies for the recommended solution. 2. In nuclear power its health safety is Hazardous to go inside the reaction chambers for inspection, company is looking for a digital solution to overcome this problem without entering the chamber. Please recommend a solution and also explain how it will work. Also, Explain 3 case studies for the recommended solution. 3. In one of the bottle-making machines, product inspection is done by sampling 10 bottles out of 1000 Bottles. Recently customer complaints have piled up and the company is looking to ensure 100% online inspection on the conveyor itself defective parts should be pushed into the rejection container, which means inspecting every bottle which is produced. But it cannot be done by a human being because the conveyor speed is 2 bottles/second. Please recommend a solution and also explain how it will work. Also, Explain 3 case studies for the recommended solution.	1. The topics like AR and VR in the syllabus are included in the challenge and the students are provided with a practical challenge in which they will visualize the need for these technologies and the case studies will give them a clear picture of the real industry problems. 2. This challenge makes the students aware of the Cobots and their importance in manufacturing. Also, AR is important in the training and inspection. 3. The topics such as cobots and IIOT real-time dashboards are aligned with this specific challenge.
	Day 15			Change Management and Its theories	0:17:57		
	Day 16			Strategies, and Role of Leadership in Digital Transformation	0:17:49		
	Day 17			Implementation Challenges, Organization Readiness, and Roadmap	0:20:04		
6	Day 18	Key Uses of Smart Manufacturing	AR for maintenance and training Predictive maintenance Virtual Training Cobots in manufacturing IIoT – Real Time dashboards and alerts Digital Twin	Predictive maintenance, AR, and, Virtual Training	0:18:15	Create a working KPI dashboard on MS Excel with the production data of any industry of choice. The dashboard should show all the analyses required by the manufacturing engineer to arrive at a logical conclusion. Take industrial case studies for the production data.	The KPIs in the industry and the IIOT dashboard which indicate this will be clearly understood by the students with practical case studies.
	Day 19			Cobots in Manufacturing, IoT Dashboards, and Digital Twin	0:30:09		

Unit - 3:

Week #	Day#	Title	Table of Contents	Video Title to	Video Duration	Unit Assessment	Outcomes
7	Day 20	Implementing Industry 4.0 for Smart Manufacturing	Typical Industrial set-up Implementing Industry 4.0 Industry wise pain points and challenges Key Performance Indicators in Industries	Industry Setup and Industry 4.0 Implementation	0:20:00	Download 3 case studies and prepare a detailed study report by comparing them. The report should show different technologies adopted by the different industries and their significance. The industries can be compared with OEE and a logical conclusion can be reached.	The case studies in this week's topics will give the student a clear idea about the connected manufacturing in the syllabus.
	Day 21				0:20:00		
	Day 22				0:20:00		
	Day 23				0:30:00		
8	Day 24	Smart Factories Usecases and Examples	Connected Manufacturing solutions: Use cases & Examples (5) Connected Supply chain: Use cases & Examples (2) Manufacturing Analytics: Concepts, examples & Use cases (3)	Manufacturing Solutions, Supply chain and Analytics	0:30:00	1. Download 3 relevant case studies on predictive maintenance. 2. Compare the average life cycle of the product and assess how the predictive maintenance has affected this life cycle.	The challenges are aligned with the concept of digital twins and how it helps in the predictive maintenance of the product.
	Day 25				0:30:00		
	Day 26				0:30:00		
	Day 27				0:30:00		
	Day 28				0:30:00		
	Day 29				0:30:00		

Unit - 4:

Week #	Day#	Title	Table of Contents	Video Title to Watch	Video Duration	Unit Assessment	Outcomes
9	Day 30	Industry 4.0 Impact on Environment and Sustainability	Environmental Management in Industry 4.0 Technologies for Environmental Management with I4.0 Challenges in implementing I4.0 for Environment & Sustainability	Environmental Management and Challenges in its Implementation	0:30:00	1. List the 7 wastes in Manufacturing 2. Recommend Industry 4.0 technologies to reduce/eliminate these 7 wastes (one technology for one type of waste) 3. Market research for the cost of technology and who can provide it within India 4. Prepare a report with ROI for each waste. For ROI estimation considers company XYZ losing 10 lakh/year on each type of waste (**Key Highlights (5 pointers)** Introduction to 7 wastes Market research for technologies ROI report preparation **Deliverables** A complete report with ROI details)	The core industry 4.0 components in the syllabus are being identified as the practical solutions for the 7 wastes in manufacturing. The students also learn about the 7 wastes in manufacturing which has been a relevant problem in the manufacturing industry for a very long time. The market research will give them better ideas of Indian companies that have implemented I4.0 technologies. The ROI calculation is directly related to the syllabus and it will give the analytical concept of I4.0 technologies to the students.
10	Day 31	Digital Twin	What is Digital Twin and How do they work? Role of Digital Twin in Smart Manufacturing	Introduction to Digital Twin, Digital Twins on IoT, and its Role in Smart Maufacturing	0:35:00		

	Day 32		Digital Twins Built on IoT Platform Digital Twins Platforms Digital Twins Implementation Digital Twins and Automotive Industry Future Trends	Implementation of Digital Twins, Digital Twins Platforms and Future Trends	0:35:00		

Unit - 5:

Week	Day#	Title	Table of Contents	Video Title to Watch	Video Duration	Unit Assesment	Outcomes
11	Day 33	Smart Machine	Introduction to Smart Machine Evolution of Smart Machine Building Blocks of Smart Machine Sensors and Signal Processing Controllers in smart Machines Smart Machine and Future Technology	Introduction and Evolution of Smart Machines	0:35:00	A project on creating Key Performance Indicator (KPI) dashboard for an Automotive Manufacturing company (Part of Industry 4.0 implementation KPI Dashboard is essential part of Industry 4.0 characteristic: Vertical Integration Different KPIs and Parameters that are essential in factories Calculation of KPIs and monitoring of parameters with sample production data KPIs from various functions – production, maintenance, quality & safety Use of MS Excel and IoT tools to prepare dashboards)	The syllabus topics such as KPI and IIOT are directly aligned with this project. The live dashboard creation from the live sensor data will allow students to replicate industry dashboards and will give them the necessary exposure to the KPIs and their various functions.
	Day 35			Controllers in Smart Machines and Future Technology	0:35:00		
12	Day 35	Digital Industry Transformation.	Product Life Cycle Management Material Requirement Planningonufacturing Process Management Manufacturing Execution System Enterprise Resource Planning	Product Life Cycle Management and Material Requirement Planning	0:35:00		
	Day 36			Manufacturing Process Management and Enterprise Resource Planning	0:35:00		

SB8012 POWERING IOT USING ARDUINO/ RASPBERRY PI L T P C
1 0 2 2

Mandatory Components required in the Proposal

In response to the EOI we hereby intend to submit a proposal for onboarding us as a training partner of TNSDC under the Naan Mudhalvan program

Course Title: POWERING IOT USING ARDUINO/ RASPBERRY PI L T P C
1 0 2 2

Course Description: The Internet of Things is transforming our physical world into a Technology reliant and dynamic system of Connected devices on an unprecedent scale. The Internet of Things (IoT) is now omni present. Its significantly assists in collection of data, network and analyze such information received to provide real time information for societal benefits The course will focus on important IoT topics, which includes industrial standards, sensor/actuator/data devices, hardware, software, security, system design and performance analysis techniques.

Course Objectives: To impart the fundamental knowledge about Hardware and Software platforms for design and development IOT application

- Hardware: Prototyping board block diagram, microcontroller programming basics, simple sensors, sensor interfacing with prototyping board and, data acquisition and sensor calibration
- Software: Cloud platform for IOT development, IOT protocols, Embedded system Programming tool, Dashboard design for IOT webpage
  - To educate the students about a simple IOT application and verify its real-time performance by integrating the hardware and software components with LIVE results and interactive GUI.
  - To enable the students to design an IOT based monitoring & control system using a prototyping board, temperature sensor, LED, Buzzer, Stepper Motor, Embedded C / Python based code development, opensource IOT cloud-based dashboard design.
  - To enhance the skill of the students by giving them challenging projects and by providing them guidance through interactive LMS platform.

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

1. Apply effectively the various enabling technologies like Embedded Systems including Embedded C for design of End device using ESP32 and network infrastructure protocols.
2. End design using Micro python and RPi PICO as well as Edge node design using Single Board Computer like Raspberry Pi and its integration with IoT infrastructure.
3. Select and design suitable communication technologies like WPAN, WLAN, LPWAN to meet the requirements of End and Edge node connectivity.
4. Apply various IoT Specific application protocols like CoAP, MQTT and Web Sockets to satisfy the constraint nature of nodes and various resources in IoT System
5. Integration of Edge and Cloud computing infrastructure with IoT End devices and deployment of closed loop IoT system from Sensing to Reacting (Actuation).
6. Design and build IoT system for a few interesting Use cases like Smart Water , Smart Energy, Smart waste management in the context of Smart City.

Various potential use cases(UC):

UC1 – Smart Farming: The student can develop the smart farming system, they can develop the automation systems in the farming processes. They will be able to develop, monitor, and control the processes of farming using the Internet of things, they can handle the use cases like smart irrigation systems, drone fertilization, and agricultural robots and monitor the soil using sensors like humidity, temperature, PH level, and fertility.

UC2 – Smart Industry: Industrial automation is possible only by IoT. So students who are well versed in IoT can develop automated systems in the Tech-industries. For instance, they can create a pick-and-place robotic arm, they can develop a safety monitor system in industries, and they can either develop a machine-to-machine communication in the industry.

UC3 – Smart Health: The student can develop a health monitor system, they can monitor the patient health with the help of health care sensors like EMG sensors, ECG, a body temperature monitor, and breathing monitor sensors. They can monitor the patient using the digital twinning mechanism that is created using the sensors incorporated system for the human body. There by jobs in Healthcare Segment.

UC4 - Smart City: The student can develop the use cases of a smart city like traffic monitor systems, garbage collectors, and monitor systems and can either create a simulation of the auto-driven vehicle using IoT simulators.

UC5 – Smart Home: The student will be able to form a network of household appliances. They can develop a home automation system where the household appliances can communicate with each other using wireless communication like Wi-Fi or Bluetooth. They can automate the garage door, smart fridge, smart AC, smart washing machine, and a voice control echo system. They will be able to identify the suitable IoT protocol for each use case.

Prerequisites: Basic Knowledge in Analog and Digital Electronics, C and Python Programming (Entry-level) *For those , not meeting the pre-requisite, a six hours bridge course will be conducted*

Course Hours and Mode of Delivery:

The Total course is for 45 hours in **Hybrid Format**

15 hours : Virtual Instructor Led Training

15 hours Virtual Labs based practical training

15 Hours of In person training using Arduino (ESP32) / Raspberry pi devices.

Course Deliver Plan:

SNo	Sessions	Mode of Delivery	Resources required
1	S1, S2,S3,S4,S8, S9,S10,S12,S14,S16, S20,S25,S28,S29,S30	Hybrid (15 Sessions)	Any One Hybrid Training Platform and a laptop installed with Arduino IDE , Cisco Packet Tracer and one set of hardware resources
2	S5,S6,S7,S11,S13 S15,S18,S19	In Person (8 Sessions	ESP 32 HW Kits
3	S17	In person (1 Session)	RPi PICO HW Kits
4	S21, S22, S23	In Person (3 Sessions)	RPi HW Kit with Accessories
5	S24, S26	In Person (2 Sessions)	ESP32 and RPi HW Kits
6	S27	Hybrid Mode (1 Sessions)	Cisco Packet Tracer

Training Standards:

Global Standards/Industry Standards: This curated course in of International Standard

Accreditation Authority: The course is certified by SkillsDA and Nasscom Future Skills

NOS Alignment: This is course is aligned to NOS/SSC N 8113; SSC/N 8120; SSC N 8210; SSC N 8213

Is Course design supported/endorsed by Industry players: Yes

If so Pls list the industries: defense, Healthcare, Automation, Drone

Course Curriculum

Powering Internet of Things using Arduino and Raspberry Pi

Session No	Topics	Theory / Practical	Course Outcome	Resources required
S-1	Introduction to Industrial Internet of Things	Theory	CO1	Hybrid mode training platform
S-2	Enabling Technologies of IoT - a detailed view	Theory	CO1	Hybrid mode training platform
S-3	Wireless Sensor Networks – Role of BLE Mesh and Wi-Fi Mesh in IoT	Theory and Demos	CO3	Hybrid mode training platform

S-4	Role of Cellular LPWAN (NB-IoT) and Non-Cellular LPWAN (LoRa, LoRaWAN) in IoT	Theory and Demos	CO3	Hybrid mode training platform
S-5	Embedded System design using MCU – ESP32- Usage of GPIO , Analogue Sensors and UART – Arduino Platform	Practical	CO1	ESP32 based IoT HW kit
S-6	Design of IoT End node using MCU – ESP32 and Arduino Platform	Practical	CO1	ESP32 based IoT HW kit
S-7	Integration of IoT End Node (ESP32 based) with ThingSpeak Cloud and deployment of closed loop end-to-end IoT application	Practical	CO5	ESP32 based IoT HW kit
S-8	Things in IoT and Identification (AIOTI) and Industrial IoT Reference Architecture	Theory	CO1	Hybrid training platform
S-9	IoT Enabling Technologies – Infrastructure, IP Addressing, Network Protocols	Theory and demos	CO1	Hybrid training platform
S-10	IoT Enabling Technologies - Data Connectivity Protocols - MQTT	Theory and demos	CO4	Hybrid training platform
S-11	Implementation of MQTT protocol using ESP32 as MQTT Client and Free on line MQTT broker	Practical	CO4	ESP32 HW Kit
S-12	IoT Enabling Technologies - Data Connectivity Protocols - CoAP	Theory and demos	CO4	Hybrid training platform
S-13	Implementation of CoAP protocol using ESP32 as CoAP Client and Server	Practical	CO4	ESP32 HW Kit
S-14	IoT Enabling Technologies - Data Connectivity Protocols - WebSockets	Theory and demos	CO4	Hybrid training platform
S-15	Implementation of WebSockets using ESP32 as WebSocket Server and browser extension as a WebSocket Client	Practical	CO4	ESP32 HW Kit
S-16	Introduction to RPi PICO – An ARM Cortex M series MCU based device as an IoT End Node	Theory and demos	CO2	Hybrid training platform

S-17	GPIO and Analogue Sensor Interface to RPi PICO using Arduino platform	Practical	CO2	RPi PICO HW Kit
S-18	Introduction to MicroPython and Embedded Application using MicroPython	Practical	CO2	ESP32 / RPi PICO Kits
S-19	IoT End Node design with ESP32 / RPi PICO and MicroPython for any one Industrial / Smart City Use case	Practical	CO1, CO2	ESP32 / RPi PICO Kits
S-20	Raspberry Pi – HW and Software Platform- Recap and detailed discussion towards application of RPi as End / Edge Device	Theory and Demo	CO2	Hybrid Training Platform
S-21	Interfacing of Analogue sensors to RPi using External ADC like MCP3008 and accumulation and display of sensor values in local web server	Practical	CO2	RPi HW Kits
S-22	Introduction to IFTTT and application of IFTTT Services for IoT Applications	Practical	CO4	ESP32 / RPi HW Kits
S-23	Video streaming and face recognition using ESP32 CAM / RPi with CAM	Practical	CO5	ESP32 / RPi Kits with CAM
S-24	Integration of ESP32 as End Device with RPi as Edge Computing Device integrated with Public Cloud - IIoT Real-time Use Case.	Practical	CO5	ESP32 plus RPi HW Kits / Cisco IoT Packet Tracer
S-25	Introduction to Node Red and Design of IoT workflow using Node Red Dash Board.	Theory and Demo	CO5	Hybrid training Platform
S-26	IoT Application using Raspberry Pi as Edge device with Node RED and MQTT Broker, NodeMCU / ESP32 as a End Device	Practical	CO5	ESP32 plus RPi HW Kits / Cisco IoT Packet Tracer
S-27	IoT based Smart Home Simulation using Cisco Packet Tracer	Practical	CO6	Hybrid training Platform and Cisco Packet tracer

S-28	IoT Data Analytics and Visualization - Implementation with IIoT and Industrial Real Time use Cases.	Demo	CO6	Hybrid training Platform
S-29	IIoT - Design and Deployment - Smart Energy Management System / Smart Water Management System integrated with Smart Cities of India - GIFT-City Model.	Demo	CO6	Hybrid training Platform
S-30	IoT use cases – Discussions and Conclusion	Theory and Demo	CO6	Hybrid training Platform

SNo	**Course Outcome**	**No of Theory and Demo Sessions**	**No of Practical Sessions**
1	**CO1**	**4**	**2**
2	**CO2**	**2**	**4**
3	**CO3**	**2**	**(integrated with 6 practical sessions related with end and edge nodes and cloud)**
4	**CO4**	**3**	**4**
5	**CO5**	**1**	**4**
6	**CO6**	**3**	**1**
Total		**15 (each 1 hour)**	**15 (each 2 hours)**

Mandatory Project work

One capstone project needs to be completed by students who will be grouped into a team of 3 members. Team has to get approval for the theme and concept before proceeding to carry out the project. Each team will be guided and mentored by experts

Students will be trained to align with job roles and industry requirements and it will be an a comprehensive hands on project work.

STUDENTS CAN CHOOSE ANY ONE USE CASE IN THE LIST AND BASED ON THE SELECTED USE CASE, THEY CAN DESIGN, BUILD AND DEPLOY CAPSTONEPROJECT WHICH COVERS ALL THE SIX COURSE OUTCOMES.

List of Software Students are exposed to

- **Tinker CAD**
- **Cisco Packet Tracer**
- **Postman**
- **Thingspeak**
- **Adafruit**
- **Ifft**

Duration of availability of Licensed Software to Students

- Will be available to the students for the full year

List of Hardware Students are exposed to

- **Esp 32**
- **Arduino Uno**
- **Raspberry pi**
- **Dht11, Potentiometer, LED**

List of consumables that will be given to per student

- **Workbooks**
- **Tutorials via LMS**
- **Assessment sheets**
- **Pen**

Student Assessment Plan :

MCQs on immersive learning on the Internet of Things, Embedded programming, Wireless Sensor Networks, LPWAN, Various Enabling Techniques, IoT Analytics, IoT End and Edge Node design. Edge and Cloud Computing, various use cases.

• Lab Assessments - Group Activities

- Working knowledge in IOT components and devices

• CAPSTONE Project to be carried out by the group and a Panel of Industry people will evaluate and review Project demonstrations.

S No	Nature of Assessment	No. of Assessments and plan	Rubrics	Marks allotted
1	Continuous Assessment Theory (CAT) Mid term 1,2 and 3rd before evaluation	3 MCQs - each 10 marks MCQ 1 – CO1 and CO2 MCQ2 – CO3 and C04 MCQ – CO5 and CO6	For each test there will be 20 MCQs – 30 Minutes duration – Total will be converted to 10 marks. (Correct answers will carry 1 marks, wrong answers will carry negative marks - 0.25 marks).	30
2	Continuous Assessment Lab (CAL)	5 Lab Assessments – Each10 Marks	Out of 10 marks – hardware design – 3 marks, Software design - 3 Marks , integration and testing – 2 marks demonstrating the output – 2 marks	50
CAL1	Lab Assessment 1 End node design using ESP 32 with appropriate sensors (**PIR senor, IR sensor, Ultrasonic sensor etc**., and actuators (Hardware :**Relay 5v ; 8 channel**. ESP32, IDE: Arduino, Embedded C Program using Arduino based programming constructs, WPAN-BLE and WLAN-Wi-Fi) [5] [CO1, CO3]			
CAL2	Lab Assessment 2: Design and Implementation of IoT Specific application protocols like MQTT / CoAP/ Websockets using ESP 32 as MCU for any one interesting IoT application(**Using stepper motor, MP3008 ADC module, Analog Senors**) [5] [CO4]			
CAL3	Lab Assessment 3: End node design using RPi PICO with appropriate sensors and actuators (Hardware : RPi PICO, IDE: Thonny Python Editor/ Arduino IDE, Embedded C Program using Arduino based programming constructs or Micro Python using Thonny Python Editor, WLAN-Wi-Fi) [5] [CO2, CO3]			
CAL4	Lab Assessment 4: Integration of End node using ESP 32 / RPi PICO with public cloud like FireBase, ThingSpeak or Ubidots ,(**using LoRa WAN)** data acquisition and IoT analytics using the data **controlling the appliances through the cloud based on the data acquired**. [CO5]			
CAL5	Lab Assessment 5: Design and deployment of IoT Application using ESP32 as a End Device and Raspberry Pi as Edge device with MQTT Broker and Node RED for data connectivity and Visualization. [COVERING ALL COS]			

3	Capstone project	One capstone project. maximum 3 students per team. Team has to get approval for the theme and concept before proceeding to carry out the project	Design- 3 Marks, Implementation – 4 Marks- Demo – 3 Marks, Presentation – 5 Marks, Viva – 5 Marks	20
	Total			**100**

Mid term /Unit Assessment 1

Assessment by way of Knowledge Check for every module .

Mid term /Unit Assessment 2

Assessment by way of practical test to check if the student can demonstrate the concepts learned.

Assessment 3 before Evaluation/Final Exam

Combination of 1st and 2nd assessment topics and preparation for final evaluation

Student Support Systems

If students are not following the course/not submitting assignments : *A special session will be conducted in weekends in hybrid method to discuss with the students and motivate them to complete assignments .*

If students fail in the assessment : *The reason for the failure will be assessed and correction will be done based on the out put and they will be provided another opportunity to get thro' the assessment.*

Doubts clearing platform: *This will be done every weekend till the completion of the course , assessment and final exam*.

Excellently performing students may be groomed further by giving enhanced training on higher level skillsets. The students may be given greater real-world challenges (typical industry scenario) and given star ratings based on their performance.

SB8013 AUGMENTED REALITY & VIRTUAL REALITY DEVELOPMENT L T P C

1 0 2 2

In response to the the Expression of Interest (EoI) invitation by Tamil Nadu Skill Development Corporation , the receipt of which is hereby duly acknowledged, we, the undersigned intend to submit the following proposal in response to the EoI for selection of Skill Training provider for Naan Mudhalvan Program of Government of TamilNadu

Course Topic: Augmented Reality & Virtual Reality Development

Target Group	**Engineering students –5th Semester (CSC, IT, EEE, ECE)**		
Subject	AR VR Development specific to CS, IT, EEE, ECE	**Total duration of the training in Hours**	45 hours (2 credits)
Theory Class Training in Hrs	15 hours (1 credit)	**Practical class Training in Hrs**	30 hours (1 credit)
Theory class focus area	Basic introduction, 3D design, metaverse, NFT, Block chain, business cases, use models	**Practical class focus area**	AR VR development for CS & other departments
Total credits	2 credits	**Type of training**	Hybrid

About the training Program:

Students will learn the fundamentals of AR & VR and introduction to application development through unity and other software.

Training Objective:

1. Introduce students to the concept of AR,VR, digital twins and Metaverse
2. Familiarise students with the HW and SW used in the field of AR & VR
3. Develop an understanding of the structure and architecture involved in the AR VR & metaverse application development
4. Develop AR VR application specific to their engineering field

Unit – I Fundamentals of AR VR 3

Fundamental AR VR concepts and characteristics, Nature of virtuality, introduced to AR VR hardware and software, AR VR applications across different industries, Introduction to Metaverse, Digital twin, Web3.0, NFT, Blockchain & Crypto currencies.

Lab component: 6

- Experience VR AR MR and its production tools
- Introduction to Unity

Outcome:

- Install and configure Unity software
- Differentiate between various realities (AR, VR, MR) and use the right terminology associated to present concepts and solutions

Unit – II Interactive Media Development 3

Taxonomy of Interactive Applications - immersive nature of AR VR technology - creative storytelling - gaming industry applications - concept for game - building a prototype – Consider Graphic styles and optimisation - communication and collaboration – Digital distribution – google play – iOS Store – Mac store.

Lab component: 6

- Create your first 3D prototype of the AR/VR experience

Outcome: Create design journey documents for developing AR VR experiences

Unit – III Fundamentals for Realtime scripting (c#) **3**

Introduction to Variables, Conditions, Loops, Patterns, - Scope of variables – OOPS in Realtime environments – Setting IDE – Scripting vs Programming – Enumeration – Memory management – Program states – Handing exceptions – Device considerations – Input systems – Hardware and Haptics feedback

Lab component: 6

- Learning Realtime programming (c#)

Outcome: Development of software code (C#) to optimise for Realtime programming pattern for AR VR Experiences

Unit – IV Level Design for AR VR using Unity 3

Basic concepts of Level designing, Level mapping – Level creation techniques – Grey boxing techniques, Focus on the layout and composition – Prioritize assets based on block out – Accessing Unity asset store – importing FBX assets – Building a level for VR/AR, Level Optimization

Lab component: 6

- Level Creation using Unity

Outcome: Develop Level design within considerations of Unity Real-time rendering concepts

Unit – V Solution Design for AR VR 3

Design process – mood board – design specification document – technical project management – AR architecture & frameworks – ARKit – Arcore – Vuforia – VR architecture & frameworks – HTC – Windows Mixed reality – Oculus – XR and definition – XR over cloud – Emerging trends in AR VR MR

Lab component: 6

- Mini Project on the Selected AR or VR device

Outcome: Design, Develop & Deploy AR or VR application in devices after building design flow that reflects user experiences

Training Hours - 15 Hrs (Theory) + 30 Hrs (Practical) = 45 Hrs

Course Delivery Plan

Sl. No	Hourly Content Plan	Delivery Tools	Delivery Mode	Project/ Exercises	T/P
1	Fundamental AR VR concepts and characteristics, Nature of virtuality, Introduction to Metaverse	PowerPoint, Live Instructor Sessions	Online	Create a digital profile	T
2	Introduction to AR VR hardware and software, Hardware features, analogue, digital, haptics, and trackers systems	PowerPoint, Live Instructor Sessions	Online	Write about the haptics profile of mobile	T

3	AR VR applications across different industries, Digital twin, Web3.0, NFT, Blockchain & Crypto	PowerPoint, Live Instructor Sessions	Online	Write a report of AR VR in day-to-day usage	T
4	Installing Unity	Recorded video with instructor voice over	Online	Setup Unity IDE and other dependency	P
5	Taxonomy of Interactive Applications - immersive nature of AR VR technology	PowerPoint, Live Instructor Sessions	Online	Report on Immersion vs interactivity	T
6	creative storytelling - gaming industry applications - concept for game - building a prototype	PowerPoint, Live Instructor Sessions	Online	Story Map and User Journey	T
7	Consider Graphic styles and optimisation - communication and collaboration – Digital distribution – google play – iOS Store – Mac store.	PowerPoint, Live Instructor Sessions	Online	Choose and define a art style, with a relevant distribution platform	T
8	Create your first 3D level in Unity	Recorded Video/ PowerPoint	Online	Install blender and create a primitive shape	P
9	Create your first 3D level in Unity	Recorded Video/ PowerPoint	Online	Create static meshes and detail meshes	P
10	Create your first 3D level in Unity	Recorded Video/ PowerPoint	Online	Create Materials and optimise textures	P
11	Create your first 3D level in Unity	Recorded Video/ PowerPoint	Online	Enable and build colliders and other physics	P
12	Create your first 3D level in Unity	Recorded Video/ PowerPoint	Online	Animate objects and setup state machines	P
13	Create your first 3D level in Unity	Recorded Video/ PowerPoint	Online	Bake and build lighting	P

14	Introduction to Variables, Conditions, Loops, Patterns, - Scope of variables – OOPS in Realtime environments	PowerPoint, Live Instructor Sessions	Online	Simple programs for numerical operations	T
15	Program states – Device considerations – Input systems – Hardware and Haptics feedback	PowerPoint, Live Instructor Sessions	Online	Flow chart expressing input and feedback systems	T
16	Setting IDE – Scripting vs Programming – Enumeration – Memory management –Handing exceptions – Device considerations	PowerPoint, Live Instructor Sessions	Online	Data structures & Programming patterns	T
17	C# Unity functions and variables, Addition of two numbers and printing a series of numbers	PowerPoint, Live Instructor Sessions	Online	Lab programs on numerical operations	P
18	String operations in C# and finding greatest numbers	PowerPoint, Live Instructor Sessions	Online	Lab programs on string operations	P
19	Controlled Loops, enumerations & coroutines in C#	PowerPoint, Live Instructor Sessions	Online	Lab programs on program states	P
20	Translate, rotate, and scale objects using code	PowerPoint, Live Instructor Sessions	Online	Lab programs on vector operations	P
21	Awake, Start, Update, FixedUpdate and LateUpdate	PowerPoint, Live Instructor Sessions	Online	Lab program about coroutines	P
22	Vehicle moving and input handling	PowerPoint, Live Instructor Sessions	Online	Lab programs on input operations	P
23	Basic concepts of Level designing – Level sketching, Level creation techniques.	PowerPoint, Live Instructor Sessions	Online	Select and define a 3D model layers	T

24	Level design using Greybox – Focus on the layout and composition – Prioritize assets based on block out.	PowerPoint, Live Instructor Sessions	Online	Find examples of unwrapping and list them	T
25	Basic Animation using Mixmo, Building Scene for VR/AR, Optimization	PowerPoint, Live Instructor Sessions	Online	Explain zoetrope and its function	T
26	3D Asset importation using Unity Asset store	PowerPoint, Live Instructor Sessions	Online	Create a simple 3D digital identy	P
27	Design process – mood board – design specification document – technical project management	PowerPoint, Live Instructor Sessions	Online	Create a project plan for the given design document	T
28	AR architecture & frameworks – ARKit – Arcore – Vuforia –	PowerPoint, Live Instructor Sessions	Online	Compare various AR types and submit a report	T
29	VR architecture & frameworks – HTC – Windows Mixed reality – Oculus – XR and definition – XR over cloud – Emerging trends in AR VR MR	PowerPoint, Live Instructor Sessions	Online	List and build a list of new VR headsets in market	T
30	3D asset importation for AR using Unity asset store	PowerPoint, Live Instructor Sessions	Online	Build a simple AR space model through textures and Image markers	P
31	Experience with AR VR	PowerPoint, Live Instructor Sessions	Onsite	Experience VR Horizon line, cyber sickness	P
32	Experience with AR VR	PowerPoint, Live Instructor Sessions	Onsite	Experience space to comfort ratio	P
33	3D VR Asset from Unity asset store & create an environment	PowerPoint, Live Instructor Sessions	Onsite	Create your 3D asset with Kit bashing	P

34	3D Integration with Unity Engine	PowerPoint, Live Instructor Sessions	Onsite	Create your 3D Project and create your level	P
35	AR Project – Vuforia Integration	PowerPoint, Live Instructor Sessions	Onsite	Setup Vuforia and link developer setup	P
36	AR Project – Vuforia Integration	PowerPoint, Live Instructor Sessions	Onsite	Create markers and build & test on device	P
37	VR Project Setup – Oculus/Carboard Integration	PowerPoint, Live Instructor Sessions	Onsite	Install VR Framework and level optimisation	P
38	VR Project Setup – Oculus/Carboard Integration	PowerPoint, Live Instructor Sessions	Onsite	Complete Manager and Interaction script for deployment.	P
39	VR Mini Project (scope mentioned in the next section)	Selected Device	Onsite		P
40	VR Mini Project (scope mentioned in the next section)	Selected Device	Onsite		P
41	VR Mini Project (scope mentioned in the next section)	Selected Device	Onsite		P
42	VR Mini Project (scope mentioned in the next section)	Selected Device	Onsite		P
43	VR Mini Project	Selected Device	Onsite		P
44	VR Mini Project	Selected Device	Onsite		P
45	Photogrammetric Modelling	iPhone, PowerPoint, Agisoft	Onsite		P

COURSE OUTCOMES:

On successful completion of the course, students will be able to:
LO1: Create a 3D model in blender of any given object and apply texturing and animation.

LO 2: Convert the 3D asset in blender into a ready-to-use model for unity.

LO 3 : Apply functionalities to the model such as movement, rotation, etc., by importing appropriate AR/VR plugins and setup any lighting if required in Unity.

LO4 : Create AR/VR application for visualizing through any AR/VR devices.

STUDENTS ASSESSMENT :

Model a simple conference room with furniture, electrical devices (Light, Fan,Switches), etc, and develop a marker-less based Augmented Reality and/or Virtual Reality application.

There will one assignment & MCQ planned at the end of each unit and one final project which will be used for the final exam marks.

Evaluation Plan & Grading Criteria:

Continuous Learning Assignment :

Unit	**Unit -I**	**Unit-II**	**Unit – III**	**Unit IV**	**Unit V**	**Total**
MCQ	10 Questions	10 Questions	10 Questions	10 Questions	10 Questions	
Points	10	10	10	10	10	50
Assignment	1. Report on AR/VR HW. 2. Install Unity & confugure	Create a design journey document	Convert the given program to realtime Program	Create a level with all required optimizations	Submit your AR Marker for AR application	
Points	10	10	10	10	10	50
					Total	100

Summative or Final Mandatory Project at the end of the course (Unit 5):

Criteria	**Idea**	**Technology structure**	**Mechanics**	**Code optimization**	**Final Build**	**Total**
Points	20	20	20	20	20	100

Mandatory Project details:

Identify a content from your field of study and convert the learning content into an interactive VR experience in your field. Follow the steps below to complete the pipeline requirements.

- The content plan, Experience design, technical specifications, Test cases are to be defined before start of Production

- Choose Target devices and the right VR framework and explain the procedure to be followed
- Create any assets required and integrate them in any VR tool of your choice
- Build the experience using programming concepts for handling inputs
- Create a test group and record findings for publishing the final report

Mode of Delivery: Hybrid

Hybrid of 45 hours with:

- 22.5 hours of physical practical/lab classes
- 15 hours of on-line theory classes
- 7.5 hours of on-line lab classes

Execution: A total of 5 weeks

- 1 week of on-line training
- 4 weeks of Physical training across 4 clusters with 25 colleges per cluster
    - Each college will get 5 days of physical training with 4.5 hrs per day for a total of 22.5 hours.
    - Similar training will be provided to 25 colleges in parallel.
- A total of 5 weeks will be required to finish the training
    - Each cluster of 25 colleges will get 1 week of on-line & 1 week of physical training.

Hardware & Software to be used:

- Hardware/Devices that will be demonstrated to the students: Oculus Quest VR, Google VR, Smartphone AR, and Smartphone VR
- Software Licenses that will be taught/used: Blender based tools/plugins, GIMP/Photoshop, Unity with c#, Visual Studio, Vuforia, Oculus SDKS
- All software chosen are open source or free for students. It would be available for students even after the course
- Smartphone hardware available with the students can be used to develop and AR VR applications even after the course. Specialized VR hardware like Oculus Quest can be accessed at 50 AR VR locations in TN and the college can also invest.

SB8014	FULL STACK	L	T	P	C
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COURSE OBJECTIVE

The objective of this course is to provide a view of design principles to present ideas, information, products, and services on websites and how to apply programming principles to the construction of website and effective use of available resources for website projects.

PRE-REQUISITE COURSES:

Pre-requisite Knowledge	Courses Available on Springboard
HTML5	HTML 5
Javascript	Javascript
Typescript	Typescript

UNIT-I ANGULAR **36**

Getting Started with Angular - Angular Development Environment Setup - Creating Components and Modules – Templates – Directives - Data Binding – Pipes - Nested Components – Forms - Services – Routing - Angular Capstone Projects [Hands-on Exercises for Web Application Development Using Capstone Project]

UNIT-II NODE.JS AND EXPRESS. JS **12**

Node.js: Why and What Node.js - How to use Node.js - Create a web server in Node.js - Node Package Manager - Modular programming in Node.js - Restarting Node Application - File Operations. Express.js: Express Development Environment - defining a route - Handling Routes - Route and Query Parameters - How Middleware works - Chaining of Middleware's - Types of Middleware's - connecting to MongoDB with Mongoose - Validation Types and Defaults – Models - CRUD Operations - API Development - Why Session management – Cookies – Sessions - Why and What Security - Helmet Middleware - Using a Template Engine Middleware - Stylus CSS Pre-processor. [Hands-on Exercises to practice the topics using problem statements]

UNIT-III MONGO DB **12**

MongoDB: Introduction Module Overview- Document Database Overview- Understanding JSON- MongoDB Structure and Architecture- MongoDB Remote Management- Installing MongoDB on the local computer (Mac or Windows)- Introduction to MongoDB Cloud- Create MongoDB Atlas Cluster- GUI tools Overview- Install and Configure MongoDB Compass- Introduction to the MongoDB Shell- MongoDB Shell JavaScript Engine- MongoDB Shell JavaScript Syntax- Introduction to the MongoDB Data Types- Introduction to the CRUD Operations on documents- Create and Delete Databases and Collections- Introduction to MongoDB Queries.[Demos to practice the topics mentioned]

TOTAL: 60 PERIODS

SUGGESTED ACTIVITIES

CONTINUOUS / SELF-ASSESSMENT (MCQ)

Capstone Project - Develop an Ecommerce site or similar web applications with cross platform responsiveness. The application must possess search, sort, review, rating, ordering features and be connected with a database to be published across HTTP and HTTPS protocols.

SUGGESTED EVALUATION METHODS

Video Proctored Exam

Self-Assessment

COURSE OUTCOMES

On completion of the course, students will be able to,

CO1 : Develop component-based application using Angular Components.
CO2 : Create Angular forms and bind them with model data using data binding.
CO3 : Explain Node.js and identify when to use, create and run Node.js.
CO4 : Design schema using advanced queries.

REFERENCE

1 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_20858515543254600000_shared/overview (Angular)

2 https://infyspringboard.onwingspan.com/en/app/toc/lex_32407835671946760000_shared/overview (Node.js & Express.js)

3 https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview (MongoDB)

Mode of Delivery	Online (Self-Learning)
Software Configuration to be arranged in Institution Premises	Node.js Typescript Angular CLI Visual studio code MongoDB
Hardware Configuration to be arranged in Instituion Premises	Windows 10, 16GB RAM
Course Evaluation	Online Assessment
Multiple Hybrid Branch of Students	Applicable for IT/CSE
Internship/Placement Opportunities	https://infytq.onwingspan.com/
NOS Alignment	Yes- Infosys Industry Standard
Train-the-Trainer	Faculty Enablement Program
Commercials	Free of Cost

SB8015	CYBERSECURITY	L	T	P	C
		2	0	1	2

COURSE OBJECTIVE

The objective of this course is to provide a view of data science, machine learning, basic implementation using Python and how machine learning is applied in various domains in the industry

UNIT-I NETWORKING AND WEB TECHNOLOGY 7

Network Components - Network Basics - Network Communication -Web Technologies TCPIP - Web Services

UNIT-II INTRODUCTION TO CYBER SECURITY 8

Recent Cyber Attacks - Cyber Security Concepts - Layers of Cyber Security - Introduction to Application Security - Secure Coding OWASP Top 10 - Coding Practices Secure Design – Closure [Practical demos and code on OWASP vulnerabilities and how to mitigate them]

UNIT-III FUNDAMENTALS OF INFORMATION SECURITY & FUNDAMENTALS OF CRYPTOGRAPHY 7

Why information security? - What is information security? - Data Security - Network security - Application Security – Closure. Why Cryptography? – Cryptography - Shared Key Cryptography – Illustration - Shared Key Cryptography - Public Key Cryptography – Illustration - Public Key Cryptography – Hashing -Digital Signature – Illustration - Digital Signature - Applications of cryptography – Conclusion [Algorithmic representation of cryptographic methods]

UNIT-IV THREAT MODELING & IDENTITY AND ACCESS MANAGEMENT 6

Basics of Threat Modeling - Learn Threat Modeling with a Use Case - Tool Walkthrough - MS Threat Modeling Tool – Assignment - Introduction to Identity and Access Management - What next

UNIT-V JAVA SE 11 PROGRAMMER II: SECURE CODING IN JAVA SE 11 APPLICATIONS 7

Course Overview – Managing Denial of Service – Securing Information – Managing Data Integrity – Accessibility and Extensibility – Securing Objects – Serialization and Deserialization Security – JCA and its Principles – Provider Architecture – Engine Class – Key Pair Generation – Signature Management – Unsecure to Secure Object – Course Summary. [Demos of Secure Coding in Java]

UNIT-VI SECURITY STANDARDS AND REGULATIONS 5

PCI DSS – ISMS -FIPS and NIST Special Publications – FISMA – GDPR – HIPAA – SOX - Conclusion

UNIT-VII IDENTITY GOVERNANCE AND ADMINISTRATION 5

Need for IGA & basics concepts - IGA Basic Concepts and On boarding - IGA Governance - Identity Administration in IGA - What next?

TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES

CONTINUOUS / SELF-ASSESSMENT (MCQ)

CAPSTONE PROJECT

Activity 1 : Converge system configuration details listed below for a given machine

Firewall configuration (Policy Setup)

Network Configuration (IP address, DNS etc)

Activity 2 :

Evaluate the website vulnerabilities for a given webpage

Activity 3 : Implement security audit for an organization with the basic security requirements such as

- Firewall Policy Details
- Access Control Mechanism
- Router Configuration

SUGGESTED EVALUATION METHODS

- Video Proctored Exam
- Self-Assessment

COURSE OUTCOMES

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

CO1 : Demonstrate network components, DHCP, DNS Server and TCP/IP architecture
CO2 : Apply and validate the design of web applications by applying Threat modelling.
CO3 : Analyze some of the applications of these cryptographic primitives in cryptographic protocols and technologies.
CO4 : Apply Microsoft Threat Modeling Tool for creating threat models.
CO5 : Investigate how to secure sensitive objects, and secure serialization and deserialization in Java. You will describe JCA, including its architecture and the principles surrounding it
CO6: Demonstrate important Security Standards and Regulations like PCI DSS, ISMS, FIPS, NIST Special Publications, FISMA, GDPR, HIPAA and SOX.
CO7: Recognize Identity Governance and Administration (IGA); what problems IGA solutions solve; governance models like - roles, certifications, policies; and identity life cycle management.

REFERENCE

1 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0125451278416527367 1_shared/overview (Networking and Web Technology)

2 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_3388902307073574000_shar ed/overview (Introduction to Cyber Security)

3 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126391642460897284 2_shared/overview (Fundamentals of Information security)

4 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126668847068037127 03_shared/overview (Fundamentals of Cryptography)

5 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126088424780595203 07_shared/overview (Threat Modeling)

6 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126568855293460482 98_shared/overview (Identity and Access Management)

7 https://infyspringboard.onwingspan.com/web/en/viewer/html/lex_auth_0135015917296926 7213125 (Java SE 11 Programmer II: Secure Coding in Java SE 11 Applications)

8 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126235884826214402 865_shared/overview (Security Standards and Regulations)

9 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126428637035806721 584_shared/overview (Identity Governance and Administration)

Mode of Delivery	Online (Self-Learning)
Course Evaluation	Online Assessment
Multiple Hybrid Branch of Students	Applicable for ECE/EEE/IT/CSE
Internship/Placement Opportunities	https://infytq.onwingspan.com/
NOS Alignment	Yes- Infosys Industry Standard
Train-the-Trainer	Faculty Enablement Program
Commercials	Free of Cost

SB8016 **Big Data Analytics** **L T P C**

1 0 2 2

Modules	Duration in Hours
Introduction to Big Data & Hadoop	45
Scala Essentials	
In Memory Computation for Big Data	
SQL Like Query Processing Engine for Big Data: Hive	
Real time Big Data Processing	

SB8017 **Cloud Essentials** **L T P C**

1 0 2 2

Modules	Duration in Hours
Linux	45
Cloud Computing Fundamentals	
Architecting Cloud Solutions	
Managing Cloud Solutions	
Migrating to Cloud	

Big Data Analytics | Objectives

After the completion of respective modules, learners will be able to:

Module	Outcomes	No. of hours of theory	No. of hours of labs
Introduction to Big Data & Hadoop	Identify the various types of data Store large amount of data into HDFS Process data using Hadoop Navigate through Hadoop Web UI Analyse various metrics using Hadoop Web UI Run various Hadoop Terminal Commands Ingest structured data into HDFS using Sqoop	2	4
Scala Essentials	Perform basic Scala operations Use control structures in Scala Create functions in Scala Use Collections framework in Scala Write basic programs using Scala Create Classes and objects using Scala Write programs using OOPs concepts	2	4

Big Data Analytics | Objectives

After the completion of respective modules, learners will be able to:

Module	Outcomes	No. of hours of theory	No. of hours of labs
In Memory Computation for Big Data	Differentiate between Disk-based and In-memory Processing Systems Use Spark in Different Deployment Modes Run Spark applications on Spark shell Configure Spark properties & view them in Web UI Perform data loading and saving through RDDs Write Spark applications using RDDs concepts Query structured data inside Spark programs using Spark SQL	3	6
SQL Like Query Processing Engine for Big Data: Hive	Write Hive Queries & Hive Scripts Execute Hive Queries on top of HDFS Create Dynamic and Static Partitions Create Buckets for Data Sampling Perform various Joins in Hive Perform ETL operations & data analytics using Hive Implement Partitioning, Bucketing, and Indexing in Hive Use various file formats in Hive	3	6
Real time Big Data Processing	Ingest unstructured data into HDFS using Flume Perform real-time data processing using Spark Work with various Kafka Command Line Tools Create data pipelines using Kafka	5	10

Cloud Essentials | Objectives

After the completion of respective modules, learners will be able to:

Module	Outcomes	No. of hours of theory	No. of hours of labs
Linux	Work with various Linux commands Manage and perform user administration Differentiate between IPV4 and IPV6 address	2	4
Cloud Computing Fundamentals	Explain the concept of Virtualization Define Cloud Computing Categorize different Cloud Computing service models Categorize different Cloud Computing deployment models Describe AWS Global Infrastructure Work with AWS CLI Identity and Access Management	2	4

Cloud Essentials | Objectives

After the completion of respective modules, learners will be able to:

Module	Outcomes	No. of hours of theory	No. of hours of labs
Architecting Cloud Solutions	Create EC2 compute instances Store data into S3 buckets Create a virtual private network Query data using various database services such as RDS Configure various AWS core services such as EC2, RDS, VPC, S3	4	8
Managing Cloud Solutions	Monitor various AWS resources using CloudWatch Perform load balancing and auto scaling Manage and optimize cloud cost Build resilient and robust cloud architectures	4	8
Migrating to Cloud	Gather information about various on-premise resources using application discovery Perform homogeneous and heterogeneous database migration to AWS cloud Migrate on-premise resources to AWS cloud Migrate application to AWS cloud	3	6

Evaluation Process

Assessment Methodology

- Learning = practical application of various tools covered in the course
- Course Assessment
  - Multiple Choice Questions
- Assessments are **auto graded**
- **Learning effectiveness** for any learner
  - Completion of all the course modules and assessments
- A short project will be provided to the students at the end of the course for assessment
  - Faculty in the college should guide the students locally to help them clarify their queries
  - Faculty also should assess the project & provide marks to Veranda for consolidation
  - Sample project (indicative to demonstrate the complexity) is shared as separate files for reference

MCQ based assessment help the learner s to clear their interviews

Continuous Evaluation

- Self-paced video consumption through LMS portal
- Hands-on practice through practical labs
- Graded assessments (MCQs) after every module of course content
- Module Assessment
  - Real-time scenario based MCQs
- Course-completion certification

Big Data Analytics – Evaluation Parameters

Sr. No.	Aspect of description	Extra aspect of description	Maximum marks
1	Data Identification	Identify whether the data is structured, semi-structured or unstructured	5
2	Data Ingestion	Ingesting Structured or unstructured data using Sqoop and Flume	6
3	Data pre-processing	Data cleaning and Data transformation	5
4	Data Store	Storing pre-processed data into HDFS	4
5	Data processing	Processing data to get meaningful insights using Spark and Kafka	5
Total			**25**

Sr. No.	Aspect of description	Extra aspect of description	Maximum marks
1	Linux	Implement Linux Commands to work with AWS CLI	5
2	Cloud Computing	Identify cloud service and deployment model	5
3	Cloud Solution Designing	Identify and configure various AWS services for a given requirement	5
4	Monitor cloud resources	Monitor AWS resources and design scalable solutions	5
5	Cost Optimization	Optimize the cloud solution cost	5
Total			**25**

LMS FEATURES:

- *Byte sized learning videos.*
- *Accessible through PC and mobile devices.*
- *Integrated MCQ assessments.*
- *Personal content library for additional readings*

Course| Questionnaire

Questions	Cloud Essentials	Big Data Analytics
MODE of Course	Online	Online
SECTOR	Information Technology	Information Technology
DEGREE	UG/PG	UG/PG
SPECIALIZATION (Engineering, Arts & Science, Polytechnic, ITI,	Engineering, Arts & Science, Polytechnic, ITI	Engineering, Arts & Science, Polytechnic, ITI
BRANCH	Any	Any
SEMESTER	7	5
DURATION in HOURS*	45	45
DESIGNED DURATION in WEEKS	15 weeks (1 Semester)	15 weeks (1 Semester)
COURSE MODULE	Linux, Cloud Computing Fundamentals, Architecting Cloud Solutions, Managing Cloud Solutions, Migrating to Cloud	Introduction to Big Data & Hadoop, Scala Essentials, In Memory Computation for Big Data, SQL Like Query Processing Engine for Big Data: Hive, Real time Big Data Processing

Course | Questionnaire– *Continued*

Questions	Cloud Essentials	Big Data Analytics
COURSE OUTCOME	Developing and implementing policies for the use of cloud services, managing requests for new technology, establishing a secure cloud environment, and ensuring appropriate availability of services	• This course provides an overview of approaches facilitating data analytics on huge datasets. • Different strategies are presented including sampling to make classical analytics tools amenable for big datasets. • Students will be exposed to various analytics tools such as Apache hive, apache flume, Kafka, MySQL
COURSE TYPE	Paid	Free
TOTAL NUMBER OF ENROLMENTS	6300	6400
TOTAL NUMBER OF COMPLETION	1061	1200
TOTAL NUMBER OF CERTIFIED	1061	1200
CERTIFICATION (Mention Global and Industrial recognition)	None	None
MODEL CERTIFICATION (Need to upload)	Shown in earlier slides	Shown in earlier slides
NOS Aligned (Yes/No)	No (applied for it)	No (applied for it)

Course | Questionnaire – *Continued*

Questions	Cloud Essentials	Big Data Analytics
Personalized student support system intervention plan if student not following the course.	Progress of each student can be tracked in the LMS. College faculty members can access this info from the LMS. VLS will train the college faculty members in the beginning for providing onsite support to the students. • We will be creating online 1 doubt clearing sessions for faculties and the students can share the doubts with the faculties, which will be in turn cleared in these sessions • We will provide pre recorded videos for frequently asked questions	Progress of each student can be tracked in the LMS. College faculty members can access this info from the LMS. VLS will train the college faculty members in the beginning for providing onsite support to the students. • We will be creating online 1 doubt clearing sessions for faculties and the students can share the doubts with the faculties, which will be in turn cleared in these sessions • We will provide pre recorded videos for frequently asked questions
Personalized student support system intervention plan if student fail in the final assessment.	VLS will train the college faculty members in the beginning for providing onsite support to the students. We provide unlimited retake option and student can also discuss the assessment related queries in their doubt clearing sessions	VLS will train the college faculty members in the beginning for providing onsite support to the students. We provide unlimited retake option and student can also discuss the assessment related queries in their doubt clearing sessions

Course | Questionnaire – *Continued*

Questions	Cloud Essentials	Big Data Analytics
Hardware Requirement	Laptop -- 16 GB RAM 250 HDD Minimum i5 8th gen X64 bit Internet connectivity – 100 Mbps and above	Laptop -- 16 GB RAM 250 HDD Minimum i5 8th gen X64 bit Internet connectivity – 100 Mbps and above
Additional Requirements	All students should activate individual cloud accounts (AWS, Azure or Google) using their credit cards. Veranda will add a session to the course to educate the students how to activate/deactivate the account.	
Personalized student support system intervention plan to clear doubts during the course.	Onsite faculty & Webinar	Onsite faculty & Webinar

Cloud Essentials - Project

Background: A start-up company wants to host its Python and React-based application (Backend: Python API and Frontend React) using AWS. But they are not familiar with the AWS cloud platform. They want to ensure that the application is secure, scalable, highly available, and cost-efficient. As a solutions architect, you have to design a proper solution to meet their below requirements.

Goal: To architect a solution that is secure, scalable, highly available, and cost-effective using AWS.

Requirements:

• They are concerned about the security of the application, so they have decided to isolate their network from the rest of the customers virtually. Set-up a secure virtual network where the only frontend of application is accessible by users and not the database

• Execute the React application code using AWS Elastic Beanstalk. Ensure that the source code of Web application is automatically picked, pushed to the master branch, and deployed on the servers

• Ensure all the UI images served to the frontend application code are provisioned via a secure storage unit

• There should be enough backups for both the Web and Database server, so if the set-up crashes, we can launch a new one from the disaster recovery backups

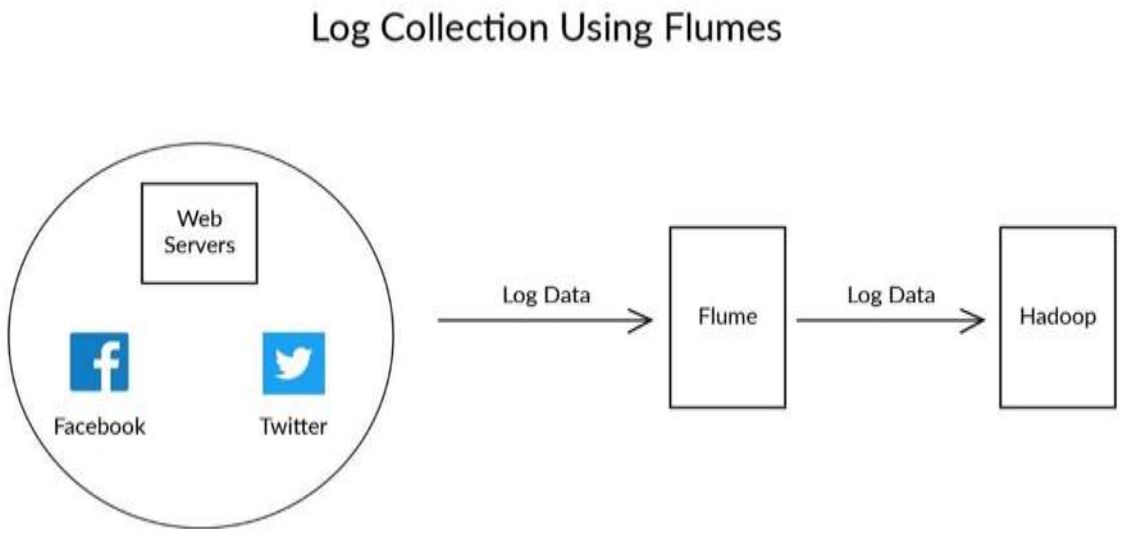
• They are uncertain about the traffic pattern that how low or high it can be, so they want the Web application to be running on at least two EC2 instances all time, and when there is a high load, they must burst up to four instances in total

• The Web application should be highly available, even if any VM fails to respond to queries, there should be a mechanism to switch the connection to another healthy VM automatically

• The Web application should also be cached globally, so users worldwide can access it with low latency

Problem Statement: Real-time Data Collection Imagine you are a Big Data Engineer, and you need to fetch logs from the web servers into your Hadoop Cluster for doing some analyses to generate some business insights.

The following figure illustrates a scenario where we need to ingest logs from sources like web servers, facebook, twitter, etc. into the Hadoop clusters and then use the ingested data as required.



As a Big Data Engineer, your task is to ingest the logs generated by the given LogGenerator.jar file into HDFS using the two Flume agents.

NOTE: 1. Configure the Flume agent 1 to consolidate the logs from the spoolDir source to an Avro sink. 2. Configure the Flume agent 2 to consolidate the logs

from the Avro source to an
HDFS sink

LIST OF SKILL BASED COURSES
(EVEN SEMESTER OF 2022-23)

S. NO.	SEMESTER	COURSE CODE	OFFERING DEPARTMENT	COURSE TITLE	L	T	P	C
1.	**IV**	SB8018	Dept. of Mech	Product Design Engineering and Modelling	1	0	2	2
2.	**IV**	SB8019	Dept. of Mech.	Manufacturing of Mechanical Components using CNC Turning / Milling	1	0	2	2
3.	**IV**	SB8020	Dept. of Mech.	Product Design and Manufacturing - 3D Surface Modelling	1	0	2	2
4.	**IV**	SB8021	Dept. of IT/ CSE/ ECE	Network Essentials	1	0	2	2
5.	**IV**	SB8022	Dept. of IT/CSE	Industrial Metaverse Using mixed reality (XR)	1	0	2	2
6.	**IV**	SB8023	Dept. of IT/CSE	Foundations for AI, ML, FS	1	0	2	2
7.	**IV**	SB8024	Dept. of Civil/ CSE/ IT/ ECE/Mech/EEE/ Tech.	Block Chain Development	1	0	2	2
8.	**IV**	SB8025	Dept. of Civil/ CSE/ IT/ECE/Mech/EEE/ Tech.	Digital Marketing	1	0	2	2
9.	**IV**	SB8026	Dept. of Civil/ ECE/EEE/Mech/ Tech	Robotic Process Automation Development	1	0	2	2
10.	**VI**	SB8027	Dept. of EEE	Embedded System Design - Board Design and Debug	1	0	2	2
11.	**VI**	SB8028	Dept. of EEE	Design of Photo Voltaic System	1	0	2	2
12.	**VI**	SB8029	Dept. of EEE	Electric Vehicle Charging System Design	1	0	2	2
13.	**VI**	SB8030	Dept. of EEE	Embedded System Design and Applications	1	0	2	2
14.	**VI**	SB8031	Dept. of EEE	Embedded System Design -Industrial Applications	1	0	2	2
15.	**VI**	SB8032	Dept. of Civil	Sustainable Building Design	1	0	2	2

S. NO.	SEMESTER	COURSE CODE	OFFERING DEPARTMENT	COURSE TITLE	L	T	P	C
1.	**IV**	SB8018	Dept. of Mech	Product Design Engineering and Modelling	1	0	2	2
2.	**IV**	SB8019	Dept. of Mech.	Manufacturing of Mechanical Components using CNC Turning / Milling	1	0	2	2
3.	**IV**	SB8020	Dept. of Mech.	Product Design and Manufacturing - 3D Surface Modelling	1	0	2	2
4.	**IV**	SB8021	Dept. of IT/ CSE/ ECE	Network Essentials	1	0	2	2
5.	**IV**	SB8022	Dept. of IT/CSE	Industrial Metaverse Using mixed reality (XR)	1	0	2	2
6.	**IV**	SB8023	Dept. of IT/CSE	Foundations for AI, ML, FS	1	0	2	2
7.	**IV**	SB8024	Dept. of Civil/ CSE/ IT/ ECE/Mech/EEE/ Tech.	Block Chain Development	1	0	2	2
8.	**IV**	SB8025	Dept. of Civil/ CSE/ IT/ECE/Mech/EEE/ Tech.	Digital Marketing	1	0	2	2
9.	**IV**	SB8026	Dept. of Civil/ ECE/EEE/Mech/ Tech	Robotic Process Automation Development	1	0	2	2
16.	**VI**	SB8033	Dept. of IT/ CSE/ECE	Network Engineering	1	0	2	2
17.	**VI**	SB8034	Dept. of Civil	Architecture Vizualisation using AR/VR	1	0	2	2
18.	**VI**	SB8035	Dept. of Chemical Engineering	Plant Simulation	1	0	2	2
19.	**VI**	SB8036	Dept. of Mech.	EV Design	1	0	2	2
20.	**VI**	SB8037	Dept. of IT/ CSE/ECE	Full Stack Development	1	0	2	2
21.	**VI**	SB8038	Dept. of Mech.	Smart and Advanced Manufacturing – Design & Simulation	1	0	2	2
22.	**VI**	SB8039	Dept. of Tech.	Smart and Advanced Manufacturing – Process Simulation	1	0	2	2
23.	**VI**	SB8040	Dept. of IT/ CSE/ECE	Professional Readiness for Innovation,	1	0	2	2

S. NO.	SEMESTER	COURSE CODE	OFFERING DEPARTMENT	COURSE TITLE	L	T	P	C
1.	**IV**	SB8018	Dept. of Mech	Product Design Engineering and Modelling	1	0	2	2
2.	**IV**	SB8019	Dept. of Mech.	Manufacturing of Mechanical Components using CNC Turning / Milling	1	0	2	2
3.	**IV**	SB8020	Dept. of Mech.	Product Design and Manufacturing - 3D Surface Modelling	1	0	2	2
4.	**IV**	SB8021	Dept. of IT/ CSE/ ECE	Network Essentials	1	0	2	2
5.	**IV**	SB8022	Dept. of IT/CSE	Industrial Metaverse Using mixed reality (XR)	1	0	2	2
6.	**IV**	SB8023	Dept. of IT/CSE	Foundations for AI, ML, FS	1	0	2	2
7.	**IV**	SB8024	Dept. of Civil/ CSE/ IT/ ECE/Mech/EEE/ Tech.	Block Chain Development	1	0	2	2
8.	**IV**	SB8025	Dept. of Civil/ CSE/ IT/ECE/Mech/EEE/ Tech.	Digital Marketing	1	0	2	2
9.	**IV**	SB8026	Dept. of Civil/ ECE/EEE/Mech/ Tech	Robotic Process Automation Development	1	0	2	2
				Employment and Entrepreneurship				

SB8018 PRODUCT DESIGN ENGINEERING AND MODELLING L T P C
1 0 2 2

COURSE OBJECTIVE

1. Create the model of the mechanical component using the part design workbench.
2. Assemble the mechanical component part to generate an assembly model.
3. Generate the 2D drafting sheet from the part model of the mechanical component.
4. Render and animate the assembled mechanical component.

COURSE CONTENT

UNIT I Sketch and Part design 3 + 6

Create a basic sketch - Profile Tools, Curve Tools, Editing Tools, Operation Tools, Constraints, construction geometries and adding dimensions. Part- Solid from sketches, Solid from surfaces, modify Tools, Operation Tools.

UNIT II Freeform Modelling (Surface Modelling) 3 + 6

Freeform Modelling- create and edit a form body, Insert edges and bridge form bodies, Refine complete the form body, Resize features with direct modelling, Move and rotate features with direct modelling.

UNIT III Assembly 3 + 6

Component color swatch and color cycling, Use McMaster-Carr parts in a design, Copy, paste, and paste new, Distributed designs, Create as-built joints, Create joints, Joint origins and midplane joints, Drive joints and motion studies, Interference detection and contact sets, Isolation and opacity control, Create groups and organize a timeline

UNIT IV Technical Drawing 3 + 6

Drawing Basics-Detailing Drawings. Explode a 3D model for a drawing, Create a drawing sheet and views, Add geometry and dimensions to a drawing, Add GD & T text, BOM, tables and symbols, Place an exploded view, Edit a title block, Export to different file formats.

UNIT V Rendering, Animation and Data Management 3 + 6

Rendering Tools- Animation- Story board, File Conversion-File Management- Data Transfer.

TOTAL : 45 PERIODS

COURSE OUTCOMES

After completing this course, the students will be able to:

- Understand the parametric CAD workflow.
- Identify the benefits of the Cloud platform Fusion 360.
- Create designs with mechanical motion.
- Manipulate appearances and physical materials.
- Create detailed drawings.
- Demonstrate proficiency in the setup and creation of a design.

FOR FURTHER READING

Simulation - Surface modelling - Generative Design - Sheet Metal- Electronics.

REFERENCES

1. John Willis, Sandeep Dogra, Cadartifex, 2018." Autodesk Fusion 360: A Power Guide for Beginners and Intermediate Users", CADArtifex, ISBN: 1720851476 or more recent edition.
2. Autodesk Fusion 360 Black Book
3. Autodesk Fusion 360 For Beginners: Part Modeling, Assemblies, and Drawings
4. Autodesk Fusion 360 - The Master Guide (Fusion 360 Beginners and Intermediate Users Book)
5. CAD/CAM: Concepts and Applications

ONLINE REFERENCES:

1. https://help.autodesk.com/view/fusion360/ENU/courses/
2. https://www.autodesk.com/certification/learn/course/fusion360-intro-to-3d-modeling-associate
3. https://www.autodesk.com/certification/learn/course/fusion360-intro-modeling-design-professional

SOFTWARE REQUIREMENT

- Fusion 360 Software

HARDWARE REQUIREMENT

System requirements for Autodesk Fusion 360	
Operating System	Apple® macOS 1. macOS 13 Ventura – NOT YET SUPPORTED (Certification coming soon) 2. macOS 12 Monterey 3. macOS 11 Big Sur 4. macOS 10.15.7, or newer, Catalina (until March 2023. More details) Microsoft® Windows® • Windows 11 • Windows 10 (64-bit) Version 1809 or newer (1803 and older supported until March 2023. More details) • Windows 8.1 (64-bit) (until March 2023. More details)
CPU Type	x86-based 64-bit processor (for example, Intel Core i, AMD Ryzen series), 4 cores, 1.7 GHz or greater; 32-bit not supported Apple silicon processors require Rosetta 2 - see this post for more information.
Memory	4 GB of RAM (integrated graphics recommend 6 GB or more)
Graphics Card	DirectX11 (Direct3D 10.1 or greater) Dedicated GPU with 1 GB or more of VRAM Integrated graphics with 6 GB or more of RAM

Disk Space	3 GB of storage
Display Resolution	1366 x 768 (1920 x 1080 or greater at 100% scale recommended)
Pointing Device	HID-compliant mouse or trackpad, optional Wacom® tablet and 3Dconnexion SpaceMouse® support
Internet	2.5 Mbps or faster download; 500 Kbps or faster upload
Dependencies	SSL 3.0, TLS 1.2+, .NET Framework 4.5 or newer required to submit crash reports

INDUSTRY SCOPE:

3D modelling for mechanical engineers, 3D CAD/CAM for machinists, Design systems for collaborators, 3D PCB design for electronics engineers, 3D prototyping for industrial designers.

INDUSTRY USE CASES

1. Design a mechanical assembly by creating a reciprocating saw link and trigger referencing bodies, sketches, and images to create 3D geometry.
2. Design a reciprocating saw mechanical assembly, including spur gears and links to modify the drive ratio and linear travel of an assembly using Fusion 360
3. Design a saw trigger model that can be injection molded using Fusion 360.
4. Design a cylinder head, which is a part of the model engine assembly.
5. Design a concept model for a car body shape using Fusion 360 Forms.
6. Design a model for 3D printing
7. Design products for a second-life laundry detergent bottle using Fusion 360 Forms.
8. Prepare a Technical Drawing from the existing 3D model
9. Design a reciprocating saw mechanical assembly, including spur gears and links to modify the drive ratio and linear travel of an assembly using Fusion 360.
10. Use form tools to Design a new form body with primitives or sketches. The form body should include the use of the Bridge and Crease tools
11. Design a new design and model a set of rims using parametric modelling workflows that utilize reference construction geometry to create 3D features for the supplied toy car model
12. Design a Tripod including mechanism that need to be assembled with appropriate joints. A combination of Joints and As-built Joints should be applied to define the degrees of freedom for each component to achieve the desired motion of a tripod.
13. Modify the bolt design to be compatible with a specified hardware constraint and create a corresponding detailed drawing.
14. Create a new Form that resembles the trigger grip as provided. The goal is to be visually accurate as opposed to dimensionally accurate with the freeform body.
15. Use Assembly tools to define the relationship of motion between the components.

16. Create a detailed drawing of the entire, exploded assembly that includes a parts list and appropriately numbered balloons for each of the components.
17. Set up a scene to render the component as provided. Apply a custom appearance and export an In-Canvas Render output.
18. Using the Form toolset, create Form primitive geometries and modify them using the Edit Form tool. Apply Symmetry to the geometry as needed to simplify mirrored operations on the model provided.
19. Create a wheel design that is parametrically linked. The parameters should drive the sketch dimensions and features for the design.
20. Create a new distributed design and insert the switch and box components. Use Joints to define relationships between each component of the design such that the switch is free to slide within the rigidly jointed casing. Define Joint Limits to restrict the motion of components in the assembly.

		L	T	P	C
SB8019	**MANUFACTURING OF MECHANICAL COMPONENTS USING CNC TURNING / MILLING**	**1**	**0**	**2**	**2**

COURSE OBJECTIVE

1. Understanding the concept of CNC programming and operations and making applications on CNC turning and milling machines.
2. Gaining Advanced knowledge of CNC machining process and hands on experience to program and make the component.
3. Applying the concepts of machine and equipment's handling with CNC Program in CNC Turning and Milling machines.
4. Comprehending the advantages and application of CNC turning and milling machines in the manufacturing industry with industrial drawing and component.
5. Experiencing a hands-on component manufacturing as per industrial practice.

COURSE CONTENT

UNIT I CNC technology and CNC programming 3 + 6

CNC programming Introduction and demonstration of line programs - CNC programming on lathe & milling machine - CNC programming for lathe and milling machines using different machining cycles - Procedures Associated with part programming, Cutting process parameter selection, Process planning issues and path planning - G & M Codes, Interpolations, Canned Cycles and Subprograms.

UNIT II Programming generation and application in CNC Simulator 3+ 6

Functions and Identification of different parts of CNC lathe including data input – Functions and Identification of different parts of CNC mill including data input -Tool compensations Exposure for programming and simulation in Fanuc control - CNC programming on lathe & milling machine for different operations in simulator - Practice on CNC controller using on-screen simulation for generating different profile.

UNIT III Programming and Operations in CNC Turning 3 + 6

Plan and optimize programs for CNC turning operations - Calculate parameters like speed, feed etc -

set a reference for the various operations - Prepare operation and operation sequence for the lathe operations like turning, grooving etc - Prepare & set CNC lathe operations and test run programmed - Execute program and inspect simple geometrical forms / standard parts - Use of various PPE's on CNC lathe machine.

UNIT IV Programming and Operations in CNC Milling 3 + 6

Plan and optimize programs for CNC Milling operations - Calculate parameters like speed feed, depth of cut etc - Set a reference for the various operations. - Various methods of work process like edge finding, block center etc - Prepare operation and operation sequence for the milling operations like face milling, End milling, Drilling, etc -Prepare & set CNC Milling operations and test run programmed - Execute program and inspect simple geometrical forms / standard parts - Use of various PPE's on CNC milling machine.

UNIT V Quality Control 3 + 6

Principles of measurement - Limits, fits and Tolerances - Direct measurement such as Vernier Caliper, Vernier Height gauge, Vernier Depth gauge, Outside Micrometer, Inside Micrometer, Depth Micrometer – Introduction to Co-ordinate Measuring Machine and measure all parameters using Co-ordinate Measuring Machine.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Students will be able to:

- Create the programming's for industrial components produced by CNC machines.
- Do the Cutting process parameter selection, tools and path planning.
- Relate and analyse to get industrial skills in the field of automotive manufacturing.
- Do the industrial measuring practice and examine functionality and comparison of final product as per specification.

FOR FURTHER READING:

Introduction To Automation – Demonstrate understanding of the use and programming of industrial robots and related automation – Functions and applications of industrial robots.

REFERENCES

1.CNC Programming and CNC Machining – Centurion University
2.Training Course on CNC Lathe & Milling Machines – National University
3. Ministry of Micro, Small and Medium Enterprises, New Delhi (MSME-Technology Centre)

ONLINE REFERENCES:

- Centurion University
- https://courseware.cutm.ac.in/courses/cnc-programming-and-cnc-machining/
- National University – Science and Technology https://portal.nu.edu.om/pts/pdf/trainingCourse_59.pdf
- Ministry of Micro, Small and Medium Enterprises, New Delhi (MSME-Technology Centre)
- https://nqr.gov.in/sites/default/files/5.%20IGTR%20AURANGABAD%20ACCCM%20CURRICULUM.pdf

SOFTWARE REQUIREMENT:

- Simulation software
- Fanuc control software
- Hass Control software

HARDWARE REQUIREMENT:

- CNC Turning machine
- CNC Milling machine
- Co Ordinate Measuring Machine
- Control Panel - Hass
- Computers
- Measuring Instruments

INDUSTRY SCOPE:

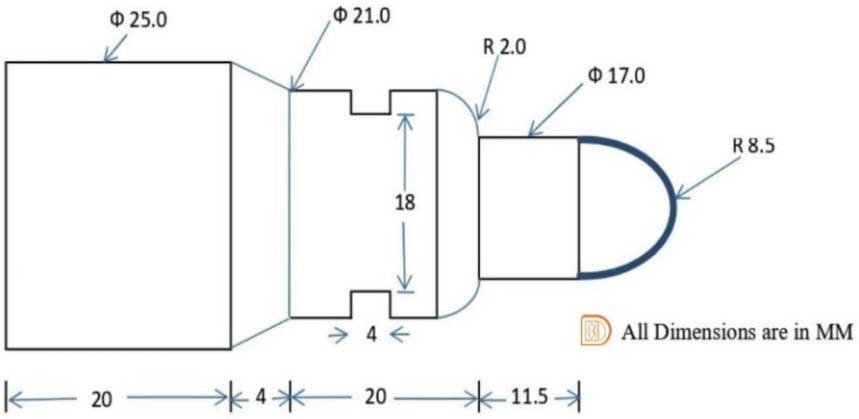
On Completion of this course, students get modern manufacturing industrial practice with capable of writing CNC programming for complex industrial components. Identify and Selection of appropriate measuring tools and instruments for manufactured component.

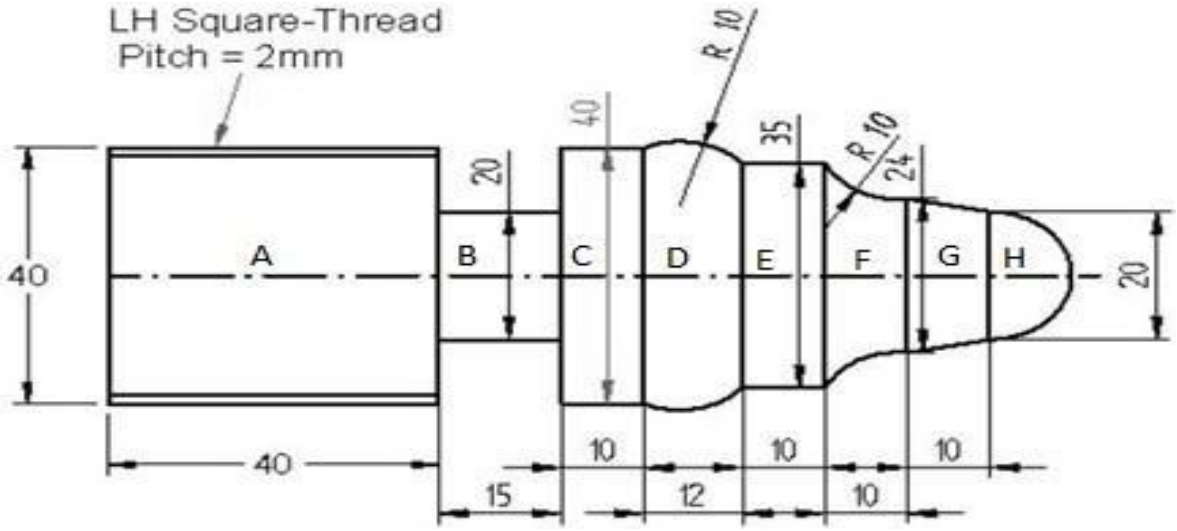
20 INDUSTRY USE CASES

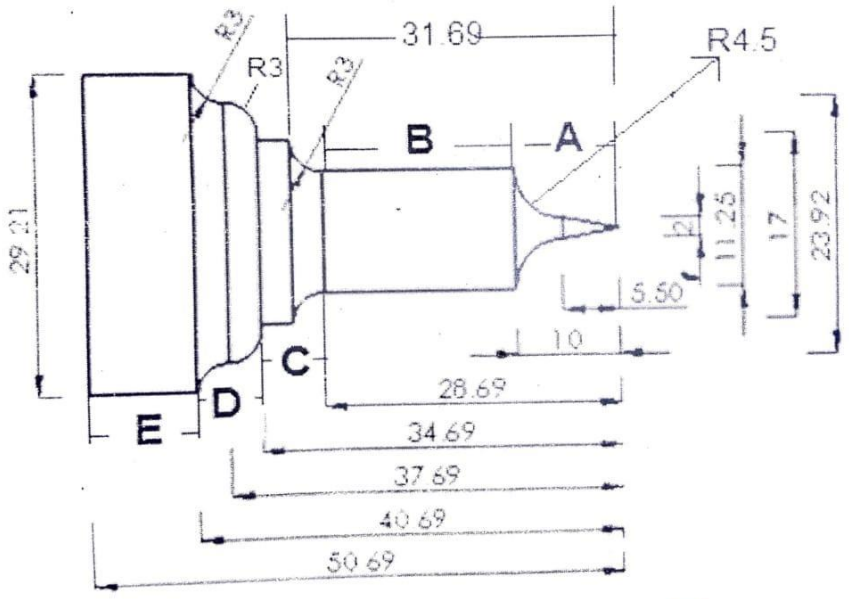
1. Create CNC Programming for below model components in multiple sectors like automobile, aerospace, medical, railway industries. Etc.,
2. Create and analyse lead time requirements.
3. Plan to achieve production resilience.
4. Stepping into evolution of CNC technology and Automation.
5. Derive the plan for reduce downtime and increase turnaround times, increasing productivity in factories.
6. Visit multiple domain factories and identify the demand of 5 axis and special purpose machines.
7. Find the more complex manufacturing setup and provide solution with IioT (Industrial Internet of Things).
8. Pick elevations of CNC Career growth and act accordingly.
9. Find the different departments support that should needed for the industrial process completion.
10. Create an interactive and future based project.
11. Create an automation process with SAP tool.
12. Derive and establish man power and work study.
13. Find the various ways to short the lead time.
14. Find and analyse to improve Zero Defects and Greater Accuracy.
15. Using Least cost method to recycle the waste material and make that to be reused.
16. Set and implement Kaizen activities in manufacturing.

17. Using the SOP guidelines monitor and regularize the process.
18. Create and standardize the action plan for machine maintenance.
19. Analyse and make use of precision cutting systems for better accuracy.
20. Using the 8D concept identify the root cause of a problem, providing corrective solutions, and preventive solutions to eliminate the recurring problems.

Model components:







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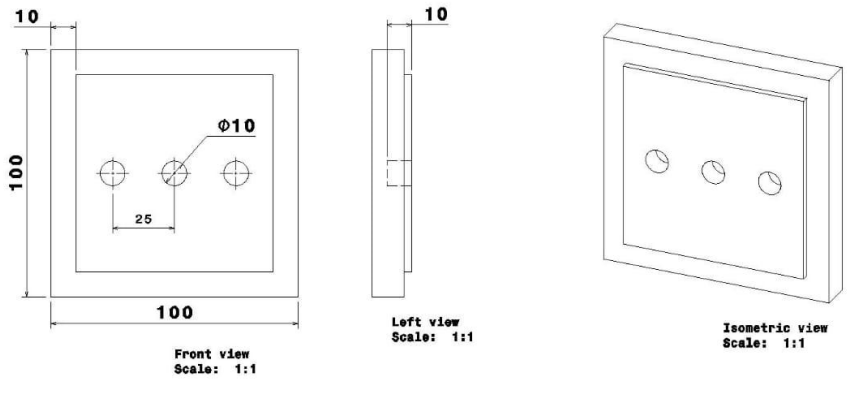

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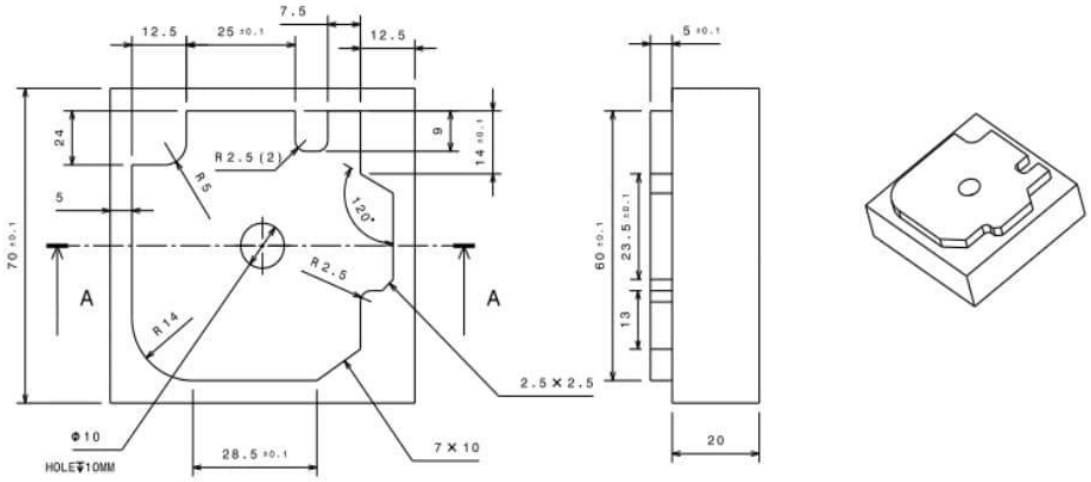
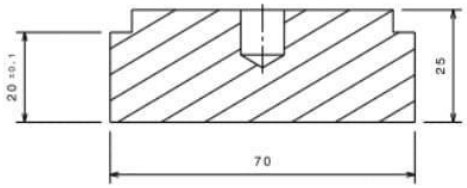
CNC - MILLING





Section view A-A

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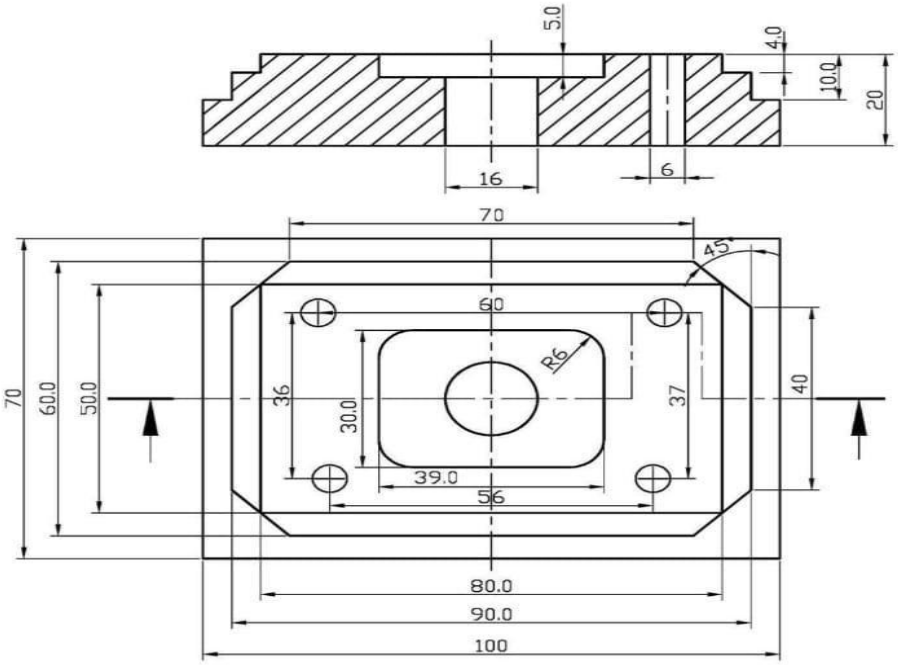
Thired Angle Projection



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FIRST ANGLE PROJECTION

SB8020	PRODUCT DESIGN AND MANUFACTURING – 3D SURFACE MODELLING	L T P C 1 0 2 2

COURSE OBJECTIVE

1. Imparts Knowledge on role of Design Engineer in sketches.
2. Imparts Knowledge on role of Mechanical Design Engineer in solid modelling.
3. Imparts Knowledge on design wire frames.
4. Imparts Knowledge on role of Assembly Designer in building assemblies.
5. To provide an extensive database of exercises for additional practice on advancedtopics of Generative Shape Design.
6. To create knowledge on Industry based practices. This course is a comprehensive introduction to defining and performing additive manufacturing process simulations.
7. It teaches you how to add material to the part, define laser paths, and model cooling effects during the build process in the context of thermal and thermal-stresssimulations.

COURSE CONTENT

UNIT I CREATING SOLID COMPONENTS 3 + 6

Creating the Sketch Support - Creating Complex Profiles and Transforming Sketch Elements - Creating Extruded and Revolved Features - Creating Holes, Threads and Taps - Creating and Analyzing Drafts - Fillets and Chamfers - Shelling and Stiffening a Part and Creating Relations between Dimensions

UNIT II ASSEMBLY DESIGN FUNDAMENTALS 3 + 6

Creating and Modifying Products-Introduction to Assembly Design-Assigning or Modifying Product Properties-Inserting PLM Objects-Inserting Existing PLM Objects-Assigning ComponentProperties-Reordering a Product Structure-Unloading Objects from a Session-Exercise: CreatingProducts

UNIT III POSITIONING COMPONENTS 3 + 6

About Degrees of Freedom-Analyzing & Displaying Degrees of Freedom-Creating Interface- Based Connections-Engineering Connections-Fixing Components Together - **Case Study - Create the Views of Industry Use Case -** Create a Front View-Creating a Section View-Adda Breakout-Insert an Isometric View.

UNIT IV CREATING SURFACES 3 + 6

Selecting the choice of surfaces - Extruding and revolving a profile and sweeping a profile - Creating a Multi-Section and an Adaptive Sweep Surface - **Case Study- Extruded surfaces creation- Creation of revolved surfaces- Selecting the input features.**

UNIT V ADDITIVE MANUFACTURING PROCESS SIMULATIONS 3 + 6

Application Overview - Guided User Assistant Panel – Setup – Meshes - Part and SupportProperties - Initial Temperatures - Moving Heat Source - Material Deposition – Cooling -Prescribed Temperatures - Structural Restraints and Loads – Procedures – Simulate – Results - Summary: Best Practices and Model Checklist - **Eigenstrain Process Simulation -** Residual Stresses – Eigenstrains - Basic Steps for Defining Eigenstrains - Defining a Uniform Eigenstrain in a Part - Pattern with Layer-to-Layer Rotation and Multiple Patches - Defining Two Eigenstrain Regions in a Part

TOTAL : 45 PERIODS

COURSE OUTCOME:

1. Students will be able to design solid models using the parametric approach
2. Students will be able to build assemblies using solid models
3. Students can generate simple mechanisms

4. Students will be able to simulate the relative motions
5. Students will generate detailed drawings for parts and assemblies.
6. Students can generate Generative Shape Design app to create curves and surfaces.
7. Best innovative design will be identified and 3D printed using Additive Manufacturing Method.
8. Students shall define and perform additive manufacturing processsimulations.
9. Students will add material to the part, define laser paths, and model coolingeffects during the build process in the context of thermal and thermal-stress simulations.

REFERENCES:

https://www.3ds.com/
https://eduspace.3ds.com/

SOFT WARE AND HARDWARE REQUIREMENTS

LIST OF EQUIPMENTS FOR BATCH OF 5O STUDENTS			
S.No	**Type**	**Description**	**Qty**
1	**Workstation**	16 GB / 32GB RAM, Intel i7 Processor, 8 GB Graphics Card, Operating System 250GB, Storage 250GB hard disk, Mouse, Keyboard.	50
2	**Projector**	LCD Projector or Smart Board	1
3	**Computer Lab**	Computer lab with 50 Students Capacity	1
4	**Software**	Dassault Systems 3DEXPERIENCE Platform	50

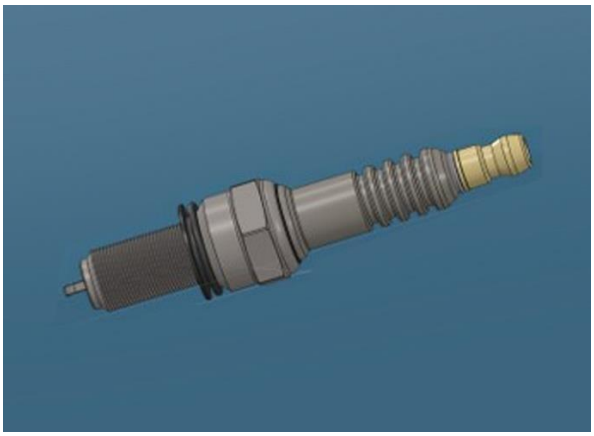
INDUSTRY SCOPE:

Automotive, Industrial Equipment, Aerospace, Agriculture, Electric Vehicle

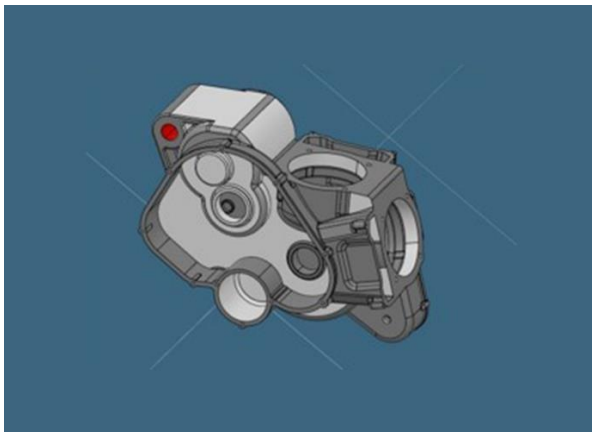
INDUSTRY USE CASES

1. Designing Two-Wheel Vehicle Components

TASK 1: Designing Bike Spark Plug



TASK 2: Designing Engine Case



Bike Spark Plug

A spark plug (sometimes, in British English, a sparking plug, and, colloquially, a plug) is a devicefor delivering electric current from an ignition system to the combustion chamber of a spark- ignition engine to ignite the compressed fuel/air mixture by an electric spark, while containing combustion pressure within the engine. Spark plugs are specified by size, either thread or nut , sealing type (taper or crush washer), and spark gap. Common thread (nut) sizes in Europe are 10 mm (16 mm), 14 mm (21 mm; sometimes, 16 mm), and 18 mm (24 mm, sometimes, 21 mm).In the United States, common thread (nut) sizes are 10mm (16mm), 12mm (14mm, 16mm or 17.5mm), 14mm (16mm, 20.63mm) and 18mm (20.63mm)Spark plug transmits high voltage electrical energy to ignite the air-fuel mixture in combustion chamber. It also assists in removal ofheat from the combustion chamber.

USES: Spark plugs are used in internal combustion engine driven vehicles, aircrafts, boats, industrial & oil field engines, power mowers, and chainsaws.

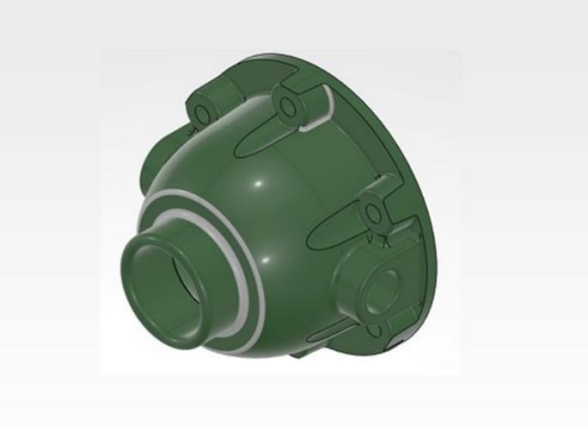
Designing Engine Case

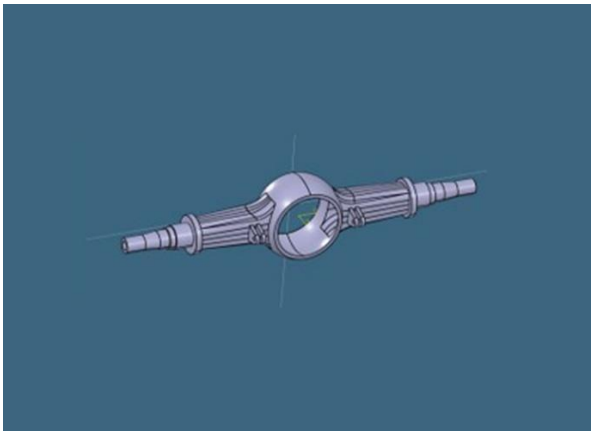
An engine casing is an important protective part of an engine that helps keep things from getting sucked or tangled in the engine components. Engine casings are widely used to protect and house even the simplest engine. An engine casing is the outside cover of an engine, and is usually madeof metal. An engine casing can also be called an engine case or a case cover. The engine case protects an engine from outside debris and pollutants.

In case of engine failure, an engine casing will protect the driver of a vehicle by keeping broken debris inside the casing. Types of engines with engine casings include motorcycle engines, jet engines, diesel truck engines, automobile engines and steam engines.

2. Designing Four-Wheel Vehicle Components

TASK 1: Designing Differential Case **TASK 2: Designing Four Wheller Axle**





In case of engine failure, an engine casing will protect the driver of a vehicle by keeping broken debris inside the casing. Types of engines with engine casings include motorcycle engines, jet engines, diesel truck engines, automobile engines and steam engines.

Differential Case

A differential is a case of gears that sits between the axles in the front or rear of a vehicle. Differentials divide the power from the engine between the axles, allowing each wheel to be driven.

Industries: Automobile

Four Wheller Axle

Following are the three different types of axles:

Rear Axles

Front Axle

Stub Axle

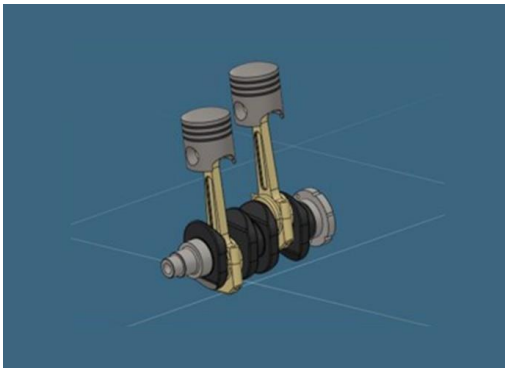
In between the differential and the driving wheels is the rear axle to transmit power from the differential to the driving wheels. It is clear from the construction of the differential, that the rear axle is not a single piece, but it is in two halves connected by the differential, one part is known as the half shaft.

Rear Axle: The inner end of the half shaft is connected to the sun gear of the differential. and the outer end of the driving wheel. In rear-wheel-drive vehicles, the rear wheels are the driving wheels. Whereas, in front-wheel drive vehicles, the front wheels are the driving wheels. Almost all rear axles on modern passenger cars are live axles, that is, they revolve with the wheels. A housing completely

encloses the rear axles and the differential, protecting them from water, dust and injury, in addition to mounting their inner bearings and providing a container of the lubricant.
Industries: Automobile

3. Designing Vehicle Components Assembly

TASK 1: Designing of Piston Assembly **TASK 2: Designing Leaf Spring Assembly**



Piston Assembly

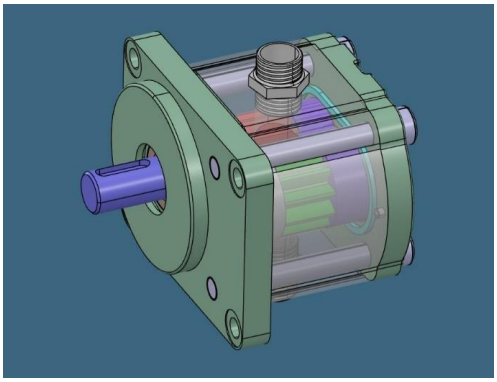
The piston is connected to the crankshaft through a connecting rod , often shortened to rod or conrod . These parts together are known as the piston assembly.
A piston aids in the transformation of heat energy into mechanical work and vice versa. Because of this, pistons are a key component of heat engines. Pistons work by transferring the force output of an expanding gas in the cylinder to a crankshaft, which provides rotational momentum to a flywhee

Leaf Spring Assembly

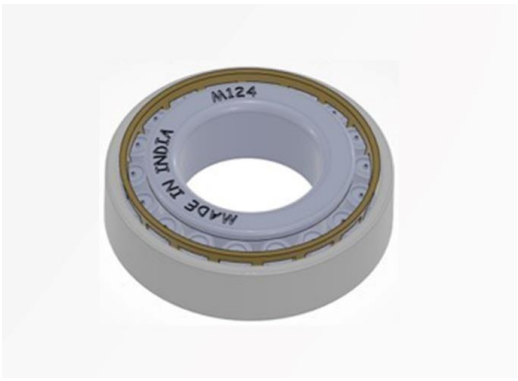
The leaf spring assembly includes a full-leaf leaf spring component and a half-leaf leaf spring component. The full-leaf leaf spring extends substantially the entire length of the leaf spring assembly and the half-leaf leaf spring extends substantially the entire length of one of the cantilevers.
Leaf springs are a basic form of suspension made up of layers of steel of varying sizes sandwiched one upon the other. Most leaf spring setups are formed into an elliptical shape through the use of spring steel which has properties that allow it to flex as pressure is added at either end, but then returning to its original position through a damping process. The steel is generally cut into rectangular sections and then once held together by metal clips at either end and a large bolt through the centre of the leafs. It is then mounted to the axle of the vehicle using large U-bolts, securing the suspension in place.

4. Designing Vehicle Components

TASK 1: Designing the Automobile OilHub



TASK 2: Designing the Ball earing Assembly



Gear Pump

A gear pump is a type of positive displacement (PD) pump. It moves a fluid by repeatedly enclosing a fixed volume using interlocking cogs or gears, transferring it mechanically using a cyclic pumping action. It delivers a smooth pulse-free flow proportional to the rotational speed ofits gears.

Gear pumps are also widely used in chemical installations to pump high viscosity fluids. There are two main variations: external gear pumps which use two external spur gears, and internal gear pumps which use an external and an internal spur gear (internal spur gear teeth face inwards, see below). Gear pumps are positive displacement (or fixed displacement), meaning they pump a constant amount of fluid for each revolution. Some gear pumps are designed to function as either a motor or a pump.

Applications

- Petrochemicals: Pure or filled bitumen, pitch, diesel oil, crude oil, lube oil etc.
- Chemicals: Sodium silicate, acids, plastics, mixed chemicals, isocyanates etc.
- Paint and ink.
- Resins and adhesives.
- Pulp and paper: acid, soap, black liquor, lime, latex, sludge etc.
- Food: Chocolate, cacao butter, fillers, sugar, vegetable fats and oils, molasses, animal food etc.

Ball Bearing

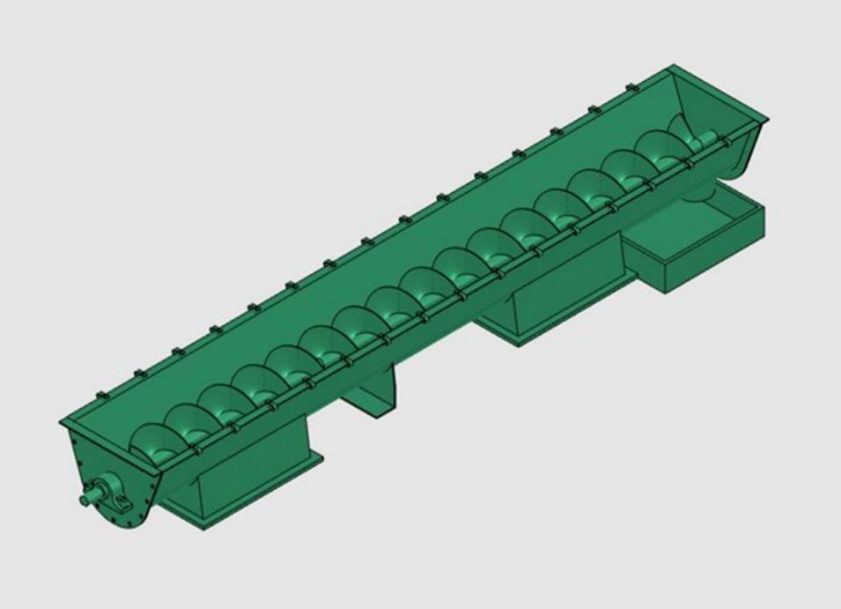
A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls andtransmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as

well. Because the balls are rolling they have a much lower coefficientof friction than if two flat surfaces were sliding against each other.

Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

Industries: Ball bearings are used in the bike industry, the automotive industry and in machine tool spindles.

5. Designing the Screw conveyor assembly with full description anduse cases

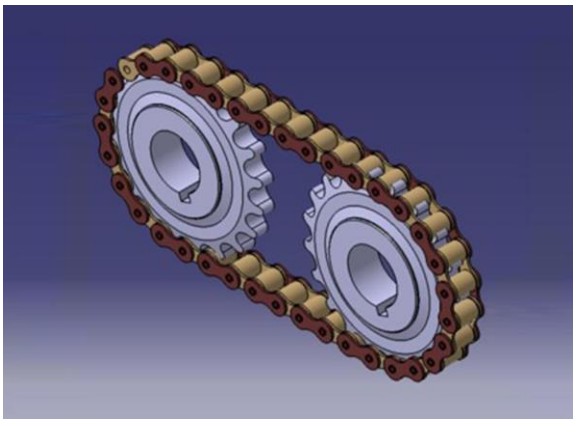


Screw conveyor

Screw conveyors in modern industry are often used horizontally or at a slight incline as an efficient way to move semi-solid materials, including food waste, wood chips, aggregates, cereal grains, animal feed, boiler ash, meat, and bone meal, municipal solid waste, and many others.

Industries: Screw conveyors are commonly used in agriculture for handling grain, in food processing plants to move dry ingredients, and in wastewater treatment plans for handling grit and dewatered sludges.
Problem: A screw conveyor is required to transport 10 tons per hour of unslaked lime with a bulk density of 60 lbs/

6. Designing the Chain Drive Assembly with full description and usecases



Chain Drive Assembly

A chain drive is a Mechanically operating system where we use different types of chains to transmit the power or for movement of something.

Generally, a chain drive is used where the distance between the power produced and where it tobe transferred is less, however, this is not applicable for all. In some cases, we can use a chain drive for longer distance power transfer.

Chain drive used in several industries for several purposes like:

Transportation Industry.

Agriculture Machinery.
Material Handling Equipment.

Building construction.

Drives for industrial crane and hoist movement

Safety and performance optimization of industrial crane

Roller chains with waisted plates / Roller chain type series GL (straight plates) / Special heavy- duty chains and power chains... are standardized according to ISO 4347. They are used as load chains in cranes, hoisting gear, and lifting equipment as well as for holding counterweights and for transmission of back-and-forth movements under load.

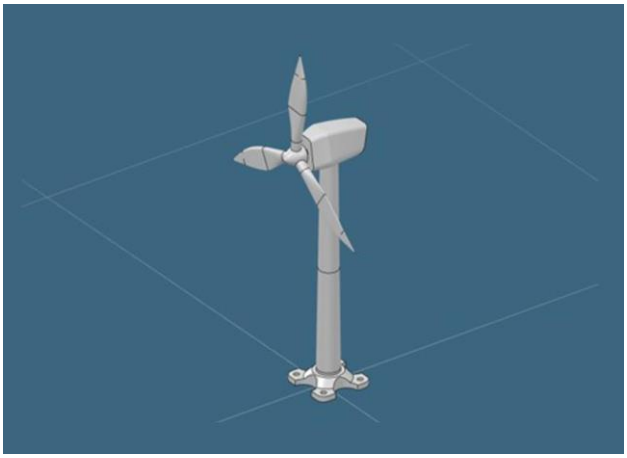
7. Drone System Assembly with full description and use cases

Drone System

A drone is an unmanned aircraft. Drones are more formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems. Essentially, a drone is a flying robot that can be remotely controlled or fly autonomously using software-controlled flight plans in its embedded systems that work in conjunction with onboard sensors and a global positioning system (GPS).
UAVs were most often associated with the military. They were initially used for anti-aircraft target practice, intelligence gathering and, more controversially, as weapons platforms.

USES: Drones are now also used in a range of civilian roles, including the following: **search and rescue, surveillance, traffic, monitoring, weather monitoring, firefighting, personal use, drone-based photography, videography, agriculture, delivery services**

8. Designing Wind Mill Assembly with full description and useCases



About Windmill

A windmill is a structure that converts wind power into rotational energy by means of vanes called sails or blades, specifically to mill grain (gristmills), but the term is also extended to windpumps, Wind turbines and other applications. The term wind engine is sometimes used to describe such devices.

A windmill is a device for tapping the energy of the wind by means of sails mounted on a rotating shaft. The sails are mounted at an angle or are given a slight twist so that the force of the wind against them is divided into two components, one of which, in the plane of the sails, imparts rotation.

Types Of Windmills

1. Horizontal-Axis Turbines
2. Vertical-Axis Turbines
3. Post Mill
4. Smock Mill
5. Tower Mill
6. Fan Mill

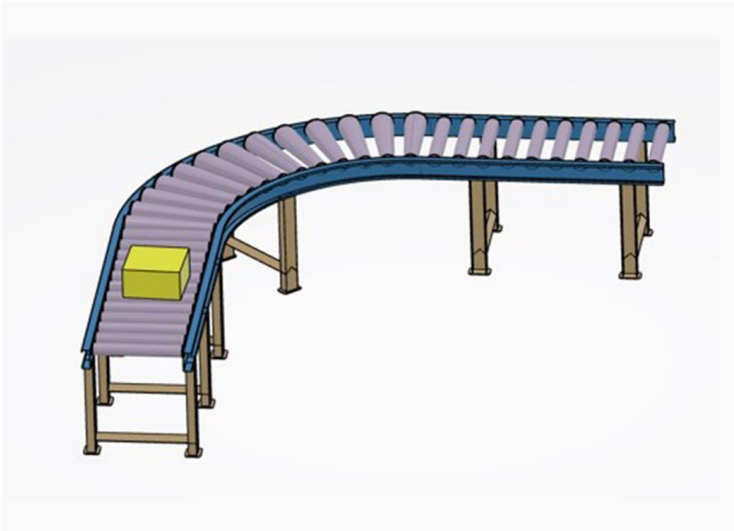
Uses Of Windmill

- Generating electricity: The most common use of windmills is to generate electricity.Modern wind turbines are designed specifically for this purpose and are connectedto the electrical grid. When the wind blows, the wind turbines generate electricity that is fed into the grid, which is then distributed to homes and businesses.
- Pumping water: Windmills have been used for centuries to pump water from wellsor reservoirs. A windmill can be used to lift water from a lower elevation to a higherelevation, where it can be used for irrigation or other purposes.
- Grinding grain: Windmills have also been used to grind grain into flour. In this application, the windmill's rotor is used to turn a millstone that crushes the grain into a fine powder.
- Other mechanical tasks: Windmills can also be used to power other mechanical devices, such as sawmills, threshing machines, and other equipment.
- Landscaping: Windmills can also be used for decorative purposes, such as in landscaping or as a feature in a garden.

Windmills in Tamil Nadu

- The Muppandal Wind Farm is India's largest operational onshore wind farm. This project is located in Kanyakumari district, Tamil Nadu. The project was developed by Tamil Nadu Energy Development Agency. Its installed capacity is 1,500 MW, which makes it the 3rd-largest operational onshore wind farm in the world.
- According to the National Institute of Wind Energy (NIWE), over 3,000 wind turbines in the state have capacities less than 1 MW each and a cumulative capacity of 800 MW that has exceeded its design life of 20 years.

9. **Designing the Line Shaft Roller Conveyor assembly with fulldescription and use cases**



Line Shaft Roller Conveyor assembly

Roller Conveyors are a series of rollers supported within a frame where objects can be moved from one place to another place by means of manually, by gravity or by power. There are a wide range of ways roller conveyors can be used and modified for different uses including transporting boxes, cardboard boxes, crates, pallets, plastic totes, polybags, slave boards and trays. Roller conveyors are normally used in environments such as warehouses or manufacturing facilities due to the nature if transporting goods.

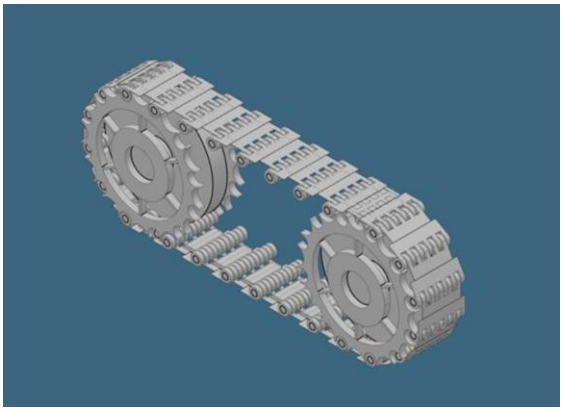
Using a roller conveyor can add versatility to the type of transfers, diverters, and stops that can be used as part of a conveyor system or automation system. Roller conveyor available in mild steel, galvanized, plastic or stainless steel based on requirements the material of the rollers can be decided.

A line-shaft conveyor is a very cost-effective solution to your order transportation and accumulation needs. This style of conveyor uses a line shaft with a series of drive spools going the shaft the length of the conveyor. These spools have a series of tensioned urethane bands which connect to the gravity rollers on the system. As the line shaft spins, it turns the spools, which in turn rotates the urethane bands on the rollers causing them to turn. The spools are designed to slip allowing accumulation without damaging the product. Our line-shaft comes with an industry leading 5-year warranty. The reason line-shaft has a lower price relative to other styles of powered conveyor is in the efficient drive design. With the use of universal joints for curves, transfers, and spurs, you can slave these additional sections off of one drive without the need foradditional motors. This allows for complex configurations with minimal cost in motors and controls.

Application:

Food handling, Packaging, Logistics, Mail delivery services, Baggage handling, Steel making, Manufacturing industries and Most of automation industries

10. Designing the Chain Conveyor Assembly with fulldescription and use cases



Chain Conveyors

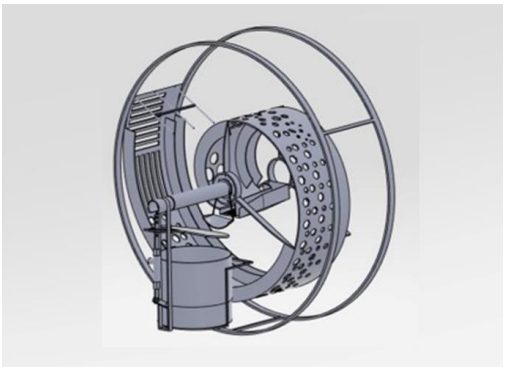
Chain conveyors are used for moving products down an assembly line and/or around a manufacturing or warehousing facility. Chain conveyors are primarily used to transport heavy unit loads.

Industries Uses Of Chain Conveyor:

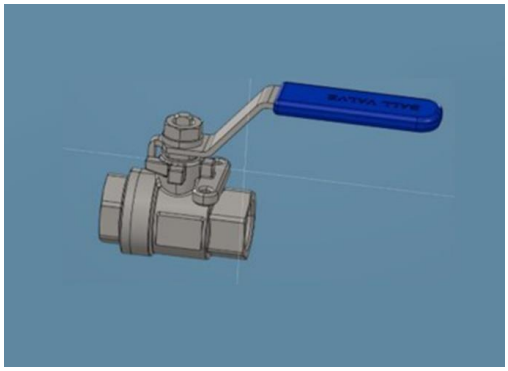
Many upcoming industry sectors use such systems technology in their production lines. The automobile industry mostly uses chain conveyor systems to convey the car parts through paint plants. These systems also have widespread use in the white and brown goods, metal finishing and distribution industries. Conveyor chains are used in a variety of applications as diverse as food service and automotive parts. Historically, the automotive industry has been a major user of this type of transportation of heavy items between various stations within a warehouse or production facility.

11. Designing Engineering Equipment's Assembly

TASK 1: Designing the Automatic SievingMachine



TASK 2: Designing the Ball 2 Way ValveBearing Assembly



Automatic Sieving Machine

Sieving machines are used for removing dust from granular products and for grading grains. Theyare also used for the classification of granular material and the separation of solids from a slurrymix in the food processing industries.

Industries: **Flour mills, Basen plants, chemical industries**
What are the types of sieving machine?

3 main types of Sieve Shakers:

Mechanical Sieve Shakers.

Vibratory Sieve Shakers.

Sonic Sieve Shakers.

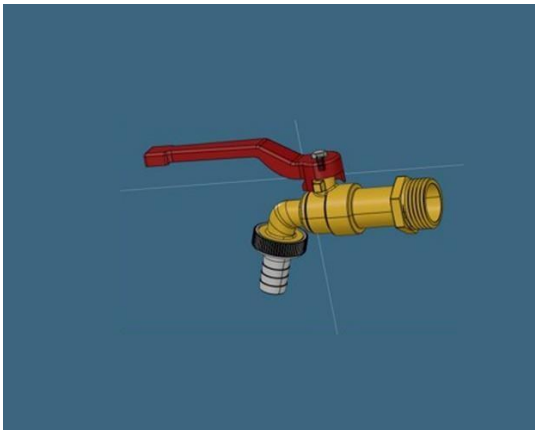
Ball 2 Way Valve Bearing Assembly
The 2-way ball valve is one of the most common valves on the market. It has 2 ports, an inlet and an outlet, and a ball with a bore in it. They are operated by a manual hand lever to turn the ball 90 degrees, which is why they are often called quarter turn ball valves or shut off valves. 2-way valves allow operators to run heating and cooling systems at variable flow rates, increasing process efficiencies, and lowering their operating costs.

There are four general types of ball valves: full port, standard port, reduced port, and v port. A full port ball valve has an oversized ball so that the hole in the ball is the same size as the pipeline resulting in lower friction loss. Flow is unrestricted, but the valve is larger.

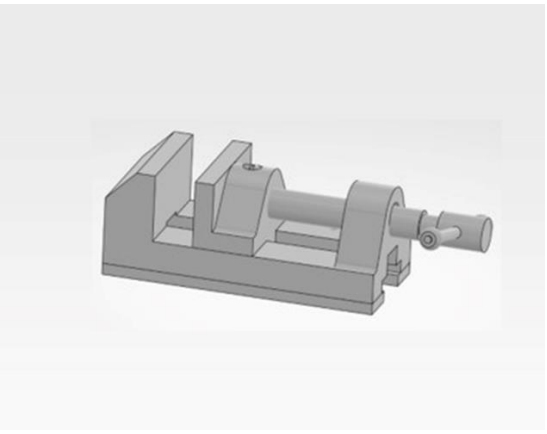
Industries: 2-way ball valve used in the Chemical, Oil & Gas, Pharmaceutical, Food Processing, Automobile industry etc.

12. Designing Engineering Equipment's Assembly

TASK 1: Designing the Rankin ValveAssembly



TASK 2: Designing the Bench Vice Assembly



Bench Vice Assembly

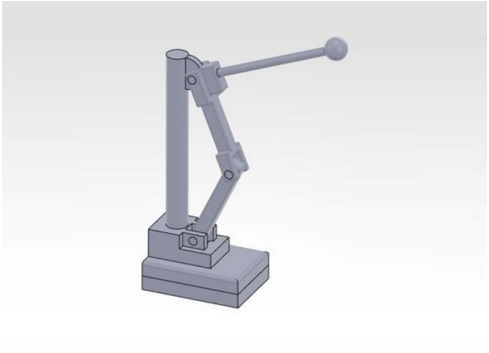
Bench Vise is a mechanical apparatus used to secure an object to allow work to be performed on it. Vises have two parallel jaws, one fixed and the other movable, threaded in and out by a screw and lever.

There are two main styles, yoke and chain. The yoke uses a top-mounted screw to clamp the pipe between two fixed angled jaws at its base; the chain style secures the pipe by wrapping it within a chain designed to adjust to length by link, tightened by a cam lever.

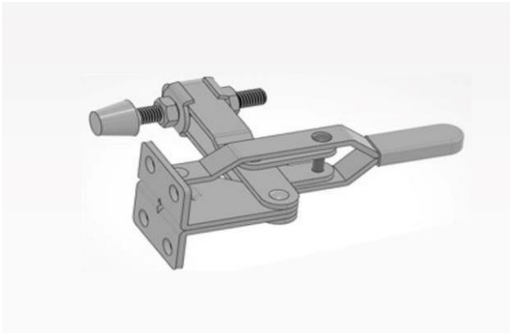
Industries: The device is widely used in the mechanical and woodworking industries, among others.

13. Designing Engineering Equipment's Assembly

TASK 1: Designing the Machine Press



TASK 2: Designing the Clamp



Machine Press

Machine press is also known as a forming press, a machine press is a tool used in the manufacturing industry to deform a workpiece under high pressure. There are different types of machine presses, including press brakes, punch presses, shop presses and more. The defining characteristic of all machine presses, however, is that they press a workpiece using high pressureto change the shape of a workpiece. Press machines have advanced features such as strength,sturdy design, and durability, which makes them poplar in end-use industries.

Industries: Press machines are widely used in industries such as automotive, food & beverage, and construction.

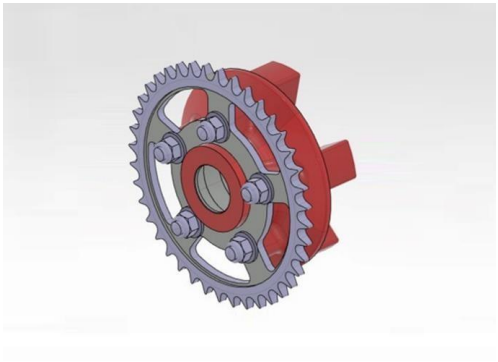
Clamp

Clamping device are used to minimize the distortion during the machining process. Once the workpiece is located, it is necessary to hold it against the machining force. The mechanism used for this is known clamps.

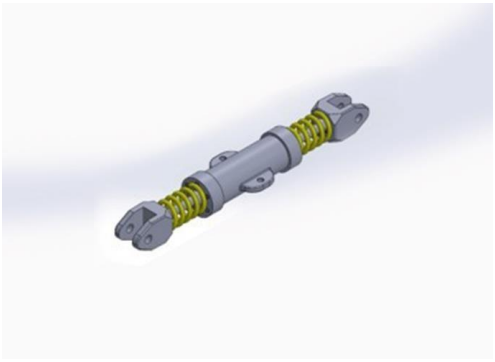
Industries: Clamping devices are used in manufacturing Industries.

14. Designing Engineering Equipment's Assembly

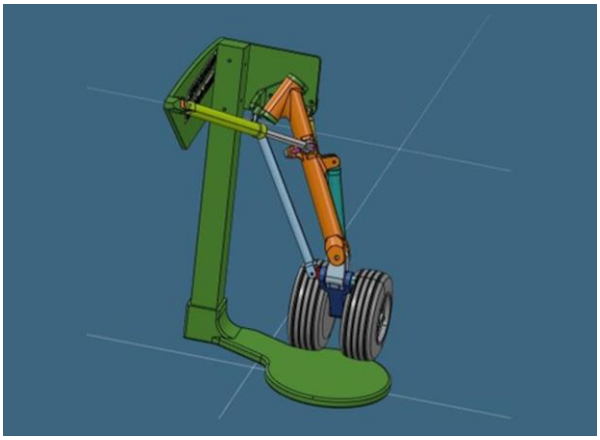
TASK 1: Designing the Chain SprocketAssembly



TASK 2: Designing the Damper System



15. Designing Aircraft Landing Gear



16. Designing the Complete Drone Assembly

17. Designing the Steering Assembly

Steering Assembly

Steering assembly is a term used to describe a system of different pivots and connecting parts located between the steering arms and steering gear that moves the tires of a vehicle. Steering assembly takes the motion from the steering gear output and transfers it to the steering arms, which in turn send it to the wheels and allow them to turn in different directions. The system functions when a driver turns the steering wheel.
Types of Steering Assembly:

When it comes to heavy-duty steering linkage gear systems, there are three general types. They are the worm-and-sector, rack-and-pinion and recirculating-ball steering gear systems.

Worm and sector

The worm gearing used in these steering systems is slightly modified. The threads of the driving worm gear are meshed with the threads of a sector gear (via an input shaft). Rotating the input shaft transfers the rotary motion (via an output shaft) to the Pitman arm. The Pitman arm movement is transmitted through the drag link, to the steering control arm, then the steering knuckle, and finally to the wheels.

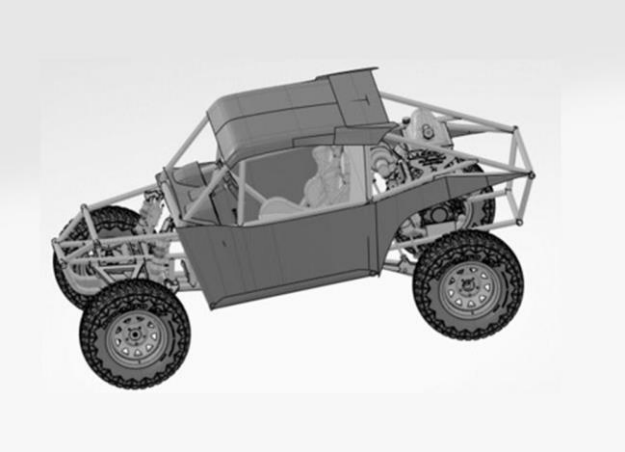
Rack and pinion

The rack-and-pinion steering linkage is the more common option seen on most cars, smaller trucks and SUVs. A semi-truck's rack-and-pinion utilizes a vertical pinion gear, horizontal rack and power-assist system that helps translate the motion of the steering wheel into linear motion, which actuates the tie rods, turning the wheels on the vehicle. Freightliner introduced rack-and- pinion steering on its Cascadia chassis in 2007.

Recirculating ball

The input shaft of this type is also connected to the worm gear. However, the worm gear that's used is straight. A ball nut mounted on the worm gear mates with it and has exterior teeth on one side that mesh with a sector gear. There are ball bearings located in the grooves between the ball nut and worm gear that transmit force when the steering wheel is turned. As the ball turning the nut moves up and down, it causes the sector gear to rotate, which in turn causes the Pitman arm to transfer motion through the drag link, to the steering control arm, and the steering knuckle to turn the wheels.

18. Designing the All -Terrain Vehicle Assembly

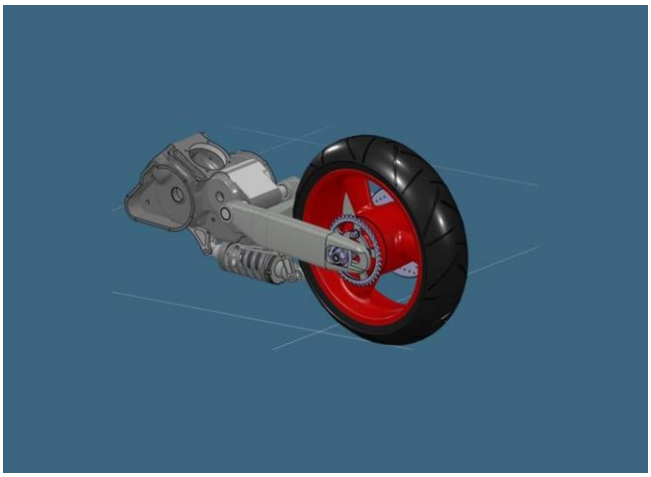


All -Terrain Vehicle Assembly

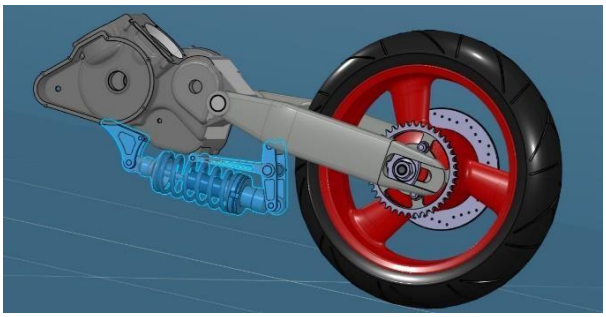
An all-terrain vehicle (ATV), also known as a light utility vehicle (LUV), a quad bike, or simply a quad, as defined by the American National Standards Institute (ANSI); is a vehicle that travels on low-pressure tires, with a seat that is straddled by the operator, along with handlebars for steering control. As the name implies, it is designed to handle a wider variety of terrain than most other vehicles. Although it is a street-legal vehicle in some countries, it is not street-legal within most states, territories and provinces of Australia, the United States or Canada.

By the current ANSI definition, ATVs are intended for use by a single operator, although some companies have developed ATVs intended for use by the operator and one passenger. These ATVs are referred to as tandem ATVs.

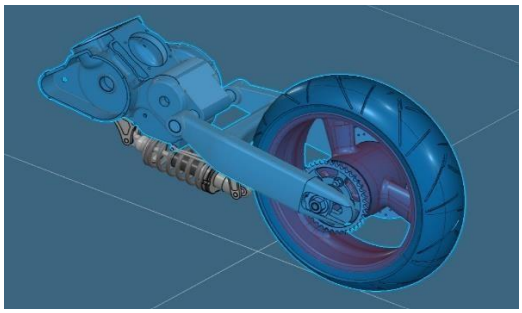
19. Designing Motor Bike Back Suspension Assembly



TASK 1: Designing Shock Absorber System

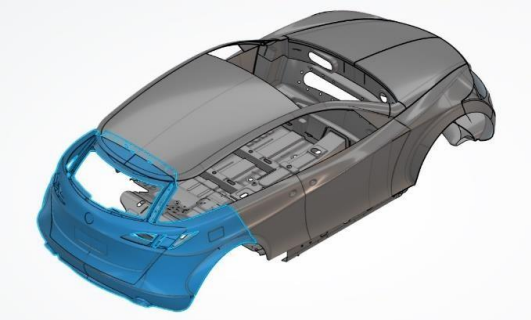


TASK 2: Designing Rear Wheel Transmission System

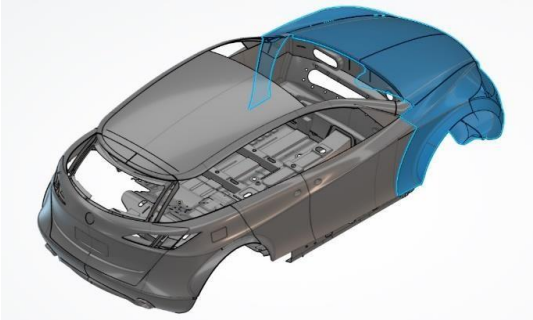


20. Designing Car Exterior Assembly

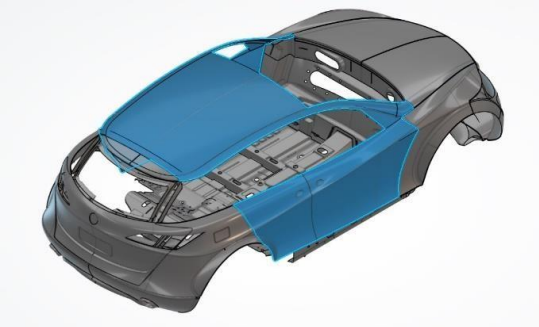
TASK 1: Designing Car Rear



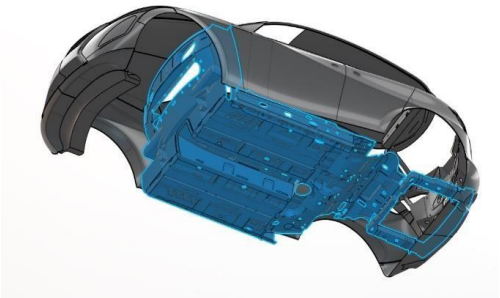
TASK 2: Designing Car Front



TASK 3: Designing Car Side & Upper Part

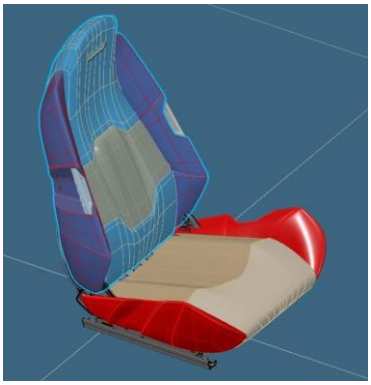


TASK 4: Designing Car Floor

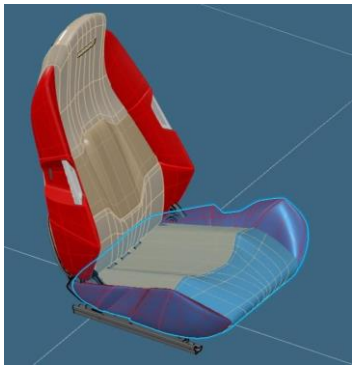


21. Designing Automobile Seat Assembly

TASK 1: Designing Front Seatback Pad



TASK 2: Designing Front Seat Cushion



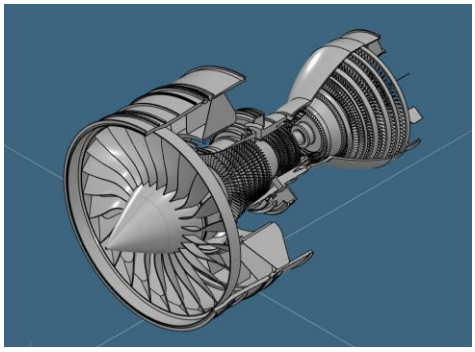
TASK 3: Designing Seat Adjuster

TASK 4: Designing Seat Plastic Joint

TASK 5: Designing Back Centered Perforated Cushion

TASK 6: Designing Cushion Centre Perforation

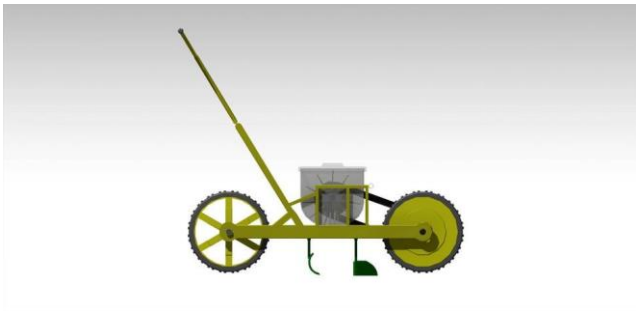
22. Designing Turbo Fan Engine



Turbo Fan Engine

A turbofan engine is a modified type of jet engine that uses a combination of bypass air and jet core efflux to create thrust. Bypass air is blown through a ducted fan. The jet core drives this ducted fan. The turbofan engine is also known as a bypass or fanjet engine.

23. Manual Seeder

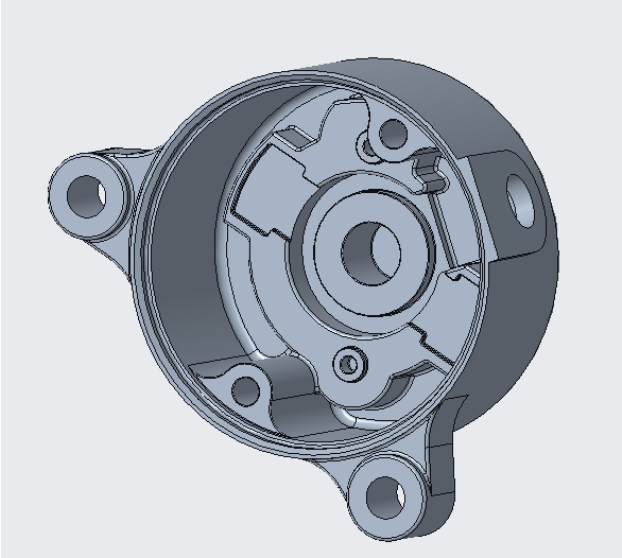


This Seeder machine will be easier for former work and increase paddy field productivity. This Push Seeder plants many seeds like Maize, bean, peanut, cotton, sunflower seed, etc.

24. Wheelbarrow

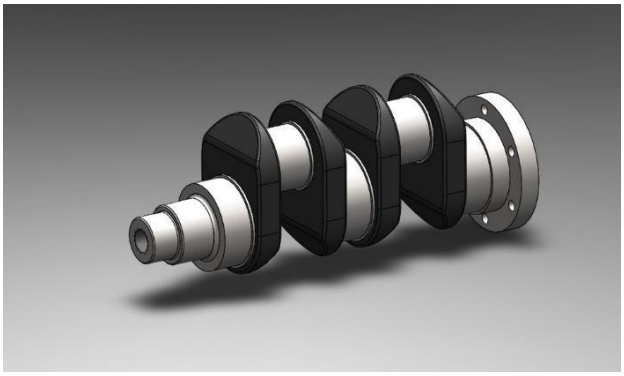
A wheelbarrow is a small hand-propelled vehicle, usually with just one wheel, designed to be pushed and guided by a single person using two handles at the rear, or by a sail to push the ancient wheelbarrow by wind.

25. Alternator Housing



Alternator housing is a casting component primarily made up of aluminum material using the HDPE process. It acts as an outer protective enclosure for the alternators used in automobiles.

26. Crankshaft



A crankshaft is a mechanical component used in a piston engine to convert the reciprocating motion into rotational motion. The crankshaft is a rotating shaft containing one or more crankpins, that are driven by the pistons via the connecting rods**.**

***Additional Industry use Cases**

1. Buckle clip -Modeling simulation
2. Reliability of Rubber seal
3. Design and development of automotive Bushings
4. weight reduction of sheet metal panel
5. Project management - design and manufacturing of motor
6. Bottle design and development - Management with dashboarding
7. Critical speed analysis of rotor systems
8. Modeling and development of fan system
9. Aerodynamic shape optimization of rotor blade of wind turbine
10. Material calibration - plastics and rubbers
11. Fully integrated Design and Analysis of brake systems
12. Automotive electrical harness
13. Integrated analysis of Pressure vessels
14. Forest trailer without crane/hydraulic arm

SB8021 **NETWORK ESSENTIALS** **L T P C**
1 0 2 2

COURSE CONTENT

UNIT I Basics of Networking **3 + 6**

Basics of Network Communication - Network Types, Data Transmission, Bandwidth and Throughput - Clients and Servers, Network Components. Online Connections – Wireless Networks, Local Network connections, Network documentation.

UNIT II Introduction to Network Simulation and communication **3 + 6**

Network Simulation using Packet Tracer: Packet Tracer Network Simulator, Packet Tracer Network Simulator , The Packet Tracer User Interface, Packet Tracer Network Configuration - Building a simple Network : Network Media Types, Ethernet Cabling, Coaxial and Fiber-Optic Cabling,Twisted Pair Operation, Verify Connectivity - Communication Principles : Network communication protocols & Standards, OSI and TCP/IP models

UNIT III introduction to Network Addressing **3 + 6**

Process of encapsulation and Ethernet framing, Hierarchical Network Design, network communication at the access layer, Broadcast Containment, Routing between networks – Routing table, creating a LAN - Internet Protocol: IPv4 Addressing – Binary conversion, IPv4 Address structure, Classful IPv4 Addressing, Public and Private IPv4 Addresses, Unicast, Broadcast, and Multicast Addresses Unicast, Broadcast, and Multicast Addresses - Static and Dynamic Addressing, DHCPv4 Configuration. IPv4 and IPv6 Address Management - Network Boundaries, Network Address Translation, IPv4 Issues, IPv6 Features

UNIT IV Introduction to Transport layer **3 + 6**

Transport Layer Services - The Client Server Relationship, TCP and UDP, Port Numbers - Application Layer Services - Network Application Services, Domain Name System, Web Clients and Servers-

HTTP & HTML, FTP Clients and Servers, Virtual Terminals-Telnet & SSH, Email Protocols - Wired & Wireless network technologies, Wi-Fi, Wireless Traffic Control, Configuring a wireless LAN device, ISP Connectivity Options, Network Virtualization, Mobile Device Connectivity

UNIT V Introduction to Network Security & Troubleshooting 3 + 6

Security Threats, Social Engineering Attacks, Malware, Denial of Service, Security Tools, Antimalware Software - Configuring basic network security: Wireless Security Measures, configuring firewall - Cisco Switches : Switch Boot Process, Cisco Routers, Router Boot Process - Cisco IOS Command Line- IOS Navigation, navigation of Cisco IOS to configure network devices - Building a Small Cisco Network - Basic Switch Configuration, Initial Router Settings, Switch to router connection - Troubleshooting common network problems: Troubleshooting, Physical Layer Problems, Troubleshooting Commands, wireless issues, Common Internet Connectivity Issues

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Create a simulated network using Cisco® Packet Tracer.
- Build a simple home network.
- Create a fully connected LAN.
- Configure an integrated wireless router and wireless client to connect securely to the internet.
- Connect wireless PC clients to a wireless router.
- Configure basic network security.
- Build a simple computer network using Cisco devices.
- Troubleshoot basic network connectivity issues

HARDWARE REQUIREMENT:

- "1 PC running Windows 10, 1 Wireless NIC or USB dongle
- A smartphone or tablet as a host device, 1 Ethernet cable
- 1 wireless home router"

SOFTWARE REQUIREMENT

- Open-source server software: For various services and protocols, such as Telnet, SSH, HTTP, DHCP, FTP, TFTP, etc.
- Tera Term source SSH client software for lab PCs.
- Oracle VirtualBox, most recent version.
- Wireshark version 2.5 or higher.

INDUSTRY USE CASE:

- Making of cross cable and straight cable.
- Configuration of switches and routers
- Creation of different Topologies using switches and Routers for Connecting Computers
- Transferring data’s in an established Computer Network using addressing schemes.
- Creation of a simple Local Area Network.
- Software Use Cases:
- Routing Protocols.
- Simulation of unicast and multicast routing protocols
- Observing Packets across the network and Performance Analysis of Routing protocol

SB8022 INDUSTRIAL METAVERSE USING MIXED REALITY (XR) L T P C
1 0 2 2

COURSE OBJECTIVE:

- Create a Digital twin
- Create build the network and messaging infrastructure for digital twin.
- Build a metaverse for hosting digital twin component
- Digital component Presentation using Virtual reality.

COURSE CONTENT:

UNIT I Build physical infrastructure using microprocessor and sensors

Introduction to Metaverse and Physical environments - Introduction to microcontroller and sensors - What is analogue and digital data - Getting started with programming for microcontroller - How to Interface Sensors with a microcontroller

UNIT II Build the transport layer for metaverse using Cloud computing services

Introduction to IoT and Cloud - Features of cloud and its initialization - How to read and write data to cloud - Integration of microcontroller and sensors from simulator with cloud

UNIT III Create digital assets required for XR interaction by using a 3D modelling tool

Introduction to Blender - 3d modelling Structure - 3D assets and Textures - Creating a model for dam reservoir - Creating various farm states Activity performed - Build 3D Models - Texture 3D models - Animate 3D Models - Setup state machines - Bake and prepare environment for sensor data

UNIT IV Integrate digital and physical assets to create a Digital Twin in Metaverse

Introduction to Unity and packages - Optimization of 3D model - Introduction to REST API - Interfacing cloud data with unity - Testing Hardware and cloud with unity

UNIT V Build Industrial Metaverse

Introduction to Oculus quest2 - How to integrate oculus quest2 with unity -Deploying project to oculus quest2

FOR FURTHER READING:

Digital twins – Visualisation and simulation using VR – Omniverse Digital twin platform – Industrial metaverse – Digital native

TOTAL : 45 PERIODS

COURSE OUTCOME:

- Create a physical hardware on simulator that reads and controls real world data.
- Digitize and build a cloud framework to build a digital twin.
- Design virtual world with multiple asset files
- Build the Phygital Model using Virtual reality and control simulated actions in realtime

REFERENCES:

1. SketchUp for Site Design: A Guide to Modelling Site Plans, Terrain, and Architecture 2nd Edition by Daniel Tal.
2. SketchUp for Builders: A Comprehensive Guide for Creating 3D Building Models Using SketchUp by John Brock.
3. SketchUp for Interior Design: 3D Visualizing, Designing, and Space Planning.
4. The SketchUp Workflow for Architecture: Modelling Buildings, Visualizing Design, and Creating Construction Documents with SketchUp Pro and Layout.

ONLINE REFERNCES:

- Digital Twin: A Complete Guide For The Complete Beginner, a book by Vijay Raghunathan & Santanu Deb Barma
- Digital Twin – Fundamental Concepts to Applications in Advanced Manufactur- ing, a book by Surjya Kanta Pal, Debasish Mishra , Arpan Pal , Samik Dutta , De- bashish Chakravarty , & Srikanta Pal
- Learning in Metaverses: Co-Existing in Real Virtuality, a book by Eliane Schlemmer
- https://docs.arduino.cc/software/ide-v1/tutorials/Windows
- https://www.circuitstoday.com/nodemcu
- https://nodemcu.readthedocs.io/en/release/

INDUSTRY USE CASES:

1. Poultry Farming: Develop an industrial metaverse project where we would be creating a digital twin of “Poultry Farming”. Poultry Farming is a domestic or commercial breeding of birds primarily for their meat, eggs, and feathers. In this instance, it is necessary to continuously monitor the real-time data in order to automate the feeding and temperature.
2. Green House: Constructing a digital twin for a Green House in which the environment is continuously monitored based on variables such as temperature, soil, humidity, and distance.
3. Automatic shutdown system: Building an automatic shutdown system in an industrial metaverse scenario like a large commercial structure. With the help of this digital twin system, all electrical equipment would switch off, if there were no people present.
4. Smart home technology: Creating a digital twin based on smart home technology in a large residential space where an automatic shutdown system is installed. Here the sensor receives the physical world data to find whether any human presence is around and would cause all electrical equipment to turn off.
5. Factory robot: Developing a digital twin that controls a factory robot to perform any pick-and-place tasks. These industrial metaverse robots are monitored to implement automated solutions like lifting or moving objects which do not require a lot of thought processes.
6. Gantry crane machine: A gantry crane machine can be used to carry objects horizontally as well as lift and lower them. The majority of its applications involve lifting big objects and moving them to new locations. We are developing a digital twin for monitoring and controlling the Gantry crane based on real-time data.
7. Supply chain system: A supply chain system plays a vital role in the production pipeline from raw goods to finished products. Conveyors are employed in these situations to facilitate simple and quick supply chain support. In order to incorporate industrial metaverse in supply chain management, a digital twin is deployed to control and observe the conveyor system.
8. Smart home energy monitor: Build a digital twin to implement a smart home energy monitor in order to measure numerous factors that affect the power flow, such as voltage dips and load current. In this system, the physical data is collected and sent to the virtual twin in order to boost the energy performance of the residential spaces using an industrial metaverse platform.
9. Milling: Milling is one of the most important steps in the production of rice. It is generally performed post the production of rice. There are a variety of operations that have to be performed during milling in order to make rice fit for the process. We are deploying a digital twin that can control the speed of the rice mill in order to achieve the best quality with smart technology.
10. Cement Mixer: Developing a digital twin that can be used for setting up the optimal ratio of a cement mixer by controlling the speed of the motor. This speed data of the physical machine is extracted and tweaked using the virtual twin.
11. Industrial Metaverse control for reservoir automation, management, and tracking

INDUSTRY SCOPE:

- Chemical plant design and control
- Agriculture automation
- Home water automation
- Landscape Maintenance automation
- Green building planning and simulation
- Facility Management and Visualisation
- Warehouse Design and Simulation
- Component Prototyping for Automotives
- Smart Building planning

JOB ROLES:

- IoT Developer
- Automation solution architect
- Embedded Developer
- IoT Analyst
- Metaverse Architect
- Metaverse Product Manager
- XR Interaction Designer
- Digital twin specialist
- Digital twin engineer
- Digital engineer
- BI Developer
- Simulation engineer

SOFTWARE REQUIREMENTS

1. VS Code
2. Rest API
3. Blender
4. Unity3D
5. Think speak
6. Woakwi

HARDWARE REQUIREMENTS

1. PC – Minimum requirements

a) 16 – GB RAM
b) 4GB - Dedicated GPU
c) 500 GB HDD

2. Oculus (VR Presentation)

SB8023	**FOUNDATIONS FOR AI, ML,FS**	**L T P C**
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COURSE CONTENT

UNIT I Understanding the WEB **3 + 6**

Understanding the WEB: Internet, Web page, Website, Web applications - HTML for web Layout: HTML Basic Components, List, Tables, Graphics, Multi-Media, Forms, Text formatting, Block components - CSS for Page Design: CSS design principles, property: values, dynamic CSS3, box model, design layout controls - JS for Client-side scripting: Handling HTML Events, Animations, Reading element state & data, form handling and validations. Handling Cookies and Session Data -

Building Dynamic web pages using HTML 5, CSS3 and JS Understanding and using Bootstrap CSS & JS, using Bootstrap Components for quick design

UNIT II Java Object Oriented Paradigms 3 + 6

Revisiting Java Object Oriented Paradigms - Understanding OOP concepts through core Java, Core Java Annotations - Understanding Server-Side Scripting - Server-side handling benefits - Introduction to Servlets and JSP Syntax, semantics, servlet lifecycle, pre- defined objects and tags for JSP - Handling Client-side data - Reading HTML form data, handling data at backend, Projecting responses to front end - Managing Sessions at Server and Cookies at Client : Creating sessions, session data, reading and writing cookies at client side - Introduction to EL (expression language) and JSTL (java standard tag library)

UNIT III Introduction to relational databases 3 + 6

Introduction to relational databases- MySQL - Introducing relational databases, need for database, persistent storage benefits, MySQL basics, commands - CRUD operations using SQL, DDL and DML Handling databases using core JAVA Creating DAO - Managing data in databases using JSP & Servlet - Connecting to MySQL DB, performing CRUD operations using, persistent storage of front-end data to MySQL DB - Handling NoSQL database – MongoDB

UNIT IV Modern web development using ReactJS 3 + 6

Modern web development using ReactJS - Introduction to ReactJS: Basics of ReactJS framework, develop using React components and single page applications - Building React Native Application from Scratch: Creating UI using React Native Creating Business Logic using J2EE Creating Database Connectivity

UNIT V Web Development using Spring Framework 3 + 6

Web Development using Spring Framework : Understanding MVC, Maven Projects & Dependencies (pom.xml) Working with annotations (spring annotations)- Database CRUD operations using DB classes - Web Development using Spring Framework - Understanding MVC - Maven Projects & Dependencies (pom.xml) - Working with annotations (spring annotations) Database CRUD operations using DB classes - Integrating web template UI with Spring - Creating responsive UI using Bootstrap Integrating Spring with all CRUD operations

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Exploring architecture of a website
- Execute Core JAVA (J2SE) Programming and Coding Skills
- Work with most popular web development technologies
- Create and host websites and web apps for commercial usage
- Create responsive and interactive UI
- Work with React JS framework to create responsive web applications
- Work with JAVA Spring framework for end-to-end web solutions
- Work with databases in web apps

FOR FURTHER READING:

Sr. No.	Title	Author	Edition	Publisher
1.	Student handbook on Full Stack Web Development	Team Edunet	2nd	Edunet Foundation
2.	HTML and CSS: Design and build websites	John Duckett	1st	John Wiley & Sons, Inc.
3.	Java: The Complete Reference	Herbert Schildt	11th	O'Reilly Media, Inc.

ONLINE REFERENCES:

Sr. No.	Topic	Course link
1.	Build a simple website using HTML, CSS, and JavaScript	https://docs.microsoft.com/en-us/learn/modules/build-simple- website/
2.	Programming Foundations: Fundamentals	https://www.linkedin.com/learning/programming- foundations-fundamentals
3.	Programming Foundations: Databases	https://www.linkedin.com/learning/programming- foundations-databases-2
4.	Succeeding in Web Development: Full Stack and Front End	https://www.linkedin.com/learning/succeeding-in- web-development-full-stack-and-front-end
5.	HTML Essential Training	https://www.linkedin.com/learning/html-essential- training-4
6.	CSS Essential Training	https://www.linkedin.com/learning/css-essential- training-3
7.	JavaScript Essential Training	https://www.linkedin.com/learning/javascript- essential-training
8.	Learning SQL Programming (2017)	https://www.linkedin.com/learning/learning-sql- programming-2017
9.	JavaScript with HTML and CSS	https://lab.github.com/bitprj/javascript-with-html- and-css
10.	Introduction to React	https://lab.github.com/githubtraining/introduction- to-react
11.	Introduction to HTML	https://lab.github.com/githubtraining/introduction- to-html
12.	Introduction to Node with Express	https://lab.github.com/everydeveloper/introduction- to-node-with-express
13.	Learning MongoDB	https://www.linkedin.com/learning/learning-mongodb-14532813?trk=learning-topics_learning- search-card_search-

		card&upsellOrderOrigin=default_guest_learning
14.	React	https://docs.microsoft.com/en-us/learn/paths/react/
15.	Enhance the user interface of your Windows 10 app	https://docs.microsoft.com/en-us/learn/modules/enhance-ui-of-windows-10-app/
16.	Build JavaScript applications with Node.js	https://docs.microsoft.com/en-us/learn/paths/build- javascript-applications-nodejs/
17.	Deploy MariaDB, MySQL, and PostgreSQL on Azure	https://docs.microsoft.com/learn/modules/deploy- mariadb-mysql-postgresql-azure/
18.	Google Analytics Essential Training	https://www.linkedin.com/learning/google-analytics- essential-training-5
19.	Introduction to SQL	https://lab.github.com/CastleArg/introduction-to-sql

HARDWARE REQUIREMENT:

- A Computer System (PC/Laptop) with Windows/Linux and the following preferred requirements:
- RAM size - 2GB or more,
- HDD size - 20 GB free disk space is required,
- High-speed internet connection (1 Mbps recommended),
- and compatibility with the following software(s):

SOFTWARE REQUIREMENT

- Notepad and Visual Studio Code Editor (https://code.visualstudio.com/) (For Full Stack Web Development)
- A Web browser (Microsoft Edge or equivalent)

INDUSTRY USE CASES:

1. To implement application for providing the basic home services (Electrician, Plumber, Water Supply) for Villagers
2. Doctor Appointment System
3. E-voting System
4. Authentication system (Pass wordless)
5. Currency Convertor – With Real Time Conversion Rate
6. Create own payment method using QR Code Scanner
7. 24/7 Website Monitoring Software
8. Online admission process implementation of data mining techniques
9. Health care Management system for managing all the health-related document within single application and to remove the paper work
10. Enhance CV Online
11. Online Compiler
12. Clone of any website (Youtube, Instagram, FB)
13. Work or Task arrangment/management/prioritise system (To-do list with deadline)

14 mental health awareness camp application
15 Sql Injection Prevention System
16 Secure Online Auction System
17 Online Visiting Card Creation
18 Detecting Data Leaks
19 Online Loan Application & Verification System

SB8024 BLOCKCHAIN DEVELOPMENT L T P C
1 0 2 2

COURSE OBJECTIVE:

1. Ability to develop a structure of data with inherent security qualities based on principles of cryptography, decentralization, and consensus
2. Develop smart contracts using the Solidity programming language (including a deep understanding of the provided Libraries)
3. Implement the consensus methods in transactions and apply blockchain for different application domains
4. Develop your own applications for various user requirements using Blockchain and launch it for public and commercial use
5. Apply Hyperledger Fabric and Ethereum platform to implement the Block Chain Application.

COURSE OUTLINE:

UNIT I Introduction and Overview of Blockchain 3 + 6

Introduction | What is a Blockchain? | Why Blockchain? | Types of Blockchain | Scope and Importance of the Technology | Future Opportunities | Blockchain Platforms | Miners - the Nonce and the Cryptographic Puzzle | Proof of Work & Proof of Stake | Consensus Algorithms | Fault Tolerance Mechanism | Creation of a Block | Transaction Record

UNIT II Blockchain - the Future of Digital currency 3 + 6

What is Bitcoin? | Bitcoin's Monetary Policy | Bitcoin Wallets | Application of Bitcoins | Bitcoin - Script, Address and Transaction | Understanding Mining Difficulty | Virtual Tour of Bitcoin Mine | Mining Pools | Nonce Range | How Miners Pick Transaction | CPU's Vs GPU's Vs ASIC's | How does Mempools Work | Orphaned Blocks | The 51% Attack | How Wallets Work | Signatures: Private and Public Keys Demo: Setting up a Wallet, Signatures & Key

UNIT III Ethereum 3 + 6

What is Bitcoin? | Bitcoin's Monetary Policy | Bitcoin Wallets | Application of Bitcoins | Bitcoin - Script, Address and Transaction | Understanding Mining Difficulty | Virtual Tour of Bitcoin Mine | Mining Pools | Nonce Range | How Miners Pick Transaction | CPU's Vs GPU's Vs ASIC's | How does Mempools Work | Orphaned Blocks | The 51% Attack | How Wallets Work | Signatures: Private and Public Keys Demo: Setting up a Wallet, Signatures & Key

UNIT IV Smart Contracts 3 + 6

What is a Smart Contract? | Smart Contract Environment | Solidity Programming | Array, Enum and Structs | Inheritance | ERC20 | ERC721

UNIT V Hyperledger and IPFS 3 + 6

What is Hyperledger? | Importance of Hyperledger | Hyperledger Architecture & its Layers | Hyperledger Transactions | Hyperledger Fabric | Hyperledger Fabric Model | Building a Hyperledger

Fabric Network | Fabric Peer | Hyperledger Fabric CA | Sawtooth | Iroha & Indy | API in Hyperledger | Network Topology in Hyperledger | IPFS Introduction | IPFS Working | IPFS for Blockchain Application

TOTAL: 45 PERIODS

COURSE OUTCOME:

On completion of the course the student:

1. can write a smart contract to insert a value into the Ethereum blockchain using metamask
2. is able to navigate the Remix IDE web URL on the browser and explore the various tabs and features of the IDE
3. can connect to the Ganache localhost through Web3 provider, Ropsten testnet using Metamask and Injected Web3
4. is able to write a Program on the arrays in the Solidity with regards to fixing the length and dynamic
5. can generate the ABI and Bytecode of a Smart Contract by compiling the solidity file
6. can develop a program that transfers the smart contracts between the parties which can aid in automated

20 INDUSTRY USE CASES

Problem Statement: 1

Blockchain technology came into the ground to overcome these issues. It offers decentralized nodes for the banking system and is used to produce a transparent banking system for its end-to-end verification advantages. This technology is a replacement for the traditional banking system with distributed, nonrepudiation, and security protection characteristics.

You are a Blockchain expert in a major corporate bank and have been tasked to create a smart contract to perform banking transactions. Create a Smart Contract for a banking application in solidity that allows users to do the following:

• Mint money into your account
• Withdraw money from your account
• Send money from your account to smart contract address
• Check balance

Problem Statement: 2

Blockchain is a technology designed to manage patient data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.

Create a solution where you can store the electronic health record of the patients in a distributed and decentralized network. You should be able to query and change the ownership of the record as necessary.

Problem Statement: 3

Blockchain is a technology designed to manage education data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.

Design a solution where you can store the digital certificates of the students in a distributed and decentralized network. You should be able to add the certificated details into the blockchain query the certificate details from the blockchain.

Problem Statement: 4
Blockchain is a technology which enables elections to be done transparently. We can avoid rigging or any corrupt activities using the technology and should be able to make sure that the votes are also accounted for on a real-time basis.
Design an electronic voting system, using the ethereum blockchain (smart contracts) and more precisely the RPC test which enables account generation with a private and public key. Blockchain electronic voting system using smart contracts.

Problem Statement: 5
Smart cities and smart houses are in fashion and thus all this can be kept in a blockchain. We can focus on building system which can manage all the real estate related contracts through blockchain technology which will enhance security and will provide more efficiency.

Design a smart contract using the Ethereum blockchain in a distributed and decentralized network. You should be able to add the property details to the blockchain, query the property details from the blockchain and should be able to change the ownership of the property appropriately.

Problem Statement: 6
Food items like fruits and vegetables generally do not have any expiry date mentioned so it becomes important to understand the origin of these food items and know the date when was it sent to the distributor from the farmer and so on.
Design a smart contract using the ethereum blockchain where you should be able to authenticate the food item and consume that without any worry
Problem Statement: 7 (Identity)
Blockchain is a technology that enables identities to be stored transparently. It offers decentralized nodes for end-to-end verification advantages. This technology is a replacement for traditional identity management with distributed, nonrepudiation, and security protection characteristics.
Design a smart contract using the Ethereum blockchain where you should be able to store the identity details in the blockchain and should be able to query the details of the identity from the blockchain

Problem Statement: 8
Blockchain is a technology that allows you to store books transparently. It offers decentralized nodes for the end-to-end verification advantages in the library. This technology is a replacement for a traditional book management system with distributed, non-repudiation, and security protection characteristics.
Design a smart contract using the Ethereum blockchain where you should be able to store your book details in the blockchain and should be able to query the details of the books from the blockchain and if required we should be able to change the ownership of the books and the same should be updated in the blockchain.

Problem Statement: 9
Blockchain is a technology that allows you to trace your drugs transparently. It offers decentralized nodes for the end-to-end verification to trace the drugs in a transparent manner. This technology is a replacement for traditional drug management systems with distributed, non-repudiation, and security protection characteristics.
Design a smart contract using the Ethereum blockchain where you should be able to track the drugs transparently.

Problem Statement: 10
Blockchain is a technology that allows you to trace your vaccines transparently. It offers decentralized nodes for end-to-end verification to trace the vaccines in a transparent manner.

Design a smart contract using the Ethereum blockchain where you should be able to track the vaccines and you should be able to add the details of the vaccine to the blockchain and should be able to query whenever it is required.

Problem Statement: 11
Blockchain is a technology that allows you to trace data transparently. It offers decentralized nodes for the end-to-end verification to trace the transportation data in a transparent manner.
Design a smart contract using the Ethereum blockchain where you should be able to track the National and state highways, toll collection, tracking of public infrastructure using the smart contract in the blockchain

Problem Statement: 12
Design a smart contract using the Ethereum blockchain where you track the progress on climate agreement through Blockchain. You should be able to add the confidential details of climate change into the blockchain, should be able to query the details from the blockchain and then change the confidential details whenever it is required.

Problem Statement: 13
Design a smart contract using the Ethereum blockchain where you can add the relevant documents on Micro-financing, and financing small businesses or individuals into the blockchain You should be able to add the financial details into the blockchain, should be able to query the details from the blockchain and then change the financial details whenever it is required.

Problem Statement: 14
Design a smart contract using the Ethereum blockchain where you can add the relevant documents on agriculture data into the blockchain You should be able to add the agriculture product details into the blockchain, should be able to query the details from the blockchain, and then change the details whenever it is required.

Problem Statement: 15
Blockchain is a technology designed to manage farm insurance data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.

Design a smart contract using the Ethereum blockchain where you can add the farm insurance data into the blockchain You should be able to add details into the blockchain, should be able to query the details from the blockchain and then change the details whenever it is required to change the insurance details whenever it is required.

Problem Statement: 16
Blockchain is a technology designed to manage toll-free data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Network members validate the data entered into the ledger, and once entered, the data is immutable.
Design a smart contract using the Ethereum blockchain where you can add the toll-free data into the blockchain You should be able to add details into the blockchain, should be able to query the details from the blockchain and then change the details whenever it is required. You can take all the parameters which you want to store as part of the toll data.

Problem Statement: 17
Blockchain technology is a decentralized, distributed ledger that stores the record of ownership of digital assets. Any data stored on the blockchain is unable to be modified, making the technology a legitimate disruptor for industries like payments, cybersecurity, and healthcare. Discover more about what it is, how it's used, and its history.
Design a distributed ledger via the nodes connected to the chain. You can use any kind of electronic device for the blockchain nodes to maintain copies of the chain network functioning and can create inherent security by giving a unique alphanumeric identification number needed to shows their transactions

Problem Statement: 18
Blockchain is a technology designed to strengthen media industry data that has the potential to deal with data privacy, royalty payments, and piracy of intellectual property. A blockchain can give the industry a much-needed facelift when it comes to data rights, piracy, and payments.
Design a smart contract using the Ethereum blockchain where you can prevent digital assets, from existing in multiple places. You should be able to add details to the blockchain, should be able to preserve ownership, make piracy from the blockchain and then change the details whenever it is required to maintain the data integrity.

Problem Statement: 19
Blockchain is a technology to secure government documents and also improve bureaucratic efficiency, and accountability and reduce massive financial burdens. Blockchain has the potential to revolutionize our elections. Blockchain-based voting could improve civic engagement by providing a level of security and incorruptibility and transparency by recording a public record of all activity.
Design a smart contract using the Ethereum blockchain where you can encrypt a biometric security system making the voting platform an open-source virtual blockchain ballot box. You can take all the parameters which you want to store as part of the ballot data.

Problem Statement: 20
Blockchain is a technology that is designed to manage non-fungible tokens (NFTs). NFTs are simply digital items, like music, art, GIFs, and videos that are sold on a blockchain, ensuring that a sole owner can claim full rights to them. Consumers can now claim sole ownership over some of the most desirable digital assets for their applications.
Design a smart contract using the Ethereum blockchain where you can add the popular IPs and brand figures into digital collectibles for consumers. You should be able to add an ecosystem into the blockchain, which allows fans and collectors to interact with icons in the form of official licensed digital collectibles.

S.No	Blockchain Reference Books
1	Saurabh Kumar and Saxena Ashutosh., 2020." Blockchain Technology: Concepts and Applications" Wiley India Pvt Ltd, First Edition, ISBN-10: 8126557664, ISBN-13: 978-8126557660
2	Arun, Jai Singh & Cuomo, Jerry & Gaur, Nitin., 2019." Blockchain for Business" Pearson Education, First edition, ISBN-10: 938958888X, ISBN-13: 978-9389588880
3	Tulajadas Choudhari, Ambadas & Sarfarz Ariff, Arshad & M.R. Sham., 2020. "Blockchain for Enterprise Application Developers" Wiley, First edition, ISBN-10: 8126599960, ISBN-13: 978-8126599967

4	Subramanian, Chandramouli & George A., Asha & K.A., Abhilash & Karthikeyan, Meena., 2020. "BLOCKCHAIN TECHNOLOGY" Universities Press (India) Pvt. Ltd., First edition, ISBN-10: 9389211638, ISBN-13: 978-9389211634

BOOKS REFERENCE:

SB8025 DIGITAL MARKETING L T P C
1 0 2 2

COURSE OBJECTIVE:

1. Ability to develop a digital marketing plan that will address common marketing challenges
2. Ability to Articulate the value of integrated marketing campaigns across SEO, Paid Search, Social, Mobile, Email, Display Media, and Marketing Analytics.
3. Potential to recognize key performance Indicators tied to any digital marketing program
4. Calibre to improve Return on Investment (ROI) for any digital marketing program
5. Launch a new, or evolve an existing, career path in Digital Marketing and the ability to build their own start-ups

COURSE CONTENT:

UNIT I Introduction to Digital Marketing 3 + 6

Basics of Marketing **|** Traditional Marketing Vs Digital Marketing **|** 5P's of Marketing **|** Segment, action, and Targeting **|** Customer Lifecycle **|** Digital Marketing Modules **|** RACER Framework **|** Digital Marketing Trends

UNIT II Social Media Marketing 3 + 6

Marketing Approach **|** Gen X **|** Gen Y **|** Gen Z **|** Gen Alpha **|** Conversation Prism **|** Social Media Strategy **|** Social Media Channels Penta Social Elements (Social Talking, Listening, WOM, Feedback, Selling) Personas Influencer Marketing Sentimental Analysis Effective Social Media Marketing Usage Social Media Tools Jargons

UNIT III Content Marketing & Automation 3 + 6

Content Marketing Landscape **|** Types of Content Marketing **|** Content Marketing Strategy **|** Affiliated Marketing **|** Content Marketing Tools **|** Jargon **|** Effective Email Marketing **|** Essentials in Email Marketing **|** Types of Emails **|** Email Automation **|** Email Marketing Metrics **|** Marketing Automation **|** Martech Landscape **|** Features of Marketing Automation **|** Choosing a Marketing Automation Platform

UNIT IV Video Marketing & Digital Marketing 3 + 6

Create Economy **|** YouTube **|** YouTube Ads **|** YouTube Partner Program **|** Instagram Marketing **|** Live Streams **|** Revenue Generating Streams **|** So-Lo-Mo | Paid Search / PPC **|** Social Media Ads **|** Types of Google Ads**|** Keywords **|** How do Google Ads work? **|** Cost & Budgets**|** Remarketing & Retargeting **|** Tools

UNIT V Search Engine Optimization & Search Engine Optimization 3 + 6

SEO & SEM Fundamentals**|** How Search Engine On-Page **|** Types of Keywords **|** On-Page SEO **|** Off-Page SEO **|** SEO Tools **|** SEO Reporting **|** Digital Marketing Strategy for a Startup/Entrepreneur **|** Business Growth Opportunities **|** Career Growth Opportunities**|** Best Practices

TOTAL : 45 PERIODS

COURSE OUTCOME:

The student can :

1. develop a compelling content strategy for all kinds of business
2. build PPC campaigns and also design Paid ads and optimize great ad copywriting
3. design suitable display ads (using tools like Canva), Publish and run ads as per business goals
4. do e-mail Marketing, social media, build a template, Insert Content and Images
5. can build their own virtual organization by providing various digital marketing services

20 INDUSTRY USE CASES:

1. Brand Name Creation: Create a brand name, Brand identity Design: Design a brand logo - using Canva and Create an email account on Gmail to link all your project work - (brandname@gmail.com), use this email account centrally to access all tools and platforms by signing up with the created gmail id.
2. Social Media Campaign: Create a mock Social media campaign - choose the ideal channel (FB, Insta, Linkedin, Youtube etc)
3. Keyword Research/Analysis: Use social listening tools handled in the course to identify keywords for your content strategy (Listdown top 5 keywords and the source of SEO tools used)
4. Blogging: Create your first blog - 500-800 words on wordpress blogs (grammarly, COPYAI) and promote the blog on any of the social media of your choice not by posting the blog directly but by creating a promo link for the blog and attract a minimum of 50 Likes on the blog.
5. Building a Website: Create your first website using - WIX/Canvae
6. Build a Landing Page: Create a landing page using - mailchimp/hubspot
7. Build a content marketing plan: with a focus on top 3 content types (video, email, blogs, podcast etc) - based on a content marketing template from Hubspot
8. Brand Promo Video: Create a 60 sec promo video for your brand - using Canva, Camtasia etc and it should be a explainer video. To achieve this first write your script, then storyboard it, followed by creating an instructional design and then finally create your explainer video
9. Instagram Reel: Create an Instagram reel for your business brand and promote it attract a minimum of 100 Likes
10. Hashtag Generation: Share a list of 5 #Hashtags for the launch campaign, first identify the buzzing area, calculate the penetration power, build a curiosity around the Hashtag and finally release the Hashtag and make a minimum of 50 members from outside your friends and family to viral it.
11. Build and Email Campaign: Create a brand launch email - using Mailchimp
12. SEO :Build and execute the On-page SEO for your website
13. Create a Google Business Page
14. PPC Ad: Create a mock paid - ad campaign for your brand - Google Adwords
15. Social Ads: Create a mock sponsored post for Facebook/ Instagram/Linkedin
16. Google Analytics: Embed a Google Analytics Code on your Website
17. Sitemap: Submit your website’s sitemap to Google Search Console
18. Youtube Ad: Create a mock Youtube Ad for your brand
19. Traffic: Generate website traffic to reach at least 500 visits by the end of your project time
20. Field Visit to two businesses (eg: Malabar Gold, MRF, HAP daily, Freshworks, Zoho) meet the digital marketing managers and perform a complete in-person interview on their respective digital marketing strategies, present the research and study in a ppt format

REFERENCES:

S.No	Digital Marketing Book References
1	Gupta, Seema., 2022. "Digital Marketing" McGraw Hill, Third Edition, ISBN-10: 935532040X, ISBN-13: 978-9355320407
2	Kagan, Jeremy & Shekhar Singh, Siddharth., 2020. "Digital Marketing: Strategy & Tactics" Wiley, First Edition, ISBN-10: 9390395496, ISBN-13: 978-9390395491
3	Maity Moutusy., 2022. "Digital Marketing" Oxford University Press, Second edition, ISBN-10: 9354972470, ISBN-13: 978-9354972478
4	Hemann Chuck & Burbary Ken., 2019. "Digital Marketing Analytics" Pearson Education, Second Edition, ISBN-10: 9353430194, ISBN-13: 978-9353430191

SB8026 ROBOTIC PROCESS AUTOMATION DEVELOPMENT L T P C
1 0 2 2

COURSE CONTENT:

UNIT I Robotic Process Automation and Industry opportunities 3 + 6

Detailed presentation of the publishing process to Orchestrator and learn to run the process with Assistant- The key components of the UiPath Studio user interface (UI).-Accessing of the 'ACME System 1' web application to receive a set of invoices in your mailbox. - steps of the process to be built based on the business needs. - UiPath Studio activities - publishing options for a process in Studio - Run a published process from the UiPath Assistant.
Variables & Arguments in Studio

Variables – Creation, Configuration in an automation project – Data types, application of conversion methods of data types – Arguments-Usage of workflow file activity to chain workflow execution and pass data through arguments – Differentiation between variables and arguments – Arrays and its use Control Flow in Studio - control flow statements - Differentiation between the most common control flow statements -Configuration of control flow statements – Parallel Activity

UNIT II UI Automation 3 + 6

UI automation with UiPath – Key elements of UI Automation with UiPath Studio - Differentiation between the modern and the classic design - Changing the design experience in Studio based on the automation requirements.

UI Automation with the Modern Design Experience Indication and selection the target required for UI Automation using the Selection Option window – Configuration of the key container Activity in the modern experience - correct input activities used in the modern design experience - input methods used in modern design experience - suitable input methods based on the requirements of an automation - input mode works - key output activities used in the modern design experience - output methods used in modern design experience-

Table extraction – Configuration of all the Key properties -Building user interface automation - nested card when working with multiple applications - Debug UI Automation projects built with the modern experience.

UI Automation with the Classic Design Experience

Customization of the properties of the input actions - output actions for automation - Improving UI element identification and efficiency of the automation.
Data Manipulation with Strings in Studio
RPA Development course and Variables course, and, the Arguments and Control Flow in Studio course - Common .NET methods to manipulate values contained in variables of type String - RegExbuilder in UiPath Studio to perform complex string manipulation.

Selectors
Selectors: Full Selectors and Partial Selectors, the UI Explorer, the Property Explorer, and fine-tuning selectors to handle different situations- Selector and its structure - various types of selectors and their settings when automating - The attributes of User Interface element - approaches to fine-tune selectors to make them reliable. Fine-tune selectors to improve element identification precision.

Descriptors
Advanced options of the selection window – Using of Enforce visibility, Dynamic Text Target and Native Text Target options - Image selection option - UI Descriptors, generation- target element validation - correct targeting method while automating UI elements - attributes of UI elements to build the automation logic - Fine-tune Descriptor to uniquely identify the required UI elements on the screen - Object Repository, key benefits of Object Repository, key concepts in the Object

Repository: UI Descriptors, UI Elements, Screens, Applications, UI Libraries.

UNIT III Project Organization in studio 3 + 6
Choose a suitable project layout for each workflow - Spliting a complex automation project into functional workflows - Creation and sharing of project template -Reusable components across projects and store them as libraries - exception handling techniques - versioning capabilities of UiPath

Debugging in Studio

Debugging features - remote debugging - overview of the debugging features, including actions and panels, followed by a basic entry into them and then the advanced tools.
Error & Exception Handling Exception handling activities like TryCatch, Throw, Rethrow, Retry Scope, and Global Exception

Handler-Different types of exceptions-common exception handling techniques and explain when they should be used - TryCatch, Throw, and Rethrow activities in automation projects - Using the
Retry Scope activities in automation projects - ContinueOnError Property - Global Exception Handler in both attended and unattended scenarios.

UNIT IV Orchestrator Overview for RPA developers 3 + 6
Creation, configuration, and provision of unattended robots through Orchestrator in UiPath, publish and managing of automation projects, and execution of jobs using an unattended robot - purpose and main capabilities of Orchestrator - Orchestrator entities - differentiate between the tenant context and the folder context - Creation, configuration and provision unattended robots from Orchestrator –

Differentiation between a background and a foreground process – Execution of jobs using unattended robots in different ways - licenses allocation and consumtion in Orchestrator.
Orchestrator Overview for RPA developers

Using Orchestrators resources in Studio - Publishing, installing and updating libraries and templates in Orchestrator. Storing files in storage buckets- Creation, population and consumption of Orchestrator queues - relationship between different queue concepts and make the correct correlations - types of processes

Email Automation
Installing the dedicated email activities in UiPath Studio and Retrieving email messages based on the email client and server in use – Automation of the interaction with emails by filtering and downloading attachments - message templates to send emails.

PDF Automation
UiPath PDF scraping and data extraction from blocks of text and tables in PDFs using UiPath Studio – Installing the UiPath PDF Activities Package – Extraction of large text segments from PDF files using different activities - Extracting a single piece of information from a PDF document - Extracting Data using multiple PDFs – Using the UI automation capabilities of Studio to extract fluctuating values from multiple files with the same structure.
Version Control Systems integration
Version control systems - Identification of the version control systems -Version control system Integration

UNIT V RPA testing 3 + 6

RPA testing in the overall automation process and features for testing in UiPath Studio - unit testing for RPA workflows and best practices from projects implemented by the UiPath development teams- Causes that affect the robot stability and how they can be tackled - Build the case for RPA testing - levels of RPA testing – Creation of basic and data-driven test cases for RPA workflows – Dedicated verification features for RPA Testing - Test Explorer to group tests together, perform debugging - mock testing simulation of real objects in RPA testing scenarios - good case practices identified by RPA developers from real automation projects.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Building Software Bots to automate manual tasks
- Students and faculties will be able to do Ui Automation
- Students and faculties will be able to do Excel Automation
- Students and faculties will be able to do email automation
- Students and faculties will be able to do String Manipulation
- Students will be able to do Debugging and exception Handling in Studio
- Students will be able to do PDF automation

Use cases:
1. Loan Application Processing
2. Generating Offer Letters | HR Use case
3. Build a shopping Robot
4. Travel Buddy Robot

SB8027 EMBEDDED SYSTEM DESIGN - BOARD DESIGN AND DEBUG L T P C
1 0 2 2

COURSE OBJECTIVE

- The students given with the introduction to Industrial Design
- Walking them through the Electronics Fundamentals and set the base for the Embedded Development
- Enabling them to Build a Hardware Unit and make them Hands-on in Firmware development Environment
- Enabling them to do a Hardware Bring-up and initiate them to Develop code for an Embedded Application
- Enhancing the debugging capability and testing capability of the students
- Let them build their own project based on the Hardware and Embedded Firmware.

COURSE CONTENT:

UNIT I Embedded Electronics & Industries 3 + 6

HW Fundamentals - SW used in Industry - Digital tool exploration (Proteus, Tinkercad, etc) - Usage techniques of multi-meter and oscilloscope Activity - SW Installation - Hands on Ohms Law & Circuit theory Outcome - Build a practical implementation of Ohms law using software

UNIT II Introduction to Firmware and board architecture Activity 3 + 6

Hands-on on Measurements of fundamental components – Sensor - Basic soldering techniques Outcome - Complete Dot board component soldering

UNIT III Microcontroller basics 3 + 6

Programming Environment setup - Typical C Programming Flow and structure - PIN Configuration - Interfaces (I2C, ADC, PWM, UART.) Activity - Interact with Peripheral interfaces through FW - Assemble components as per PIN Configuration Outcome - Complete component Assembly on board

UNIT IV Firmware Development Activity 3 + 6

Board bring up - FW development - Load FW in the newly built HW Outcome - Complete unit ready for testing and debug

UNIT V Unit Interface level testing 3 + 6

Functional and Non-Functional testing - Random Bugs identification - Debugging board

TOTAL: 45 PERIODS

COURSE OUTCOME

A fully functional demo board/ Product will be developed from scratch using various components helping the student understand various industrial applications making them job ready

HARDWARE REQUIRED

- Custom Built Microcontroller Components:
- Microchip
- Temperature Sensor Interface
- Analog and Digital IO interface
- On Board Analog input
- 20 X 2 Alpha Numeric LCD
- Accelerometer Interface
- Power Regulator
- Powered from USB
- Multimeter
- PC – i5 with windows - 64 bit & 8GB RAM

SOFTWARE REQUIRED

- MPLAB IDE Tool (Student Version)
- C Compiler Evaluation version

INDUSTRY USE CASES:

1. **Smart blind stick:** The smart blind stick is a modern day's blind stick that assists visually challenged people. The blind stick consists of an ultrasonic sensor that helps in detecting the obstacle. The blind stick also consists a servo motor in which the ultrasound sensor is mounted. Based on the shaft direction the obstacle direction can also be identified. The blind stick also consists of Bluetooth sensor that helps in getting connected with the smart phone for voice intimation of obstacle direction. The 2 sensors are connected with controllers.

Task 1: Do a research on blind people and their difficulty in using the conventional blind stick. Check out on how to upgrade the blind stick.
Task 2: List down the components required. Design the circuit in simulation software and check its output.
Task 3: Start developing the code for operating the microcontroller.
Task 4: Build the circuit with the components required and upload the developed program to the microcontroller.
Task 5: Check the efficiency of all the interfaced components and rectify those components to increase the system efficiency.

S.NO	Component	Quantity
1	ESP 8266	1
2	Ultrasonic sensor	1
3	Servo motor	1
4	HC-05	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

2. **Sunlight based solar panel system:** The sunlight based solar panel system is used to increase the productivity in solar power generation units. In this system the solar panel will turn based on the direction of sun. This leads to more solar light interaction with the solar panel. This results in the more productivity of electricity using solar power. Light dependent sensors are used for light(solar) intensity detection. The panels are installed on the servo motor which moves in accordance with the sunlight.

Task 1: Do research on relationship between solar panel positioning and sun movement directions.
Task 2: Design a solar tracker circuit on simulation software to increase the solar energy productivity.
Task 3: List down the components required for building the solar tracker. Develop the code for microcontroller to control the solar tracker system.
Task 4: Interface the components as per the circuit diagram that is developed. Upload the program to the microcontroller
Task 5: Check the efficiency of a fixed solar panel and a solar panel in the solar tracker. And give a report on this.

S.NO	Component	Quantity
1	ESP 8266	1
2	LDR sensor module	1
3	Servo motor	1
4	Bread board / PCB board	1
5	Connecting wire	1

3 Automatic motor controlled system: Home automation is growing rapidly in this decade, this project is one of the best products in this domain. In this system a water level sensor is used for detecting the water level in the tank. Relay circuit is used in switching on and off of the motor pump. Both the relay circuit and water level detecting circuit is communicated via the ESP8266 controller.

S.NO	Component	Quantity
1	ESP 8266	1
2	Water level sensor	1
3	DC motor pump	1
4	Relay	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

4. Patient monitoring system: PMS is one of the most important equipment in intensive care units (ICU) and critical care units(CCU). In this device various vital parameters like temperature, respiration rate, pulse rate, oxygen level and many other parameters are monitored continuously. Using thermistor, flex sensor, pulse rate sensor interfaced with controller we can monitor such vital parameters.

Task 1: Do a study on various bio vital parameters and select the parameters that we are going to monitor.
Task 2: Do a research on how the selected parameters can be received from the human and monitored.
Task 3: Design a circuit to measure the selected bio signals in a simulation software and verify its output.
Task 4: Develop code for the microcontroller to measure all the bio-signals. And also develop a protection circuit as human interaction takes place.
Task 5: Build the circuit with the components and upload the developed program to the controller. Once the assembly gets completed check its functioning

S.NO	Component	Quantity
1	ESP 8266	1
2	Thermistor	1
3	Max30102	1
4	Flex sensor	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

a. Sensor guided embedded robot: Sensor guided embedded robot is a made of a three tyre chasis in which two wheels are sensor controlled and another is a castor wheel. The sensor

usually used is an IR sensor which makes the robot avoid obstacle or follow a line. The sensor is connected with the controller which gives the information for the motor driver that makes the motor function.

Task 1: Confirm the application of the robot that we are going to develop and do a study on it.
Task 2: List down the sensors and microcontroller unit that is needed for developing the robot.
Task 3: Design the circuit in simulation software and check whether the circuit designed can make the robot run.
Task 4: Develop the code for the microcontroller system. Compile the program to avoid errors in it.
Task 5: Interface the sensors, chasis and microcontroller and upload the program to the microcontroller and check the functioning of the robot.

S.NO	Component	Quantity
1	ESP 8266	1
2	Three tyre chasis	1
3	IR sensor	3
4	Motor driver L293D	1
5	Bread board / PCB board	1
6	Connecting wire	Required quantity

b. Automated home based fan and light system: In this project the basics of home automation can be studied. The fan and light is controlled by the controller which gets the input from the sensors. For controlling the fan thermistor is used. When the temperature crosses the cut-off temperature the controller makes the fan run. Similarly light is controlled by the LDR. When the light intensity falls below the cut-off point the controller turns the light on.

Task 1: Do a research on home automation and plan the appliance that we are going to automate.
Task 2: Design a circuit for automating the fan and light from the temperature and light intensity data.
Task 3: List down the components and sensors required for developing this project. Simulate the circuit in the simulation software and evaluate its functioning.
Task 4: Develop the code for microcontroller for automating the fan and light from the data received from the sensors.
Task 5: Build the circuit with the required components and upload the program to the microcontroller.

S.NO	Component	Quantity
1	ESP 8266	1
2	LDR	1
3	LED	3
4	Motor driver L293D	1
5	Thermistor	1
6	Motor	1
7	Relay	1
8	Bread board / PCB board	1

a. **Embedded based irrigation system:** It is an automated system that makes the pump on only when the soil is dry. The soil moisture sensor is inserted in the soil which continuously monitors the soil moisture level and gives input to the controller. Once the soil moisture reaches the dry level the controller turns on the pump through which the water is passed to the soil and moisture level can be maintained.

Task 1: Do a research on the water requirement for agriculture and benefits of drip irrigation system.
Task 2: List down the components required for building the automated drip irrigation system. Design the circuit in simulation software and check its output.
Task 3: Start developing the code for operating the microcontroller. The microcontroller will control the functioning of water pump from the sensor data
Task 4: Build the circuit with the components required and upload the developed program to the microcontroller.
Task 5: Place the system in an agriculture field to check its working efficiency.

S.NO	Component	Quantity
1	ESP 8266	1
2	Soil moisture sensor	1
3	DC pump	1
4	Motor driver L293D	1
5	Bread board / PCB board	1

Debug Projects:

Project 8: Troubleshooting of low voltage power supply in SMPS

Problem statement: Output voltage is not coming properly

Bugs/Issues introduced in the board:

i. **AC input**
ii. **Transformer**
iii. **Rectifier**
iv. **Regulator**
v. **Missing of connection**

Task 1: know the AC and DC fundamental and lows related with low voltage Task 2: Role of active and passive components in circuit designing
Task 3: fault detection in electrical and electronics through the step by step routing Task 4: Finding the fault component and give the solution for that fault

Skills to be taught:

- Voltage and current knowledge
- Testing knowledge of AC and DC power supply components (like rectifier, voltage regulator and so on)
- Various application mode of multi meter (AC, DC, Continuity)

Components

- Low voltage board
- Multimeter

Outcome

- Troubleshoot & Fix of Active and Passive components related bugs in the board
- Usage of safety and testing tools

Project 9: Troubleshooting of high voltage power supply in inverter board

Problem statement: Fluctuation in output voltage

Bugs/Issues in the board:

1. DC input
2. Inverter IC
3. MOSFET
4. Booster circuit
5. Missing of connection

Task 1: know the AC and DC fundamental and lows related with high voltage
Task 2: Role of semiconductors and integrated circuit components in circuit designing Task 3: fault detection in electrical and electronics through the step by step routing Task 4: Finding the fault component and give the solution for that fault

Skills to be taught:

- Voltage and current knowledge
- Testing knowledge of DC and high voltage AC component Knowledge (like MOSFET, transformer, open and short circuit and so on)
- Various application mode of multimeter

Components

- Inverter board
- Multimeter

Outcome

- Troubleshoot & fix High frequency components and Booster circuit bugs

Project 10: Troubleshooting of wireless data transmission circuits
Problem statement: Communication broken.
Bugs/Issues in the board:

1. Tx connection
2. Rx connection
3. Communication protocol
4. Oscillator
5. Connection issue

Task 1 Various wireless communication technology in embedded system design Task 2 Suitable wireless technology for industrial application
Task 3 checking the data transformation through troubleshooting technique Task 4 solve the issue and check the communication status

Skills to be taught:

- Testing knowledge of electronic and communication component
- Testing knowledge of communication components using oscilloscope

Components

- Wireless data transmission boards(Tx Rx or Bluetooth, Wifi boards
- Oscilloscope

Outcome

- Debug & fix data communication bugs

Project 11 : Checking the clock signal for given controller board
Problem statement : Not connecting issue
Bugs/Issues introduced in the board:

1. Tx connection
2. Rx connection
3. Communication protocol
4. Oscillator
5. Connection issue

Task 1 Need of clock signal in communication system Task 2 Clock signal in various state of communication Task 3 Clock signal testing techniques
Task 4 Clock signal correction techniques

Skills to be taught:

- Clock signal configuration
- Program based signal information

Components

- Microcontroller
- Oscilloscope

Outcome

- Importance of clock in communication
- Checking of clock signal
- Logic analyzer

Project 12 : Serial data communication analysis using logic analyzer /oscilloscope
Problem statement : Communication not happened in serial communication system
Bugs/Issues in the board:

1. Encoder and Decoder
2. Rx connection
3. Tx connection
4. Oscillator
5. Connection issue

Task 1 Need of serial communication
Task 2 serial Communication protocols and hardware Task 3 logic analysis for data in serial communication Task 4 Correction techniques data in serial communication **Skills to be taught:**

- Communication protocols
- Binary data information
- Logic analyzer

Components

- Microcontroller
- Logic analyzer/oscilloscope

Outcome

- Debug Serial communication and its hardware
- Data checking in serial communication
- Use Logic analyzer

Project 13: Parallel data communication analysis using logic analyzer /oscilloscope
Problem statement : Communication not happened in parallel communication system

Bugs/Issues in the board:

1. Encoder and Decoder
2. Rx connection
3. Tx connection
4. Oscillator
5. Connection issue

Task 1 Need of parallel communication
Task 2 serial Communication protocols and hardware parallel Communication protocols and hardware
Task 3 logic analysis for data in parallel communication Task 4 Correction techniques data in parallel communication

Skills to be taught:

- Communication protocols
- Binary data information
- Logic analyzer

Components

- Microcontroller
- Logic analyzer/oscilloscope

TOTAL: 45 PERIODS

Outcome

- parallel communication and its hardware
- Data checking in parallel communication
- Logic analyzer

Project 14: Trace the embedded software operation using logic analyzer
Problem statement : Embedded system not working
Bugs/Issues in the board:

1. Power supply issue
2. Communication issue
3. Clock signal issue
4. Logic issue
5. Connection issue

Task 1 Find the correct problem
Task 2 Find the reason for the problem Task 3 Solve the issue
Task 4 Check the performance
Skills to be taught:

- Hardware and software about embedded system
- Application of embedded system

Components

- Embedded project
- Logic analyzer

Outcome
Circuit hardware knowledge Communication protocol Troubleshoot and solution techniques

SB8028	DESIGN OF PHOTO VOLTAIC SYSTEM	L T P C 1 0 2 2

COURSE OBJECTIVE:

At The end of the course, the students will acquire knowledge of -

1. Solar-Photovoltaic systems.
2. Key components required to install the solar PV
3. The prediction of PV module behavior under different physical and environmental parameters.
4. Solar irradiance, temperature, series and shunt resistances on the resulting photovoltaic parameters
5. Solar behavior at Indian context.

COURSE CONTENT:

Unit I-Introduction to Solar PV **3+6**

Solar Energy-PV Technology-PV Materials-PV Types-PV Module Rating- PV System-Components,

Unit II-Design & Sizing of PV System

Design & sizing principles- Sizing of Components- MPPT tracking system for PV array-assembly on layout- Solar panel orientation and tilt angle at various locations.

Unit III-Simulation using MATLAB

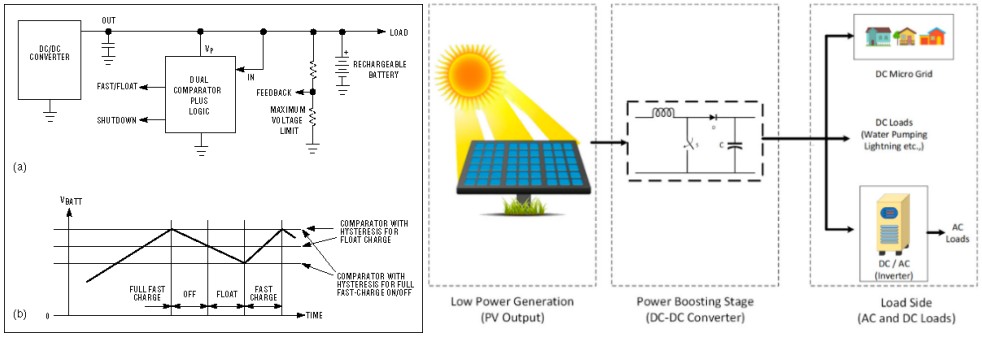
Theory and Background – The Single Diode Model- Reading Datasheets- Building Solar Cell Model in MATLAB and Simulink- Studying the Effects of Irradiance, Temperature- Simulate the IV characteristic-5 exercise for the project

Unit IV- Grid Connection of Solar

Smart grid components – Metering - On-Grid rooftop- Bi-directional meter-1-phase & 3-phase bi-directional meter- Inverter systems- String inverter- Micro inverter- Power optimizers- Converter systems- boost converter and buck converter-Analysis using MATLAB.

Unit V-Hardware model of DC- DC Convertor- Solar Panel

Power Circuit- Opto coupler Circuit Operation-IC connections-MOSFET Circuit Operation-Snubber Design- Software circuit & output- Hardware circuit & output- Result Analysis. IOT based MPPT system design.



TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Create an electrical design of solar PV power plant
2. Evaluate the energy simulation report using MATLAB
3. Apply the circuit of Solar to with basic practical components.
4. Design the entire solar system based on the specific load.

FOR FURTHER READING:

1. Solar Photovoltaic Technology and Systems: A Manual For Technicians, Trainers And Engineers-Book By Chetan Singh Solanki
2. Solar PV Power: Design, Manufacturing and Applications from Sand to Systems Book by Rabindra Kumar Satpathy and VenkateswarluPamuru

ONLINE REFERENCE:

1. https://www.rcciit.org/students_projects/projects/ee/2018/GR4.pdf
2. https://iopscience.iop.org/article/10.1088/1742-6596/2019/1/012091/pdf
3. https://www.energy.gov/eere/solar/solar-photovoltaic-system-design-basics
4. https://www.ecosoch.com/grid-solar-pv-system/

SOFTWARE REQUIREMENTS

1. MATLAB
2. SIMULINK

HARDWARE REQUIREMENTS

1. MOSFET (IRF540)
2. Opto Coupler IC (TLP250h)
3. Diode (1n4007)
4. IC (IR 2110)
5. Resistors (470Ω, 10Ω, 10kΩ)
6. Capacitors(100μF, 100nF)
7. 12 V dc source
8. 12V dc female port
9. Connecting wires

INDUSTRY SCOPE

1. Solar PV Project Manager (E&C) of one/ multiple solar PV power plants.
2. Site in-charge and commercial manager,
3. Design, constructs the substation and grid interface incorporating grid code and regulatory provisions incorporated in the design.

After designing the entire solar module in MATLAB

Five parts to study the effects of –

(i) Irradiance,
(ii) Temperature,
(iii) Series Resistance,
(iv) Shunt Resistance and
(v) Ideality Factor of the device

A variable resistor is connected across the cell which is ramped from zero to a high value (around 100 Ω) to trace the IV and P-V curves as simulation proceeds.

The output current, voltage and power values are exported to the MATLAB workspace in the form of arrays using the “To workspace” Simulink blocks for further analysis and plots.

Students were required to analyze the exported data and extract critical PV parameters, such as the maximum power ($Pmax$), fill factor (FF) and efficiency (η).

Product Portfolio		RIG					SAAM			YAJUR					ATHARVA														
ELECTRICAL PARAMETERS	Model	ISEN40	ISEN50	ISEN60	ISEN75	ISEN80	ISEN100	ISEN125	ISEN150	ISEN200	ISEN225	ISEN250	ISEN260	ISEN300N	ISEN150	ISEN200	ISEN225	ISEN250X	ISEN300	ISEN305	ISEN310	ISEN315	ISEN320	ISEN325	ISEN330	ISEN250Y	ISEN300X	ISEN330X
	No. of Cells (Multi-crystaline)	36	36	36	36	36	36	36	36	48	54	60	60	66	72	72	72	72	72	72	72	72	72	72	72	120	144	144
	Power (Wp)	40	50	60	75	80	100	125	150	200	225	250	260	300	150	200	225	250	300	305	310	315	320	325	330	250	300	330
	Voltage at Max Power (Vmax)	18.02	18.09	18.04	18.07	18.02	18.09	18.09	18.11	24.14	27.16	30.12	30.58	33.67	36.22	36.16	36.47	36.18	36.18	36.33	36.43	36.52	36.59	36.73	37.20	60.24	72.36	37.20
	Open Circuit Voltage (Voc)	22.10	22.20	22.13	22.18	22.10	22.20	22.20	22.23	29.64	33.35	37.05	37.28	41.43	44.46	44.41	44.48	44.46	44.45	44.59	44.70	44.85	45.00	45.02	45.07	74.10	88.90	45.07
	Current at Max Power (Imax)	2.24	2.77	3.34	4.16	4.47	5.56	6.94	8.31	8.31	8.31	8.31	8.51	8.92	4.15	5.56	6.18	6.92	8.30	8.40	8.51	8.63	8.75	8.85	8.88	4.16	4.15	8.88
	Short Circuit Current (Isc)	2.36	2.90	3.53	4.34	4.73	5.86	7.31	8.74	8.74	8.74	8.75	8.93	9.26	4.37	5.86	6.58	7.28	8.75	8.83	8.93	9.02	9.12	9.16	9.21	4.38	4.38	9.21
	Module Efficiency (%)	14.0%	13.7%	14.8%	14.1%	15.0%	15.3%	15.0%	15.2%	15.2%	15.4%	15.4%	16.0%	16.8%	15.2%	15.2%	15.4%	15.4%	15.5%	15.8%	16.0%	16.3%	16.5%	16.8%	17.0%	15.4%	15.5%	17.0%
	FF (%)	77.4%	77.8%	77.1%	78.1%	77.1%	77.3%	77.4%	77.5%	77.4%	77.4%	77.2%	78.2%	78.3%	77.4%	77.3%	77.0%	77.4%	77.2%	77.5%	77.7%	77.9%	78.0%	78.8%	79.6%	77.2%	77.1%	79.6%
ALL ELECTRICAL DATA MEASURED AT STC (STANDARD TEST CONDITION) IRRADIANCE 1000W/M², SPECTRUM 1.5 AM, TEMP. 25°C																												
MECHANICAL PARAMETERS (All Dimensions are in mm)	Length (A)	428	548	610	800	800	986	1250	1486	1336	1486	1650	1650	1806	1486	1336	1486	1650	1964	1964	1964	1964	1964	1964	1964	1650	1964	1964
	Width (B)	666	666	666	666	666	666	666	666	986	986	986	986	986	666	986	986	986	986	986	986	986	986	986	986	986	986	986
	Thickness (C)	22	22	22	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
	Edge to Centre Hole Distance (D)	214	274	305	400	400	490	625	743	668	743	825	825	903	743	668	743	825	982	982	982	982	982	982	982	825	982	982
	Edge to Mounting Hole Distance (E)	107	137	153	200	200	245	313	372	334	372	395	395	473	372	334	372	395	552	552	552	552	552	552	552	395	552	552
	Mounting CTC Distance Horizontal (F)	631	631	631	629	629	629	629	629	949	949	949	949	949	629	949	949	949	949	949	949	949	949	949	949	949	949	949
	Edge to Optional Mounting Hole Distance (G)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	245	245	302	NA	NA	NA	245	302	302	302	302	302	302	302	245	302	302
	Mounting CTC Distance Vertical (H)	214	274	305	400	400	490	625	743	668	743	860	860	860	743	668	743	860	860	860	860	860	860	860	860	860	860	860
	Mounting Hole (I x J)	7 x 12	7 x 12	7 x 12	7 x 12	7 x 12	7 x 12	7 x 12	7 x 12	7 x 12	7 x 12	9 x 14	9 x 14	9 x 14	7 x 12	7 x 12	7 x 12	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14	9 x 14
	Centre Hole Dia (K)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Cable Length (L)	NA	NA	NA	NA	NA	NA	NA	NA	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	NA	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M	0.9/1M
	Weight in KG	3.4	4.4	5.1	5.8	5.8	7.0	9	10.7	14.2	15.8	17.5	17.6	19.2	10.7	14.2	15.8	17.6	20.9	20.9	20.9	20.9	20.9	20.9	20.9	17.6	20.9	20.9

▪ Operating Conditions - 40°C to + 85°C at 85% RH ▪ Temperature Co-efficient for Voc/ C (β)= -0.34%, Isc/ C (α) = 0.05%, power/ C (γ) = -0.40% ▪ NOCT = 45°C ± 2°C at 800 W/m², AM 1.5, wind 1 m/s, Temp. 20°C

20 INDUSTRY USED CASES

1. Solar power for drip irrigation system

Task 1: Calculate the power requirement for drip irrigation system. The power calculation depends on the pump involved in the system.
Task 2: List down the components and materials required for building the drip irrigation system.
Task 3: Design the circuit that can generate the power that we calculated. And simulate the circuit in the MATLAB.
Task 4: Get the VI characteristics of the designed circuit and evaluate whether the designed circuit matches the power requirement.
Task 5: Build the circuit and implement it in the irrigation system.

2. Off Grid-based Solar System

Task 1: Do power estimation in home for household appliances.
Task 2: Determine the solar cell productivity for this application.
Task 3: calculate the excess power value and select the storage system. Building Solar Cell Model and backup system in MATLAB
Task 4: Simulate the IV/ PV characteristic for application and storage power and give the report based on load requirement.
Task 5: Design the circuit for using power and storing of power. Do the Connection with materials (For current we may use batteries)

3. Milk pasteurization using solar

Task 1: In an Aavin milk industry daily 1lakh liters of milk thermised between 57c to 68 c for 15 minutes. And also Pasteurization is done two methods. Find and submit a report.
Task 2: Replace with solar system. Find the required list of kits required.
Task 3: Do the simulation in MATLAB to check feasibility.
Task 4: Assemble the kit and do the working conditions(Scaling)
Task 5: Submit a comparison report if how much energy can be saved.

4. On Grid-based Solar System

Task 1: Do power estimation in home with equipment's .
Task 2: Make the hand-on layout and mathematical calculation for the requirement
Task 3: Building Solar Cell Model in MATLAB
Task 4: Simulate the IV/ PV characteristic and give the report based on load requirement.
Task 5: Do the Connection with materials other than PV panel.
For current you can use battery resources.

5. Stereo Cooler Charged by Solar

Task 1: Do power estimation in Stereo Cooler
Task 2: List down all the components required for building a stereo cooler
Task 3: Design an solar cell that provide power to make the stereo cooler work
Task 4: Build a stereo cooler of your preferred design and connect the components as per the circuit.
Task 5: Give input to the stereo unit and evaluate the working of stereo cooler. Also simulate the VI characteristics of the stereo cooler using MATLAB.

6. PV Tracker using Solar

Task 1: Do power generation estimation in Single PV at different time of a day
Task 2: Do research and find the relationship between time and productivity of the solar cell.
Task 3: Design a circuit for attaining maximum productivity from the solar cell.
Task 4: List down the components required and start building the circuit in real time.
Task 5: Place the solar tracker in an open space and evaluate whether the productivity is increased.
For current you can use battery resources

7. Solar based desalination plant

Task 1: Develop the workflow of the desalination plant. And calculate the power required for desalination plant
Task 2: List down the components and materials required for building the system
Task 3: Design a circuit that can power up the desalination plant. And simulate the circuit in the MATLAB environment
Task 4: Start building the circuit with the mentioned components and get the VI characteristics of the system.
Task 5: Test the system by giving salt water as the input and evaluate the system by checking salt content in the desalinated water 100 %

8. Solar preheater for boilers

Task 1: Wood fired boilers are working under the efficiency of 27%. To increase they found preheating is not enough. So design a solar pv plant above the boiler area.
Task 2: Note down all the components required and design a circuit that can produce heat.
Task 3: Building Solar plant Model in MATLAB and simulate the VI characteristics
Task 4: With the results obtained, start building the solar plant using the required components
Task 5: Solar plant should generate 350c of water.

9. Army location detection using flexible solar panels

Task 1: List down material required
Task 2: Building Solar panel of six in a cloth Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing get materials and do all connections
Task 5: Do the erection by stitching on the bag. Track the location using it

10. Battery Charger using Solar

Task 1: List down material required to do with 30 V battery.
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing get materials and do all connections
Task 5: Charge your emergency light with battery.

11. Moveable Solar Power Unit

Task 1: List down material required to do the project.
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing get materials and do all connections
Task 5: Check the movable solar PV position in different locations.

12. Shrub based on Solar

Task 1: List down material required to do the project.
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing get materials and do all connections
Task 5: Assemble all materials appropriately.

13. Solar Charging Station- On grid station

Task 1: Evaluate the required power to charge TATA nexon EV
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing and list the materials.
Task 5: Submit the report along with cost estimation

14. Solar Charging Station- Off grid station

Task 1: Evaluate the required power to charge TATA nexon EV
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing and list the materials.
Task 5: Submit the report along with cost estimation

15. Automatic Solar system for all seasons.

Task 1: Consider two seasons summer and winter. Both the seasons angle may differ. So find data for last 10 years and average it.
Task 2: Depending on the requirement list down material required and program required.
Task 3: Building Solar Plant Model with all materials required in MATLAB
Task 4: Simulate the IV/ PV characteristic and give the report.
Task 5: Erect the system in the college and submit report on how it works.

16. Power Supply based on Solar Energy for green house

Task 1: Evaluate the required power consumption of 4 pumps, 5 air blower, 30 LED lights
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing and list the materials.
Task 5: Submit the report along with cost estimation

17. Solar Panel for Light Tracking & Servo Controlling

Task 1: List down material required to do the project using LDR & servo motor of following spec

- Operating Voltage is +5V typically.
- Torque: 1.8 kg-cm (4.8v)
- Speed: 0.10 sec/60.
- Gear Type: Plastic.
- Rotation : 0°-180

Task 2: Do research and find the relationship between time and productivity of the solar cell.
Task 3: Design a circuit for attaining maximum productivity from the solar cell.
Task 4: Start building the circuit in real time and also simulate the VI characteristics for both solar panel with and without light tracking.
Task 5: Place the solar tracker in an open space and evaluate whether the productivity is increased.

18. Solar Switch for Water Heater

Task 1: List down material required to do the project
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing get materials and do all connections
Task 5: Assemble all materials appropriately.

19. Solar Inverter Project using SG3525

Task 1: Develop the workflow of the solar inverter. And calculate the power required to charge the battery for the inverter.
Task 2: List down the components required for building the Solar Inverter using SG3525
Task 3: Design a solar cell circuit to charge the battery. Also design a DC to AC converter circuit.
Task 4: Build the solar inverter by combining the circuits using the required components
Task 5: Pair the inverter with any home appliance and use it.

20. Revolving Solar Inverter with Microcontroller

Task 1: List down material required to do the project for 50 W.
Task 2: Building Solar plant Model with all materials required in MATLAB
Task 3: Simulate the IV/ PV characteristic and give the report.
Task 4: With the results select PV sizing get materials and do all connections
Task 5: Assemble all materials appropriately

21. Solar powered medical device sterilizing unit

Task 1: Calculate the power required for the sterilizing unit.
Task 2: List down the components required for supplying the power for sterilizing unit.
Task 3: Design the circuit that is capable of generating power for sterilizer and simulate it in the MATLAB
Task 4: Get the VI characteristics of the developed system. And evaluate that it matches with required VI characteristics
Task 5: Assemble all materials appropriately as per the circuit connection and sterilize the medical devices

22. Algae Prevention system with solar energy
Task 1: Do research about the algae prevention.
Task 2: Calculate the power required for algae prevention system. List down the materials required to do the project
Task 3: Design an electronic circuit that is capable of running in a water medium. Also design a solar cell circuit that provides supply to the electronic circuit.
Task 4: Combine both the circuits and build the algae prevention set up with the required components
Task 5: After completing the connections leave it on a water storage unit or water reservoir

SB8029	**ELECTRIC VEHICLE CHARGING SYSTEM DESIGN**	**L T P C**
		1 0 2 2

COURSE OBJECTIVE:
At the end of the course, the students will acquire knowledge of -
1. Concepts of battery pack charging
2. Selecting components and designing a charging system with Inverter and SMPS
3. Developing a regulator to control the output voltage.

COURSE CONTENT:

UNIT I EV Battery and Battery Pack Configuration 3 + 6

Introduction to Electric vehicle – Architecture of EV – Fundamentals of Battery - Different Types of Battery chemical composition – Safety and Protection standards for EV Chargers - Battery Modelling – Battery boot camp – Li-ion cell Preview – Equivalent Circuit modelling – Vehicle dynamic and vehicle range calculation – Series and Parallel configuration.

UNIT II Standards 3 + 6

BIS – IS17017 – IS17017 -1,2,21,22 for AC – IS17017 -23,24,25 for DC –ISO/IEC 15118 Vehicle to grid communication interface – IS15118 - Bharat AC charger AC001 – Bharat DC charger DC001 – IEC 60309 connector - GB/T 20234 connector - battery swapping standards.

UNIT III Types of Chargers 3 + 6

Type of chargers, level -1, level-2 and level-3 – Difference between Slow charger and fast charger - Slow charger design and rating - Fast charger design and rating - AC charging and DC charging - onboard charging specification - Isolated customisable DC to DC converter for EV – Buck and Boost Configuration.

UNIT IV Battery Management System 3 + 6

Introduction to BMS – BMS design and Architecture – connecting Battery with BMS – Safety in BMS – overvoltage protection - reverse polarity protection - over current protection - thermal management - Cell Balancing Circuit – Limitation of battery - Cell Protection process – SOC estimation and prediction of the battery pack using ARM microcontroller – SOH – SOH Prediction and Estimation - IOT for Battery Status

UNIT V Charging Station 3 + 6

Solar panel types - Solar power calculation – Location-based solar implantation – IOT integration of Solar station with electric charging grid – Slow charging – Fast Charging – wireless charging system and smart charging system- Vehicle to grid connection charging - subsidy calculation of solar at domestic load.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Develop a MATLAB / AUTODESK Tinkercad / Circuit Lab simulation for a DC charger comprising of the converter, SMPS, voltage regulator and protection circuit by selecting the suitable rating of the resistor, capacitor, inductor, MOSFET and diode based on the required DC load.
2. Design a hardware model of a DC charger for a given DC load with voltage regulation.

FOR FURTHER READING:

1. Residential EV charging kit – Voltage regulation for battery pack – Over voltage protection

ONLINE REFERENCE:

1. Battery Management Systems, Volume I: Battery Modeling by Gregory L. Plett, Publisher: ARTECH HOUSE PUBLISHERS; Unabridged edition (2015) Language: English ISBN-10: 1630810231 ISBN-13: 978-1630810238
2. Battery Management Systems, Volume II: Equivalent-Circuit Methods Gregory L. Plett, Publisher: Artech House Publishers; Unabridged edition (2016). Language: English ISBN-10: 1630810274 ISBN-13: 978- 1630810276
3. ECE4710/5710: Modeling, Simulation, and Identification of Battery Dynamics, University of Colorado, Colorado Springs. http://mocha-java.uccs.edu/ECE5710/index.html.

4. Thermal Management of Electric Vehicle Battery Systems, Ibrahim Dincer, Halil S. Hamut, Nader Javani, John Wiley & Sons, 2017, ISBN 1118900227, 9781118900222

SOFTWARE REQUIREMENTS

1. MATLAB Simulink / AUTODESK Tinkercad / Circuit Lab

HARDWARE REQUIREMENT:

Computer with an Internet connection and any of the above-mentioned software, ARM, microcontroller, ARM processor, battery, battery pack, BMS 12SxP, BOOST, circuits, BUCK, BUCK-BOOST, BUCK BOOST circuitry, current sensor, current station, DC power supply, display LCD with i2c, inductor coil, L4006, LM2596, microcontroller, MOSFET driver, oscillator circuit, rectifier BUCK BOOST, resistive load, SD card memory module, SD card module, sensing circuit, SMPS board, solar panel, switable current circuit, thyristor board, transformer, voltage divider circuit, voltage sensor, WIFI module, CRO, Multimeter, Function Generator, and other electrical and electronics lab tools with consumables.

INDUSTRY SCOPE

Completion of this course, students can get industry scope as high demand in the EV charging system domain.

INDUSTRY USE CASE EXAMPLE

1. Design Of Level 1 DC charging Station (120V 15A) (SAEJ1772 standard).

Task 1: Simulate the Basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A PWM Generator Circuit Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-on Different components used in Level 1 using AUTODESK Tinker CAD
Task 5: Design A 120V (LEVEL 1) DC Charging station and Convertor for Battery Charging

2. Design Of Level 2 DC charging Station (240V 40A) (SAEJ1772 standard)

Task 1: Simulate the Basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT and MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A PWM Generator Circuit Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On the Different Components Used in level 2 And Simulate in Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A 240 (LEVEL 2) DC Charging station and Convertor for Battery Charging

3. Design Of Level 3 DC fast charging station. (DCFC).

Task 1: Simulate the Basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A PWM Generator Circuit Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On the Different Components Used in level 3 and Simulate in Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A (LEVEL 3) DC Charging station and Convertor for Battery Charging

4. Design Of Single/Three phase AC-DC Converter for DC charging station. (Thyristor Based).

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT and MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab

Task 3: Simulate A Thyristor Circuit Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On the Different Components Used in AC-DC Converter and Simulate in Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A 230v to AC-DC Converter Using Thyristor for Battery Charging

5. Design Of Single/Three phase AC-DC Converter for DC charging station. (Transformer Based).

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (Bit and MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Coupled Transformer (Step Up and Step Down) Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On the Different Components Used in AC-DC Converter and Simulate in Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A 230v AC-DC Converter Using Transformer for Battery Charging

6. Design Of AC-DC Converter Using UC384x series IC.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A PWM And MOSFET Switching Circuit Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On the Different Components Used in AC-DC Converter and Simulate in Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A Design A 230v to 48V AC-DC Converter (SMPS)

7. Design A battery management system Circuit for A Single Li-Ion Battery Cell with overvoltage and Reverse polarity protection.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Voltage Divider and Voltage Reference Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-on with the Different Components Used in BMS And Simulate It Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A BMS Circuit for a Single Li-ion Battery

8. Design A battery management system Circuit for 4S1P with overvoltage and overcurrent protection.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Voltage Divider and Voltage Reference Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On the Building A Battery Pack and Simulate It Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A battery management system Circuit for 4S1P with overvoltage and overcurrent protection

9. Design A Wireless Charging Circuit for Battery Charging.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate Coupled Inductor and Power Transfer Using Autodesk Tinkercad /Circuit Lab

Task 4: Hands-on with the Inductor Power Transfer and Simulate it Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A Wireless Charging Circuit for Battery Charging

10. Design A Solar-Powered Hybrid Charging Circuit for EVs.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Solar Cell Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On the Erecting Solar Panel and Simulate it Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A Solar Powered Battery Charging Station

11. Design A battery pack for EV for desired specification compatible with LEVEL 1/2/3 charging station.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Battery pack Using Autodesk Tinker cad /Circuit Lab
Task 4: Hands-On the Battery and Other Components and Simulate Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A battery pack for a given specification

12. Design A Real-Time SOC Estimation Circuit for A Battery

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Battery and Measure Using at mega Microcontroller using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On Programming in ATMEGA Microcontroller and Simulate it Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A Microcontroller Based SOC Estimation Circuit

13. Design A Real-Time Prediction Circuit for Battery Operation

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Battery Pack and Measure Using ATMEGA Microcontroller using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On Programming in ATMEGA Microcontroller and Simulate it Using Autodesk Tinkercad /Circuit Lab

14. Design A Real-Time Battery Testing and Monitoring System (Single Cell).

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)
Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab
Task 3: Simulate A Battery and Voltage Reference Using Autodesk Tinkercad /Circuit Lab
Task 4: Hands-On Programming in ATMEGA Microcontroller and Simulate it Using Autodesk Tinkercad /Circuit Lab
Task 5: Design A ATMEGA Microcontroller Battery Testing Circuit

15. Design A Real-Time Battery Testing and Monitoring System (Battery Pack)

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)

Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab

Task 3: Simulate A Battery and Voltage Reference Using Autodesk Tinkercad /Circuit Lab

Task 4: Hands-On Programming in ATMEGA Microcontroller and Simulate it Using Autodesk Tinkercad /Circuit Lab

Task 5: Design A ATMEGA Microcontroller Battery Testing Circuit

16. Design A Dc-Dc Converter Tester for Multiple Load Configuration.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)

Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab

Task 3: Simulate A Battery and Voltage Reference Using Autodesk Tinkercad /Circuit Lab

Task 4: Hands-On Programming in at mega Microcontroller and Simulate it Using Autodesk Tinkercad /Circuit Lab

Task 5: Design A DC-DC convertor tester using an ARM microcontroller

17. Design A Fast Charger Circuit for EV.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)

Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab

Task 3: Simulate A High-Power Charger Circuit and Voltage Reference Using Autodesk Tinkercad /Circuit Lab

Task 4: Hands-On the Building A Battery Pack and Simulate it Using Autodesk Tinkercad /Circuit Lab

Task 5: Design A Fast Charger Circuit

18. Integration Of EV Charging Stations into The Grid Through IoT.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)

Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab

Task 3: Simulate A GPS With Wi-Fi Board Using Autodesk Tinkercad /Circuit Lab

Task 4: Hands-On the Wi-Fi Module and Interface it with Charging

Task 5: Design an Interface Circuit Using a Wi fi module and GPS

19. Design A Data Logger for The Battery Pack for Performance Estimation.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)

Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab

Task 3: Simulate A Sd Card Reader and Voltage/Current Sensing Using Autodesk Tinkercad /Circuit Lab

Task 4: Hands-On the Sd Card, Voltage and Current Sensor and Simulate it Using Autodesk Tinkercad /Circuit Lab

Task 5: Design A Data Logger for An EV Vehicle Using Arm Microcontroller

20. Design A Smart Charging Platform with A Data Acquisition System.

Task 1: Simulate The basic Electrical and Electronics Components in Autodesk Tinkercad /Circuit Lab Software (BJT And MOSFET Switching)

Task 2: Simulate A Function Generator and CRO Using Autodesk Tinkercad /Circuit Lab

Task 3: Simulate a voltage divider and voltage reference using Autodesk Tinkercad /circuit lab

Task 4: Hands-On building a battery pack and Simulate It Using Autodesk Tinkercad /Circuit Lab

Task 5: Design A Smart Charging Platform with A Data Acquisition System

SB8030 EMBEDDED SYSTEM DESIGN AND APPLICATIONS L T P C
1 0 2 2

COURSE OBJECTIVE

Students will be able to:

- To apply their knowledge to design the embedded prototype using microprocessor/microcontroller board with its external peripheral device line GPIO, timer and memory.
- To apply RTOS features like threads, mutex, semaphores and interrupts to program the multi-tasking application.
- To use the serial communication protocol with embedded systems for motion control application.

COURSE CONTENT

UNIT I Configuration of Embedded system board 3 + 6

Embedded system board architecture - Identify embedded platform/simulator – Digital I/O interface, Analog I/O interface – Interrupts – Timer – PWM – Interface of peripheral device

UNIT II Software Tools 3 + 6

About software introduction – Introduction to Different Types of IDE, Visual Studio and Thorny IDE, and Language used – C and Embedded C - Python, micro python firmware - Thorny Shell, About IoT and Free Cloud.

UNIT III Peripherals and Sensors Interfacing 3 + 6

LED blinking task – Buzzer, Relay and switch Interfacing, 7 segment and LCD Interfacing PWM Generation, different types of Analog and digital sensors are interfacing – LM 35 –Ultrasonic –LDR-IR –Potentiometer and Accelerometer.

UNIT IV Wired and Wireless Communication Protocols 3 + 6

Wired communication- Serial Communication: UART – I2C – SPI – CAN Bus, wireless communication ZigBee, Bluetooth and Wi-Fi, wired and wireless communication application interfacing systems.

UNIT V Free RTOS on Embedded Processor 3 + 6

Free RTOS Introduction – Task creation – Free RTOS Thread management – Free RTOS Queue Management – Mutex – Semaphore – Task Priority – Free RTOS scheduling algorithm.

TOTAL : 45 PERIODS

COURSE OUTCOME

- Students will be able to design and develop the embedded system board to acquire the data from sensors like temperature, pressure, humidity, flow etc, and communicate collected signals to the computer through UART, I2C and SPI port.
- Develop the embedded system to interface with accelerometer, ultrasonic sensor, and encoder to acquire the position and orientation information to actuate the DC motors using Free RTOS multitask
- Gain advanced knowledge of RTOS
- Comprehending the advantages of storing spatial information in spatially enabled databases and writing SQL queries to retrieve and analyze spatial data.
- Experiencing extensive and hands-on in Embedded and IoT concepts

REFERENCES

1.RP2040 Assembling language Programming – Stephen smith
2.Raspberry pi pico Essentials: Program, Build and Master Over 50 Projects with micro python

SOFTWARE REQUIREMENT

- Thonny IDE
- Python and Micro Python Language
- Free RTOS

HARDWARE REQUIREMENT

Processor - ARM Cortex M0 (Raspberry pi Pico RP2040)

INDUSTRY SCOPE

\On Completion of this course, students get industry scope in embedded & IoT based products, Location tracking and safety, Public Health, and automotive Industry

20 INDUSTRY USE CASES

1. Create a 0 to 50 MHz Function generator for lab use.

The student has to use the PIO feature, which is another CPU, to generate this 0-50 Mhz sqaure waveform for the Industrial and Scientist use. As the assembly language program of PIO is deterministic, the PIO can generate a square waveform with minimum fitter.

2. Create a Home Automation systems.

The student will use all features of RP2040 + WiFI to read and control many home appliance like light, fan, Intruder, TV, Fridge Etc.

3. Create a IoT based application

A powerful IOT Application can be built around RP2040 + WiFI based Board. Many Environment sensors can be added to this to this board for IOT Air Quality Mentoring, which is very essential IOT usage for AIRPORT, HOUSE, MALL Etc.

4. To build a 24 Channel Logic analyzer

The student can build a 24 Channel 100 Mhz Logic Analyzer using the unique feature of PIO. This is cost effective and very useful tool for MSME industries for debugging Digital Hardware.

5. To build a commercial 4-wheel drive robot

The RP2040 Dual Core Processor is used to build This Moving Robo, which consists of Dual Core Cortex M0+ Microcontroller with Flash RAM, PWM, ADC, WiFi Connectivity and many on board features.

L293D is a quadruple half H-bridge bidirectional motor driver lC provided.

An infrared sensor (lR sensor) provided for Object Detection.

One Ultrasonic sensor for Object Detection.

Kit includes two-line following Modules

Kit includes two encoder modules for robot speed control

Includes Servo, Sonar, encoder sensors

6. Porting Free RTOS on RP2040

As Free RTOS is quite popular in many Industries and for many certifications Free RTOS is a must. Hence, Free RTOS is ported on RP2040 and few example programs for multiple tasks will be provided.

7. To develop the health care system

RP2040 based development board with ECG, Blood pressure sensor will be provided for a simple health care system building.

8. To build the doorbell with camera and voice

A Door Bell with many features like Voice, Video, Image Recognition, Password, door electronic lock etc. are the demand for a Multi-story Apartments.

Cost is another favourable factor. RP2040 is much cheaper, but with good features to implement above parameters of the Door Bell. RP2040 based Hardware with MEMS Microphone, Camera, Door Lock etc, will be used to implement a Door Bell.

9. Live video streaming using RP2040

RP2040 based development board with ECG, Blood pressure sensor will be provided.

10. Create an Industry application for engine Parameter monitoring system.

RP2040 based development board with sensor boards for multiple Thermocouple sensors to measure temp at various points of a 4-stroke diesel engine. Other sensors like smoke sensor will be provided for engine health monitoring.

11. RTOS based 8 channel data acquisition

RP2040 based multi-tasking Free RTOS will be designed for a 8 channel Data Acquisition. Students will be exposed on data capturing and conversion of raw data to desired format.

12. To build a PID controller

Since RP2040 is Dual Core at 133Mhz speed , we can implement a math intensive like PID can be implemented. In this Design 2 channel 12 bit ADC are used to digitise a Process Variable and a 12 bit single channel DAC is used for controlling the Process Controller. Can be used to control a Level/Flow/Temperature/Pressure based process control system.

13. To develop DPM for voltage / Current

RP2040 + ADC based Voltage and current measurement with 16*2 LCD Display, as Digital Panel Meter. Various Ranges can be provided.

14. Create a home Energy meter

RP2040 + WiFi based Energy Meter will be designed for home usage.

Analog Devices ADE9000 AFEs based single phase energy meter with Arduino Shield for energy and power quality measurement. This Design enables quick evaluation and prototyping of energy and power quality measurement systems for a Home. Designers can directly interface this Hardware with current transformers and voltage leads., Arduino library and application examples will be included for students ease of use.

Arduino-compatible energy and power quality measurement shield with ADE9000 multi-phase energy and power quality monitoring IC

3P4W, 3P3W, or 3-wire single phase measurements

Direct interface with current output current transformers

Up to 240Vrms nominal line-neutral voltage measurement.

15. To develop PWM based inverter 100 W

RP2040 + 3 Leg IGBT will be used to build a 100W Inverter with single phase 230V, 50Hz output. 200Watts solar panel will be the input to this Inverter.

16. To Develop DC to DC converter

DC-DC converters required in many applications, especially in Renewable Energy Power Generation. For Solar & Wind Buck, Boost Type DC-DC Converters are required. There are other types of DC-DC Converter like Buck-Boost for bidirectional battery Charging, Sepi, Fly back etc. Converters. RP2040 provides flexible PWMs to implement this. RP2040 with MOSFET Power Device will be used to implement Buck and Boost type DC-DC Converters.

17. To develop a Drip irrigation system

A 500 square feet area, drip irrigation can be implemented using RP2040+WiFi Module will be used to implement this. An Anroid based APP will be offered for controlling trip watering. Wifi based moisture sensor for sensing the water required for the plant and an automatic solenoid based watering system for saving time. All Garden data like temp, moisture, pressure , light can be sent to Cloud for scientific farming of vegetables

18. To develop Energy monitoring system (home / Industry / College)

In many places, energy consumption should be monitored and controlled for energy saving. This will be based on RP2040+WiFI with Current and Voltage monitoring through an Energy Meter. In addition, the presence of people, over voltage/current, under voltage/current will be monitored and power will be switched off accordingly for better power utilisation.

19. To develop weather Monitoring systems

IN MANY applications (Solar Plant, Dairy Farm, big agriculture field) a weather monitoring system is required. Sensors like Air Velocity, Direction, Humidity, Air Quality, and Temperature can be interfaced

to RP2040 + WiFI based Board for the data to be uploaded to Cloud Server for the concerned Engineers for review. As this data is continuous, it could be an example for Big Data.
20. Develop a SMPS Parameter monitoring system.
Many MSME Industries design and manufacturing Switch Mode Power Supplies and DC- DC Converters of various power ratings. To test this, there is a need of loading the SMPS for desired time duration. The Current, voltage, temperature should be digitized and send it to cloud server through RP2040 + WiFi based Board. All relevant Engineers can monitor the result for corrective decision.

SB8031 EMBEDDED SYSTEM DESIGN - INDUSTRIAL APPLICATIONS L T P C
1 0 2 2

COURSE OBJECTIVES

Upon completion of the course, learners can able to apply the fundamentals of embedded systems for the development of new industrial applications.

COURSE CONTENT

UNIT I Electronics and PCB Overview: 3 + 6
Introduction of Embedded System and number systems - Boolean Algebra and Basic Electronic Components - What is datasheet, power supplies control needs - Why using Heatsink, How Handling Electronic Equipment - Basic Shouldering Methods and wire Diagram Connection -
PCB Classification and How can handing a PCB Board

UNIT II Embedded Programming using Arduino IDE 3 + 6
Basic Data Types - Variables and Programming Constructs - Functions and Data Structures - Advanced Topics - Overview of the C/C++ library using Arduino IDE - Embedded System and Oriented Topics

UNIT III Microcontroller Architectures and Sensors 3 + 6
Introduction to Microcontroller Architectures - Introduction to Communication Protocol - ADC and DAC Converters - Motor Controls and classifications - What is sensor and how its works - The Sensors workflow analysis

UNIT IV Embedded Interfacing with Modules 3 + 6
LCD display types and its uses - Motor connections and timers - Counters and Switches - Multiple Sensors Interfacing - What is PWM and its uses - What is two Embedded Systems Communications

UNIT V Getting Started with IOT 3 + 6
Introduction to IOT - What is NodeMcu and its Functions - What is local Network Communication - IoT Platforms and how it communicates - NodeMcu with Blynk platform - How to find the problem Statement, how to solve the Problem

20 Industrial use cases:

1. Smart irrigation system for agriculture
2. Automatic Street lighting control system
3. Home automation system
4. Predictive maintenance system for manufacturing plants
5. Vehicle tracking and fleet management system
6. Intelligent traffic control system
7. Energy monitoring and management system for buildings

8. Waste management system for smart cities
9. Predictive weather forecasting system for aviation
10. Industrial process control system
11. Predictive maintenance system for wind turbines
12. Automatic water treatment system
13. Supply chain optimization system for logistics
14. Precision farming system
15. Environmental monitoring system for oil and gas pipelines
16. Quality control system for pharmaceutical manufacturing
17. Predictive maintenance system for power plants
18. Automatic material handling system for warehouses
19. Predictive maintenance system for heavy machinery
20. Predictive maintenance system for transportation infrastructure.

SOFTWARE REQUIREMENTS:

1. Blynk
2. PADS
3. Arduino ide
4. C/C++

HARDWARE REQUIREMENTS:

1. Arduino Uno
2. ARM Processor
3. LCD Display
4. Motors with Drivers
5. 12v adapter, Jumper wires, Connectors
6. Temperature, Humidity, IR sensors
7. Relay
8. Breadboard

Industrial scope of Embedded systems:

1) Surgical devices for medical applications.
2) Inspection devices for pipeline industries.
3) Fermentation monitoring systems for dairy industries.
4) Satellite communication for space exploration.
5) Automation systems for industrial automation.
6) Goods fleet management systems for supply chain industries.
7) Smart switches for home automation.
8) HVAC system for warehouse management
9) surveillance systems for military purposes
10) Smart devices such as watches, smartphones, and tablets

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On completion of this course, learners will be able to:

- To perform the basics of embedded programming using Arduino ide.
- To simulate the working of microcontrollers, communication protocols, and sensors.
- To be able to interface sensors and actuators with embedded systems.
- To get started with IoT and the Blynk Platform.

REFERENCES:

1. https://www.youtube.com/watch?v=etPHoqm-coY
2. https://www.youtube.com/watch?v=eW3oz4Nldg4
3. https://www.youtube.com/watch?v=H878UW4PMu8
4. https://www.youtube.com/watch?v=Hpx4d2ME4v4
5. https://www.youtube.com/watch?v=Ol-9qjNP_FY
6. https://www.youtube.com/watch?v=zEeD0DjcP_U
7. https://www.youtube.com/watch?v=QL-6PdiDTeo
8. https://www.youtube.com/watch?v=ge0Aailr3ao
9. https://www.tutorialspoint.com/embedded_systems/index.htm
10. https://www.udacity.com/course/embedded-systems--ud169

SB8032	SUSTAINABLE BUILDING DESIGN	L	T	P	C
		1	0	2	2

COURSE OBJECTIVE

The project-oriented training to gain knowledge on designing sustainable buildings and infrastructure using BIM tools. This hands-on project training will lead students to create their own projects with an industrial approach. And powerful processes to achieve sustainable goals while designing a high-performance building with all aspects.

COURSE CONTENT

UNIT I Advanced 3D Modelling for Architectural Design 3 + 6

Modelling Curtain walls - Modelling floors and ceilings- Modelling roofs - Modelling stairs and railings - Modelling Site and topography - Modelling Masses - Modelling rooms and areas -Applying materials

UNIT II Industrialized construction of a sustainable building model 3 + 6

Creating sustainable BIM model in Autodesk Revit (Architectural, Structural, MEP) - Design and building process using BIM 360 - Work collaboratively with BIM 360 - Water Efficiency and Energy Audit

UNIT III Documentation and Publishing for Architectural Design 3 + 6

Creating sections and section views for Architectural design - Creating interior and exterior elevations for architectural design - Using views for architectural design - Creating schedules for architectural design

UNIT IV Energy analysis of a building 3 + 6

Export geometry into analysis packages Green Building Studio using the gbXML file format - Conceptual energy analysis using Autodesk Insight - Thermal properties of constructions.

UNIT V Performance of a building 3 + 6

HVAC load calculations - Thermal properties of constructions. (But not specific thermal analysis within the tool) - Track key quantities and eco-metrics in schedules (for example, the percentage of recycled materials in the project) - Indian Green Building rating system: IGBC, GRIHA

TOTAL : 45 PERIODS

COURSE OUTCOMES

After completing this course, the students will be able to:

1. Design buildings in 3D and work with tools that are key to your professional growth
2. Create BIM models using Revit and Understand the fundamental environmental, social, and economic issues underlying sustainability
3. Do energy analysis with Revit Insight and Green Building studio
4. Innovative BIM Workflows for Industrialized Construction
5. BIM: A Powerful Process to Achieve Sustainable Goals
6. Get a hands-on approach to creating and editing walls, doors and windows, roofs, stairs, ramps, and railings by following typical design workflows. Practice these workflows on your own and use your skills to solve new challenges

FOR FURTHER READING:

BIM Tools for Sustainable Buildings and Infrastructure- Energy Analysis with Revit Insight and Green Building Studio.

REFERENCES

1. https://www.autodesk.com/certification/learning-pathways/revit-architectural-design
2. Sustainable Construction: Green Building Design and Delivery
3. Building a Sustainable Home: Practical Green Design Choices for Your Health, Wealth, and Soul
4. Sustainable Building: Design Manual: v. 1 Paperback – 1 December 2004

ONLINE REFERENCES

1. https://www.autodesk.com/certification/learn/course/revit-3d-modeling-architectural-design-professional
2. https://www.autodesk.com/certification/learn/course/revit-advanced-3d-modeling-architecture-professional
3. https://www.autodesk.com/certification/learn/course/families-and-parameters-architectural-design-professional
4. https://www.autodesk.com/certification/learn/course/revit-managing-projects-professional

SOFTWARE REQUIREMENT

- Fusion 360 Software
- Autodesk Revit, Autodesk BIM 360, Insight,
- Green building studio

HARDWARE REQUIREMENT

Revit 2022 **Minimum: Entry-Level Configuration**	
Operating System *	64-bit Microsoft® Windows® 10 or Windows 11. See Autodesk's Product Support Lifecycle for support information.
CPU Type	Intel® i-Series, Xeon®, AMD® Ryzen, Ryzen Threadripper PRO. 2.5GHz or Higher. Highest CPU GHz recommended. Autodesk® Revit® software products will use multiple cores for many tasks.

Memory	8 GB RAM • Usually sufficient for a typical editing session for a single model up to approximately 100 MB on disk. This estimate is based on internal testing and customer reports. Individual models will vary in their use of computer resources and performance characteristics. • Models created in previous versions of Revit software products may require more available memory for the one-time upgrade process.
Video Display Resolutions	**Minimum:** 1280 x 1024 with true color **Maximum:** UltraHigh (4k) Definition Monitor
Video Adapter	**Basic Graphics:** Display adapter capable of 24-bit color **Advanced Graphics:**

	DirectX® 11 capable graphics card with Shader Model 5 and a minimum of 4GB of video memory
Disk Space	30 GB free disk space
Pointing Device	MS-Mouse or 3Dconnexion® compliant device
.NET Framework	.NET Framework Version 4.8 or later.
Browser	Microsoft Internet Explorer 10 (or higher)
Connectivity	Internet connection for license registration and prerequisite component download

INDUSTRY SCOPE:

- Architecture, construction, Modelling and Optimisation of Building Performance, Green Building Codes and Standards, Sustainable BIM designing and analysis.

20 INDUSTRY USE CASES

1. Biophilic building Design

Note: sample figure only

Design creatively a biophilic building design feature on your idea that showing Double-flow ventilation limits heat losses

Task 1: create a building having double flow ventilation with aesthetic features of biophilic.

Evaluation metrics: Design concept review

Task 2: Massing and sighting BIM feature.

Evaluation metrics: Design concept review

Task 3: Building performance analysis with Insight.

Evaluation metrics: Assessment in analysis.

Task 4: Generating BOM

Evaluation metrics: Evaluating BOM

Task 5: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

2. Striking-cube like building

Note: sample figure only

Develop a design that reflected by cladding the building in metal panels with perforations that create tunnel-like light effects.

Task1: create a building using collaborative workflow with prefabricated concrete walls

Evaluation metrics: Design concept review & evaluating materials used

Task 2: Energy analysis with Insight

Evaluation metrics: Assessment in analysis

Task 3: Creating BOM of building.

Evaluation metrics: Evaluating BOM

Task 4: Rendering BIM model using Revit cloud rendering services

Evaluation metrics: Design review

Task 5: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

3. Tallest engineered timber building

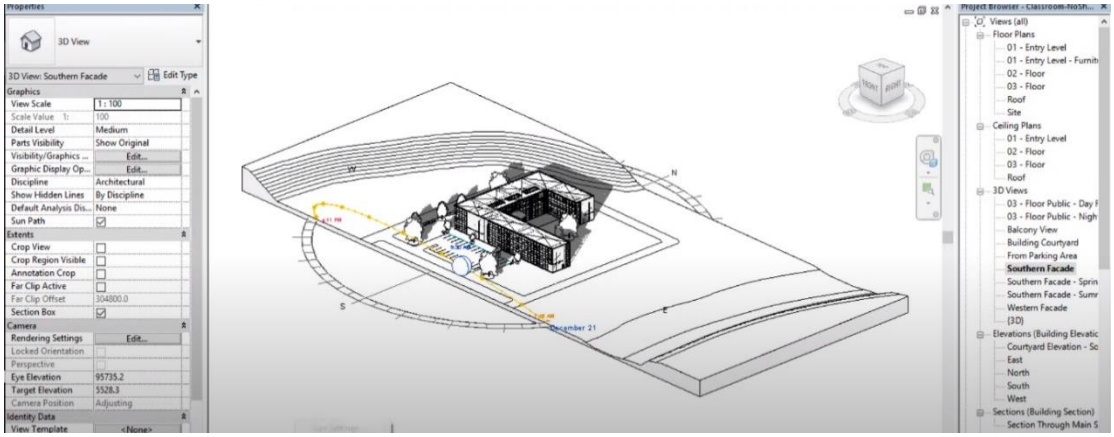
Note: sample figure only

Create an all-timber structural system that significantly reduces the building's embodied carbon compared with conventional construction methods.

Task1: Create an 14 level structural design using wood material
Evaluation metrics: Design concept review & evaluating materials used
Task 2: With respect to structural model create building.
Evaluation metrics: Design concept review & evaluating materials used
Task 3: Use green build studio to analyze.
Evaluation metrics: Assessment in analysis
Task 4: Rendering BIM model using Revit cloud rendering services
Evaluation metrics: Visualizing the design.
Task 5: Project presentation
Evaluation metrics: Based on project delivery and presentation by students.

4.Sun and site positioning

Do sun and site positioning by assigning a location, Latitude and longitude of this location, which have a great influence on the Sun path.



Note: sample figure only

Task 1: Model development and for energy simulation, a model is exported to gbxml

Evaluation metrics: Analysis review

Task 2: Analysis with green studio.

Evaluation metrics: Assessment in analysis

Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

5. Achieving Lifecycle Success with a Digital Twin

Load an existing Architecture, MEP and structural engineering model to Revit .collect core data's and informations and extract to other open formats needed for simulations, cost counting, construction inspections and facility management, such as IFC, gbXML

Note: sample figure only

Task 1: Create Revit model and then load to Navisworks Explore additionally Navisworks facilitating successful digital prototyping.

Evaluation metrics: check clash detection.

Task 2: Collect data's from Revit models and review the Building Management System (BMS) layout and construction accuracy.

Evaluation metrics: Q&A session for group from faculty

Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

6. Design of a zero-emission building

The project used Revit to determine the amount of materials used in order to improve the building performance and calculate the embodied emission.

Note: sample figure only

Task 1: Create a Revit sample model with proper massing and siting innovatively.

Evaluation metrics: Design review

Task 2: Use analysis method to calculate emission

Evaluation metrics: Analysis review

Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

7. Stadium 974 with containers

Create a stadium with container families.

Note: sample figure only

Task 1: Create a stadium sample model with containers as family

Evaluation metrics: Design review

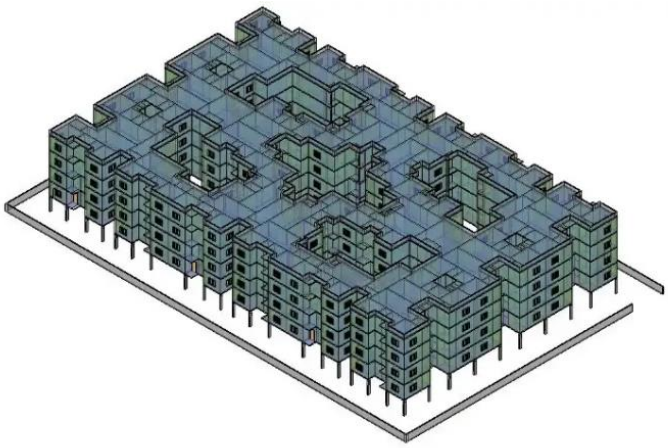
Task 2: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

8. **Energy Analysis with Revit Insight and Green Building Studio**

Do energy analysis with Revit insight and Green building studio for an existing building.

Note: sample figure only



Task 1: Load a Revit model sample file into Revit insight and Green building studio and do the necessary energy analysis for it.

Evaluation metrics: Analysis Review.

Task 2: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

9. Daylight analysis using Autodesk Insight

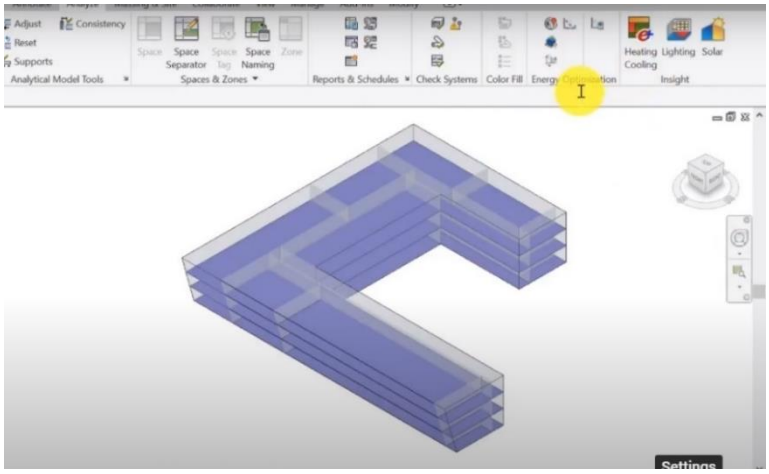
Create a commercial building in Revit and do necessary daylight analysis with Autodesk Insight.

Note: sample figure only

Task 1: Create an architecture model with commercial properties
Evaluation metrics: Design Review.
Task 2: Day light analysis
Evaluation metrics: Analysis Review.
Task 3: Project presentation
Evaluation metrics: Based on project delivery and presentation by students.

10. Heating/Cooling loads Analysis and reports.

Create a commercial building in Revit and do Heating/cooling analysis with Autodesk insight and generate the reports.



Note: sample figure only

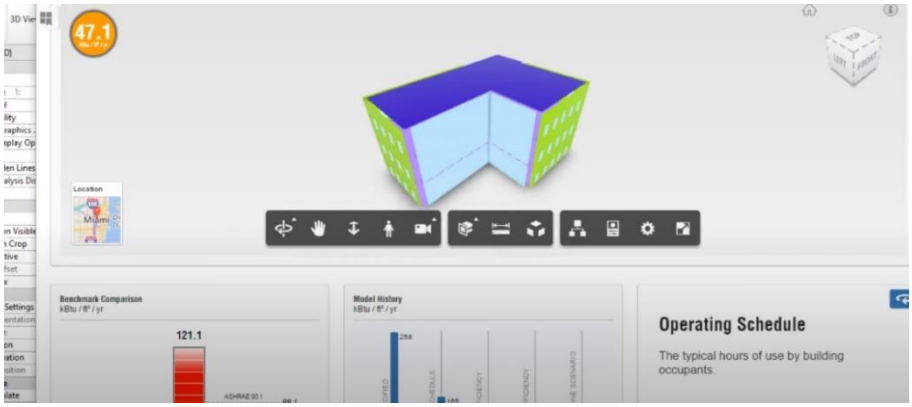
Task 1: Create an architecture model with commercial properties
Evaluation metrics: Design Review.
Task 2: Heating/cooling analysis. And generate reports.
Evaluation metrics: Analysis Review.
Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students.

11. Impact of envelop Thermal properties.

Load an existing Revit model into Insight and explore the impact of changing the thermal properties of building envelope elements using Insight.

Note: sample figure only



Task 1: Load an architecture model into Insight

Evaluation metrics: Design Review.

Task 2: change the range of values being considered for the thermal properties of different constructions

Evaluation metrics: Analysis Review.

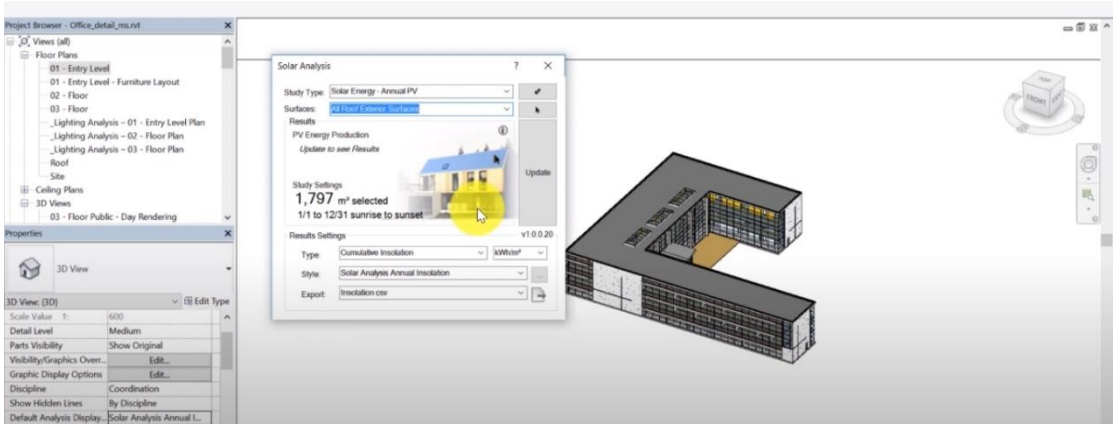
Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students

12. Solar analysis

Create a residential building with properties and do solar analysis.

Note: sample figure only



Task 1: Create and Load an architecture model into Insight

Evaluation metrics: Design Review.

Task 2: Do solar analysis

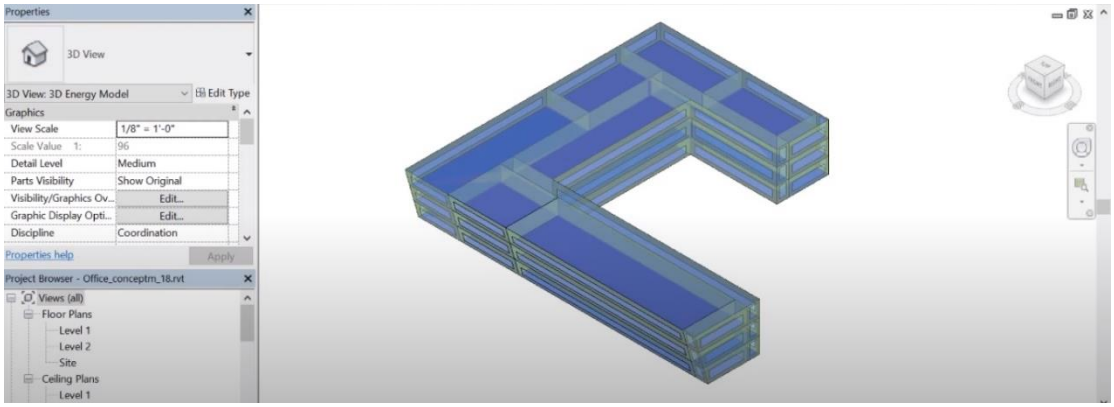
Evaluation metrics: Analysis Review.

Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students

13. Performing Energy analysis Conceptual Models

Create a conceptual mass model in Revit and generate Insight. Use Revit will give you more options for specifying various parameters in your model.



Task 1: Create and Load an architecture model into Insight

Evaluation metrics: Design Review.

Task 2: Performing Energy analysis Conceptual Models

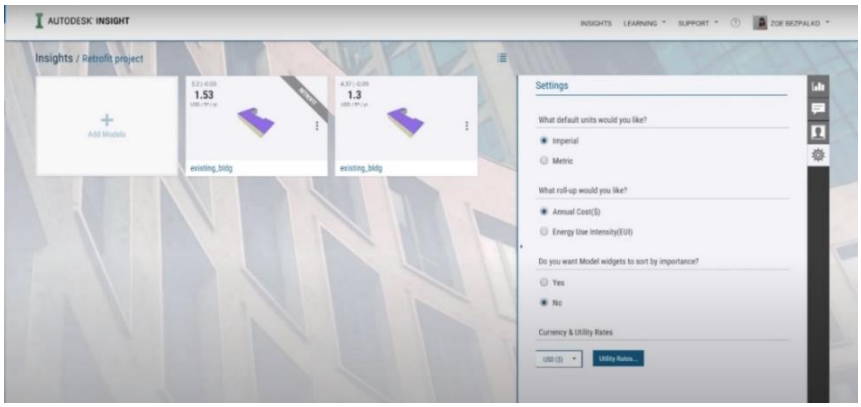
Evaluation metrics: Analysis Review.

Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students

14. Retrofit Analysis

Create a model in Revit and do retrofit analysis for currency and utility rate.



Task 1: Create and Load an architecture model into Insight

Evaluation metrics: Design Review.

Task 2: Create and do retrofit analysis

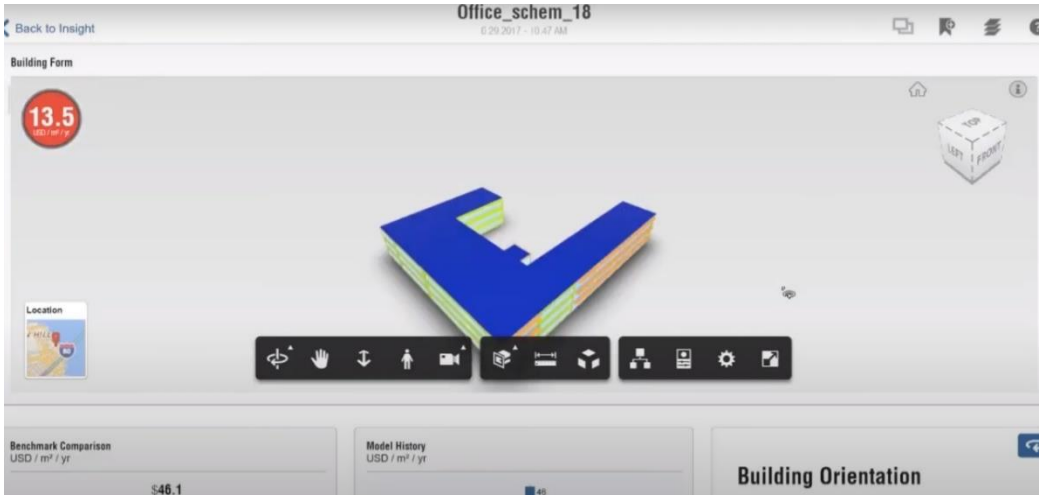
Evaluation metrics: Analysis Review.

Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students

15. Generating Insight for Schematic Models

Create a Revit model and perform an energy analysis for schematic design



Note: sample figure only

Task 1: Create and Load an architecture model keep as schematic model

Evaluation metrics: Design Review.

Task 2: Create and do Energy analysis for schematic model.

Evaluation metrics: Analysis Review.

Task 3: Project presentation

Evaluation metrics: Based on project delivery and presentation by students

16. Green Library model

Create a Library innovatively shows sustainable environment architecture

Task 1: Create an architecture model of library innovatively.

Evaluation metrics: Design Review.

Task 2: Project presentation

Evaluation metrics: Based on project delivery and presentation by students

17. Pixel building

Pixel consists of a rooftop clad with both fixed and mobile PV panels as well as vertical wind turbines.

Note: sample figure only

Task 1: Create an architecture model similar to Pixel building model and use reusable materials

innovatively.

Evaluation metrics: Design Review.

Task 2: Project presentation

Evaluation metrics: Based on project delivery and presentation by students

18. Floating Apartment

The structure of the Floating School consists of 256 plastic drums

Task 1: Create an architecture model similar to floating apartment model and use reusable materials innovatively.

Evaluation metrics: Design Review.

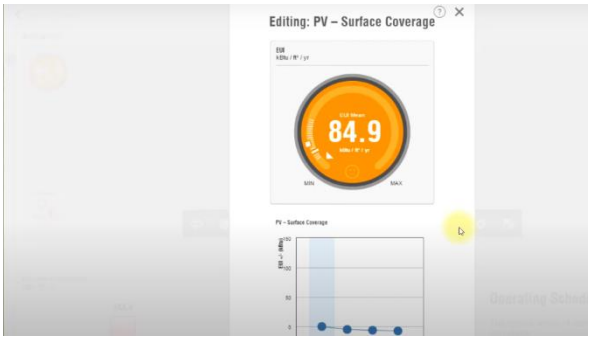
Task 2: Project presentation

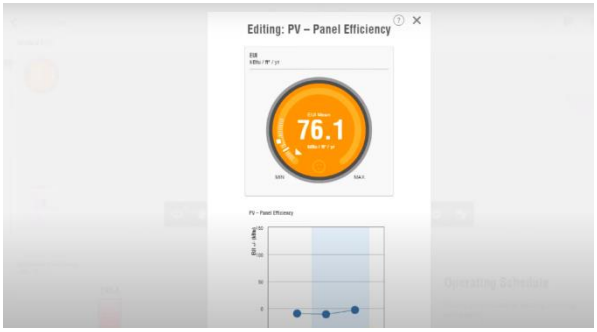
Evaluation metrics: Based on project delivery and presentation by students

19. Exploring Factors that Impact PV Potential: surface coverage and panel efficiency.

Exploring the factors that impact the photovoltaic potential of your project using Insight.

Using Insight, you can easily explore the impact and interaction between several design variables that affect the photovoltaic potential of the surfaces in your model. The inter-related Factors available to explore in the Insight Interface include:





Task 1: Load an architecture model into Insight

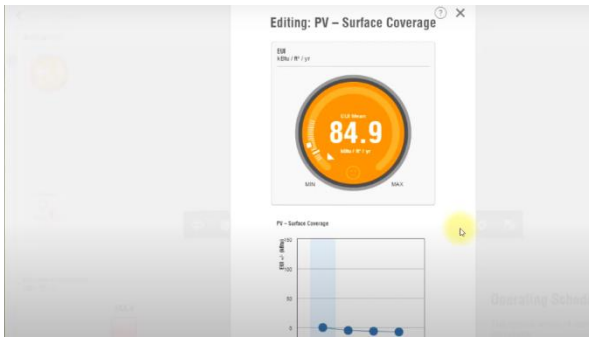
Evaluation metrics: Design Review.

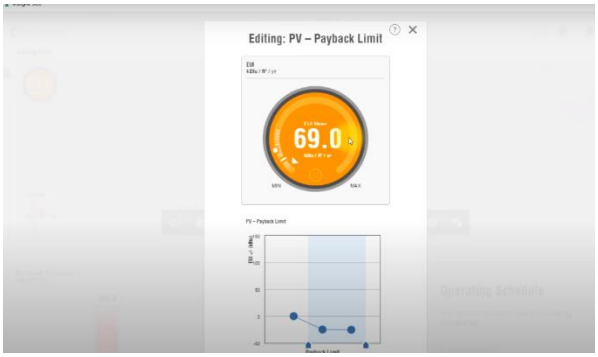
Task 2: Do analysis in insight for factors impact PV potential

20. Exploring Factors that Impact PV Potential: surface coverage and payback limit.

Exploring the factors that impact the photovoltaic potential of your project using Insight.

Using Insight, you can easily explore the impact and interaction between several design variables that affect the photovoltaic potential of the surfaces in your model. The inter-related Factors available to explore in the Insight Interface include:





Task 1: Load an architecture model into Insight

Evaluation metrics: Design Review.

Task 2: Do analysis in insight for factors impact PV potential

SB8033	**NETWORK ENGINEERING**	**L T P C**
		1 0 2 2

COURSE CONTENT:

UNIT I Basics of Networking and Protocols 3 + 6

Networking – Components, types, Internet Connections, Requirements of a reliable network, Internet Connections – LAN, WAN Interconnection Network trends - BYOD, online collaboration, video, and cloud computing, Network security threats, Basic Switch and End Device Configuration - Cisco IOS Access, IOS Navigation, command structure of Cisco IOS software, Basic Device Configuration - Configuring a Cisco IOS device using CLI, Save Configurations, Ports and Addresses, Configuring IP Addressing, Verify Connectivity

Network Protocols – Rules, protocol suites, role of standards organizations in establishing protocols for network interoperability, TCP/IP model and the OSI model in standardization of communication process, Data Encapsulation, Data Access

UNIT II Introduction to data layer, physical layer 3 + 6

Physical layer protocols, services, and network media support communications across data networks, Physical Layer Characteristic, Copper Cabling, UTP Cabling, Fiber-Optic Cabling, Connection using wired and wireless media

Number systems: decimal, binary, and hexadecimal systems - Data Link Layer- media access control in the data link layer in communication across networks - The characteristics of media access control methods on WAN and LAN topologies, the characteristics and functions of the data link frame -

Ethernet Switching - Ethernet Frame, Ethernet MAC Address, MAC Address Table, Switch Speeds and Forwarding Methods

UNIT III Introduction to Network layer and Addressing 3 + 6

Network Layer: Network Layer Characteristics, IPv4 & IPv6 Packet, routing tables to direct packets to a destination network in network devices , function of fields in the routing table of a router.

MAC & IP addressing, ARP, Operation of IPv6 neighbor discovery - Basic Router Configuration- Configure Initial Router Setting, Interfaces on a Cisco IOS router, default Gateway IPv4 Addressing - IPv4 Address Structure - public, private, and reserved IPv4 addresses., IPv4 Unicast, Broadcast, and Multicast, Types of IPv4 Addresses, Network Segmentation, Subnet an IPv4 Network - a /24 prefix, a /16 and /8 prefix - Variable Length Subnet Masking, VLSM addressing scheme - IPv6 Addressing – Implementation & the need for IPv6 addressing, Representation, IPv6 Address types. GUA and LLA Static Configuration - configuring static global unicast and linklocal IPv6 network addresses. Dynamic Addressing for IPv6 LLAs – Configuration of link-local addresses, IPv6 Multicast Addresses, Subnetting an IPv6 Network

UNIT IV Introduction to Transport layer 3 + 6

ICMP Messages- how ICMP is used to test network connectivity, Ping and Traceroute Testing - Transport Layer - Operations of transport layer protocols in supporting end-to-end communication. Transportation of Data - the purpose of the transport layer in managing the transportation of data in end-to-end communication - Characteristics of the TCP & UDP, Port Numbers of TCP & UDP, TCP Communication Process - TCP session establishment and termination processes facilitate reliable communication, Reliability and Flow Control, UDP Communication - the UDP client processes to establish communication with a server.

UNIT V Introduction to Application Layer & Network Security 3 + 6

Application Layer - operation of application layer protocols in providing support to end-user applications - Application, Presentation, and Session - functions of the application layer, session layer, and presentation layer work together to provide network services to end user applications. - Operation of end user application in a peer-to-peer network, Web and Email Protocols, IP Addressing Services - DNS and DHCP operation, File Sharing Services – File transfer Protocols - Network Security Fundamentals - Security Threats and Vulnerabilities, Network Attacks - security vulnerabilities, Network Attack Mitigation - general mitigation techniques, Device Security - Configuring network devices with device hardening features to mitigate security threats. - Building a Small Network - Devices in a Small Network, protocols and applications used in a small network, Scale to Larger Network - how a small network serves as the basis of larger networks - Verify Connectivity – Using the output of the ping and tracert commands to verify connectivity and establish relative network performance - Host and IOS Commands, Troubleshooting Methodologies & Scenarios

TOTAL : 45 PERIODS

COURSE OUTCOME:

- Configure a Cisco IOS device using CLI.
- Configure a host device with an IP address.
- Configure initial settings on a Cisco IOS router.
- Implement initial settings including passwords, IP addressing, and default gateway parameters on a network switch and end devices.
- Configure devices to use the default gateway.
- Configure two active interfaces on a Cisco IOS router.
- Implement a VLSM addressing scheme.

- Configure link-local addresses dynamically.
- Implement a subnetted IPv6 addressing scheme.
- Configure switches and routers with device hardening features to enhance security.
- Configure network devices with device hardening features to mitigate security threats.
- Troubleshoot issues with devices in the network.

HARDWARE REQUIREMENT:

- 2 x ISR4221/K9 Routers
- 2 x WS-C2960+24TC-L Catalyst switches
- 1 wireless router (generic brand) with WPA2 support
- Ethernet patch cables
- PCs - minimum system requirements
  o CPU: Intel Pentium 4, 2.53 GHz or equivalent
  o OS: Microsoft Windows 7, Microsoft Windows 8.1, Microsoft Windows 10, Ubuntu 14.04 LTS,macOS High Sierra and Mojave
  o RAM: 4 GB
  o Storage: 500 MB of free disk space
  o Display resolution: 1024 x 768
  o Language fonts supporting Unicode encoding (if viewing in languages other than English)
  o Latest video card drivers and operating system updates
- Internet connection for lab and study PCs
- Optional equipment for connecting to a WLAN
  o 1 printer or integrated printer/scanner/copier for the class to share
  o Smartphones and tablets are desirable for use with the labs

SOFTWARE REQUIREMENT

- Cisco IOS versions:
  - Routers: Version 15.0 or higher, IP Base feature set
  - Switches: Version 15.0 or higher, lanbaseK9 feature set
- Packet Tracer 8.0
- Open-source server software:
  - For various services and protocols, such as Telnet, SSH, HTTP, DHCP, FTP, TFTP, etc.
- Tera Term source SSH client software for lab PCs.
- Oracle VirtualBox, most recent version.
- Wireshark version 2.5 or higher.

INDUSTRY USE CASE:

1. Create network and assign Static IP address to the host using Supernetting and subnetting.
2. Design a network using VLANs, Wireless LANs and InterVLAN routing.
3. Design a simple firewall for host and network.
4. Configure and troubleshoot redundancy on a switched network using EtherChannel.
5. Simulation of Transport Layer Protocols and analysis of congestion control techniques in network
6. Develop a DNS client server and DHCP server to resolve the given host name or IP address
7. Implementation of Layers for security protocols and server configuration

SB8034 ARCHITECTURE VIZUALISATION USING AR/VR L T P C
1 0 2 2

COURSE OBJECTIVE:

- Create a 3D Building Exterior Elevation.
- Create Interior design of building.
- Presentation using Virtual reality.

COURSE CONTENT:

UNIT I Creating a 3D scan, stitching & building a 3D model 3 + 6

What is photogrammetry - What is LIDAR - LIDAR apps and Technique, Scan LIDAR Meshes - Convert to CAD - Import CAD scan - Stitching images - Creating walls, Floors & Roofs, Doors & Windows

UNIT II Building an Interior Design using Blender 3 + 6

Importing 3D - Cleaning up 3D scans - Creating Interiors - College lobby, Library, Study room, Washroom, Conference Hall, Institution Computer lab

UNIT III Creating an Exterior Design for the Building 3 + 6

Creating elevation – Stairs, Window, Sunlight - Textures details – Considerations for sunlight, Room & object textures

UNIT IV Scene Building for VR 3 + 6

Scene building - Preparing for VR - Importing VR Models - Adding Skybox

UNIT V VR Presentation 3 + 6

Creating VR tools - Creating interactive menus, options, buttons, UI - Creating Walkthrough - Virtual Reality Presentation.

TOTAL : 45 PERIODS

COURSE OUTCOME:

1. Create a 3D Exterior Elevation and Interior model for the given building plan.
2. Render the 3D model of the given building and create a realistic views and Videos.
3. Design for performance of building
4. Present the Model using Virtual reality.

FOR FURTHER READING:

Virtual Reality – Walkthrough using VR – Parametric architecture

REFERENCES:

1. SketchUp for Site Design: A Guide to Modelling Site Plans, Terrain, and Architecture 2nd Edition by Daniel Tal.
2. SketchUp for Builders: A Comprehensive Guide for Creating 3D Building Models Using SketchUp by John Brock.
3. SketchUp for Interior Design: 3D Visualizing, Designing, and Space Planning.
4. The SketchUp Workflow for Architecture: Modelling Buildings, Visualizing Design, and Creating Construction Documents with SketchUp Pro and Layout.

ONLINE REFERNCES:

- Architectural Visualization with V-Ray Next for SketchUp, a course by María Alarcón
- Photorealism for Interior Spaces with Lumion, a course by Angular Lab
- https://help.sketchup.com/en/sketchup/getting-started-self-paced-tutorials
- https://www.udemy.com/share/106hka3@K3X-wvSJ_iKej00tbRmgtLOxImvNOPkJ5ilN1Pa4hIV7hhFuhS62zd2r1JRZ2AI/
- http://www.sketchup.com/products/sefaira

SOFTWARE REQUIREMENTS

1. Sketchup
2. Twin motion
3. Unity or Unreal
4. Blender
5. Photoshop

HARDWARE REQUIREMENTS

1. PC – Minimum requirements
   a. 16 – GB RAM
   b. 2GB - Dedicated GPU
   c. 500 GB HDD
2. Oculus Quest 2 (VR Presentation)
3. iPad PRO 2022 with LiDAR Camera

20 USE CASES - FINAL PROJECT SHOWCASE (EACH INDIVIDUAL STUDENT):

1. Pre-built/Existing Architecture Space: Each team of students would 3D scan the department of their choice from their college using photogrammetry & LiDAR, and build 3D modelling using Blender, Lighting & Texturing and develop the content for VR, adding VR Walkthrough elements with Interactive UI & Menu. (More than 20 + use cases)

2. To-be built/New Architecture Space: Each team of student would choose from a set of 15 spaces from the categories of office, residential, factory from the scratch (2D drawing) and build 3D modelling using Blender, Lighting & Texturing and develop the content for VR, adding VR Walkthrough elements with Interactive UI & Menu. (More than 20 use cases)

SB8035	**PLANT SIMULATION**	**L T P C**
		1 0 2 2

COURSE OBJECTIVE

- To enhance the students to develop and enrich practical knowledge & skill on different process equipment design, control automation and operations
- To provide industrial working environment, practical working knowledge and skill, hands-on experience of chemical and petrochemical plant operations through dynamic simulator
- To give the students experience and **skill** on what-if analysis and troubleshooting, energy optimization of Industrial equipment / plant.
- Implementation of engineering principles in real plant design, operation and control.

UNIT I Fluid Dynamics & Transport Phenomena 3 + 6

Simulation modules:

- Fluid flow
- Centrifugal Pump
- Centrifugal Compressor
- Reciprocating compressor
- Fluidized bed

UNIT II Mass Transfer **3 + 6**

Simulation modules:

- Distillation column, Crude Distillation Unit
- Evaporator (single and multiple)
- Boiler
- Furnace
- Crystallizer
- Extraction

UNIT III Heat Transfer **3 + 6**

Simulation modules:

- Heat Exchanger
- Furnace
- Boiler
- Distillation Column, Crude Distillation Unit
- Extraction

UNIT IV Chemical Reaction Engineering **3 + 6**

Simulation modules:

- CSTR, CSTR in series
- Plug flow reactor
- Fixed Bed reactor
- Mixed flow reactor

UNIT V Unit Operations, Process Control & Instrumentation **3 + 6**

Simulation modules:

- Basic and advanced control system
- Ball Mill
- Cyclone separator
- Product Blending
- Crude Distillation Unit

TOTAL : 45 PERIODS

COURSE OUTCOME

- To implement Process Control automation and safety with DCS Operations through simulation
- To Simulate following processes:
  - Fluid flow
  - Centrifugal Pump
  - Centrifugal Compressor
  - Reciprocating compressor
  - Fluidized bed
  - Distillation column
  - Crude Distillation Unit
  - Evaporator (single and multiple)
  - Crystallizer
  - Extraction
  - Heat Exchanger
  - CSTR, CSTR in series
  - Plug flow reactor
  - Fixed Bed reactor
  - Mixed flow reactor
  - Basic and advanced control system

- Ball Mill
- Cyclone separator
- Product Blending

REFERENCES

- Unit operations of Chemical Engineering, Warren L. McCabe, Julian Cleveland Smith
- Chemical Reaction Engineering, Octave Levenspiel
- Process Systems Analysis and Control, Donald R. Coughanowr
- Austin, G.T.,Shreve's Chemical Process Industries
- Dryden, C.E., Outlines of Chemicals Technology
- Kirk and othmer , Encyclopedia of Chemical Technology
- Srikumar Koyikkal, Chemical Process Technology and Simulation

SYSTEM REQUIREMENT

Software: Windows Operating system Version 10.0 and above – Professional edition
Hardware: Intel i5/i7 PC, 8 GB RAM, 200 GB HDD, LCD monitor, under LAN network

INDSUTRY SCOPE

INDUSTRIES:

Chemical process plants – Refinery, Fertilizer, Petrochemical, Chemical, LNG Industries, EPC / Design Companies, Automation Companies, Design / Simulation companies

JOB OPPORTUNITIES:

Plant / DCS Operations, Process Engineering / Design, Technical services, Control engineering, Advance Process Control, Process Modeling & Simulation, Process optimization, Digital Transformation, Data Analytics, Asset Performance management (APM), Safety Management, Technical training.

USE CASES & TASKS

1. PS1001 ON-OFF LEVEL CONTROLLER

Student has to find the set value of ON-OFF control valve (i.e., at what level of tank the inlet valve will Open and Close) by the following procedure:

- Change the "High Set"(LIC001) and "Low Set" "(LIC002) (For Eg: 70% & 30%),
- Decrease the globe valve HIC001 position by 10%.
- The Shut Off valve will Close when PV of LIC001 reaches 70% and it opens when PV of LIC001 reaches 30%.
- Observe and note the PV of LIC001 (i.e., the level change) and PV of FI001 (i.e.,Flow inlet to tank) in every time interval of 60 seconds.
- Plot the graph Time Vs. PV.
- Result is substantiated from the graph plotted.

2. PS1002 ON-OFF TEMPERATURE CONTROLLER

Student has to find the set value of ON-OFF control valve (i.e., at what temperature of the L-1 outlet the inlet steam valve of TIC001 will Open and Close) by the following procedure:

- Change the "High Set" and "Low Set" (For Eg: 90 Deg C & 80 Deg C),
- Decrease the inlet lube oil flow (or) Increase the outlet lube oil flow (or) Increase the steam inlet flow by altering the respective globe valve positions.
- The Shut Off valve will Close when PV of TIC001 reaches 90% and it opens when PV of FI003 reaches 80%.
- Observe and note the PV of TIC001 (i.e., the Temperature change) and PV of FI003 (i.e.,

Steam Flow inlet to tank) in every time interval of 30 seconds.
- Plot the graph Time Vs. PV.
- Result is substantiated from the graph plotted.

3. PS1003 P & PI CONTROLLER

The students have to find the suitable P and I values from the two different set of values for the flow controller when there is a disturbance to achieve the set flow by following the procedure:

- Note the design flow from unit A to unit B, the controller output (MV) of FIC001, Differential pressure across the orifice, the flow transducer O/P, SDBT O/P, SLPC O/P and I/P converter O/P.
- Open the drain valve(HIC001) to 10%
- Observe and note the flow & the corresponding valve opening (MV) of FIC001 and FIC002.
- Observe and note the flow & the differential pressure across the orifice
- Observe and note the flow & the flow transmitter O/P
- Observe and note the flow & SDBT O/P
- Observe and note the flow & SLPC O/P
- Observe and note the flow & I/P converter O/P.
- Plot the two graphs Time Vs. Flow, Valve opening MV (or) controller output of FIC001 and FIC002.

4. PS1004 PRESSURE CONTROLLER

The students have to find the suitable P and I values from the two different set of values for the pressure controller when there is a disturbance to achieve the set pressure by following the procedure:

- Note the design pressure V-001, the controller output (MV) of PIC001.
- Alter the globe valve in the line from Unit B.
- Observe and note the pressure PV of PIC001 & the corresponding valve opening (MV) of PIC001.
- Plot the graph Time Vs. Pressure or PV of PIC001, Valve opening (MV) or controller output of PIC001

5. PS1005 LEVEL CONTROLLER

The students have to find the suitable P and I values from the two different set of values for the level controller when there is a disturbance to achieve the set level by following the procedure:

- Note the design level V-001, the controller output (MV) of LIC001.
- Alter the globe valve (HIC001) in the line from the unit A.
- Observe and note the level or PV of LIC001& the corresponding valve opening (MV) of LIC001.
- Plot the graph Time Vs. Level or PV of LIC001, Valve opening (MV) or controller output of LIC001.

6. PS1006 DIRECT & CASCADE CONTROLLER

Students have to compare the control action on level by the direct control and the cascade control by the following procedure:

- Note the level of the vessel V-001, LIC001 controller output (or) Valve position.
- Note the level of the vessel V-002, LIC002 controller output and FIC001 controller output (or) valve position.
- Alter the outlet pressure (PIC001) in-between 2 to 8 Kg/cm2 .
- Observe and note the level of vessel V-001, LIC001 controller output (or) Valve position.

- Observe and note the level of vessel V-002, LIC002 controller output and FIC001 controller output (or) valve position.
- Plot two graphs Time Vs. other parameters noted for two tanks.

7. PS1007 SPLIT RANGE CONTROLLER

Students have to find the range of controller output split into the two control valves by the following procedure:

- Note the design PIC001 controller output (MV), design XV001 valve opening (PV) and design XV002 valve opening (PV).
- Increase the inlet gas flow by increasing the position of HIC001 to 80%.
- Observe and note the changes in controller PIC001 output (MV), XV001 valve opening (PV) and XV002 valve opening (PV) in every time interval of 30 seconds.
- Plot the graph Time Vs. changes in controller output (MV), XV001 valve opening (PV) and XV002 valve opening (PV).
- Result is substantiated from the graph plotted.
- How to ensure the flow in flare without altering the design value of the inlet valve HIC001
- Decrease the SV of the controller

8. PS1008 RATIO CONTROLLER

Students have to calculate at what ratio the Component A and B are mixed by the following procedure:

- Note the design Component A flow rate, Component B flow rate and Component A and B composition at the outlet line.
- Increase the inlet valve position of component A line.
- Note the Component A flow rate.
- Observe and note the Component B flow rate and also the component A and B composition in every time interval of 10 seconds till the steady state is reached.
- Plot the graph Time Vs. Component B flow rate, and Composition of A and B.
- Result is substantiated from the graph plotted.

9. PS1009 FEEDBACK AND FEEDBACK CONTROLLER

Student have to compare the control action on the temperature by feed forward and feedback controllers by following procedures:

- Note the design outlet temperatures from both the heater and also the controller output or valve positions of the two controllers TIC001 and TIC002.
- Decrease the inlet valve HIC001 position to 10%.
- Observe and note down the temperature at the outlet of heater F-001 and the controller output (or) valve position of TIC001.
- Observe and note down the temperature at the outlet of heater F-002 and the controller output (or) valve position of TIC002.
- Plot the graphs for the heater F-001 and F-002 Time Vs. other parameters observed.

10. PS1010 3-ELEMENT BOILER CONTROLLER

Student has to study how the three element boiler control takes the action to increase the flow of feed water in the increase in demand of steam or vice versa by the following procedure:

- Note the design flow rate of water inlet to the steam drum, design controller output (or) MV of FIC001. Also note design level in the steam drum, design steam outlet to the header, design fuel flow to the burner, design controller output (or) MV of PIC001.
- Increase the demand in the steam by altering the position of the HIC001.
- Observe and note down the feed water flow, controller output (or) MV of FIC001.

- Observe and note the tank level and steam flow rate.
- Observe and note the fuel flow and controller output (or) MV of PIC001.
- Plot the graph Time Vs. flow rate, level and steam flow.
- Plot the graph Time Vs. fuel flow.

11. PS2005 HEAT EXCHANGER

The following variables can be changed and their influence on heat exchanger performance can be checked.

Cold Fluid Side

- Type of Cold fluid (Deg API)
- Boiling Point
- Inlet Temperature
- Dirt factor

Hot Fluid Side

- Type of Cold fluid (Deg API)
- Boiling Point
- Inlet Temperature
- Dirt factor

Shell Side Geometric Parameters

- Inner Diameter (ID)
- Baffle Spacing
- Number of Passes

Tube Side Geometric Parameters

- Inner Diameter (ID)
- Outer Diameter (OD)
- Tube Pitch
- Number of Tubes
- Number of Passes
- Length of the Tube
- Flow Area per Tube
- Surface Area per Linear Length

12. PS2003 CENTRIFUGAL PUMP

Study the effect of change in RPM of the Pump to Head, Flow rate, NPSH (required) and Power

- Take the Flow controller FIC001 in Manual.
- Reduce the RPM in steps of 20 (945, 925, 905)
- For every change made, observe the dynamics and once the system reaches steady state, note down the values of the following variables.
  a) Head
  b) Flow rate FIC001
  c) Power
  d) NPSHR
- Reset the model to design condition
- Take the Flow controller FIC001 in Manual.
- Increase the RPM in steps of 10 (975, 985, 995)
- For every change made, observe the dynamics and once the system reaches steady state, note down the values of the following variables.

- Head
- Flow rate FIC001
- Power
- NPSHR

13. PS2013 CENTRIFUGAL COMPRESSOR

Study the effect of change in:

- Feed temperature.
- Gas Molecular weight.
- Supply Pressure.
- Compressor RPM

Perform Startup

14. PS2001 DISTILLATION COLUMN

A. MALFUNCTION SCHENARIO

- Power Failure
- Instrument Air Failure
- Steam Supply failure
- Feed Pump P-001 Failure
- Feed Pump P-002 Failure
- Fan A Failure
- Reflux Pump P-003 Failure

B. PROCESS DISTURBANCES

- Heavy Ends in feed
- Feed Temperature Change
- Reboiler Fouling
- Air cooler Fouling
- Steam I/L Pressure
- FIC001 Feed Valve override
- FIC002 Steam supply Valve override

C. START UP PRACTICE

15. PS2006 FURNACE

A. MALFUNCTION SCHENARIO

- APH Rotor Coupling Failure
- Tube Failure
- Stack Damper Failure
- Root Valve Failure
- Atomizing steam Indicator Failure
- DOD Failure
- FD Fan Fail
- ID Fan Fail
- Fuel Gas Supply Fail
- Fuel oil Supply Fail

B. PROCESS DISTURBANCES

- Feed temperature change

- APH fouling
- Pass1 fouling

C. START UP PRACTICE

16. PS2016 EVAPORATOR

- Study the Heat transfer coefficient and Steam Economy for change in feed flow rate 800, 900, 1000, 1100, 1200 Kg/ Hr
- Study the Heat transfer coefficient and Steam Economy for change in feed flow temperature 120, 125, 140, 135, 140 Deg C

17. PS2011 CYCLONE SEPARATOR

- Study the effect of Inlet Gas Flow rate on Pressure Drop, Cut Diameter, and Collection Efficiency, Entrained particles in Gas outlet & Collected Particles.
- Study the effect of loading rate on Entrained particles in Gas outlet & Collected Particles.
- Study the effect of Particle Diameter on Cut Diameter, Collection Efficiency, Entrained particles in Gas
- Study the effect of Particle Density on Cut Diameter, Collection Efficiency, Entrained particles in Gas outlet & Collected Particles
- Study the effect of Gas Viscosity on Cut Diameter, Collection Efficiency, Entrained particles in Gas outlet & Collected Particles

18. PS2012 CRYZTALLIZER

- Study the effect of feed flow rate
- Study the effect of steam flow rate

19. PS2007 CSTR

- Study the effect of change in cooling water flow
- Study the effect of change in Feed B temperature
- Study the effect of change in Order of the Reaction

20. PS2008 CSTR IN SERIER

PERFORM STARTUP ACTIVITY

21. PS2009 FIXED BED REACTOR

MALFUNCTIONS:

- II bed Quench Gas Fail
- III bed Quench Gas Fail
- Feed Failure
- Hydrogen Failure

PERFORM STARTUP ACTIVITY

22. PS2010 PLUG FLOW REACTOR

- Study the effect of Conversion on Exit temperature, reaction rate, and volume
- Study the effect of Order of the reaction on space-time.
- Study the effect of Order of the reaction on product concentration.
- Study the effect of Order of the reaction on conversion.
- Study the effect of feed flow rate on space-time, product concentration, conversion

23. PS2019 BALL MILL

PERFORM STARTUP ACTIVITY

SB8036 EV DESIGN L T P C
1 0 2 2

COURSE OBJECTIVE

Students will be able to:

1. Work with HEV and EV technology and related components.
2. Design, simulate and build prototype of EVs and subsystems.
3. Design, construct and assemble traction motor transmission system and cooling system.
4. Integrate the wiring of low-voltage EV components and test them for vehicle-level integration.

COURSE CONTENT

UNIT I HEV powertrain Architecture 3 + 6

Problems with current transportation - Impact of air pollution - Current solutions - Hybrid electric vehicles and its subsystems - Concept of Hybrid electric drivetrain - Hybrid electric vehicle architecture, Series hybrid powertrain, Parallel hybrid powertrain, Power-split hybrid powertrain

UNIT II EV powertrain Architecture 3 + 6

Electrification advantages - EV components - Types of EV- Overall block diagram - Electric variant & new mechanical platform - Few examples of EV and their performance - Forces on the vehicle- Transmission system - Drive cycles- Power & Energy calculations- Powertrain & drivetrain - Charging infrastructure

UNIT III Traction Motor and Transmission system 3 + 6

Traction Motors- Working principle- Torque speed characteristics- Types of motors- Traction inverter basics, Power semiconductor devices, Single speed and multi speed transmission system - Efficiency maps for different gear ratios

UNIT IV Battery system for EV 3+6

Types of battery for transportation application - Lead acid - Nickel metal hydride - Lithium-ion cells and chemistries - choice of series and parallel number of cells - construction of the battery pack - Battery Management System- BMS topologies- Protection functions - Battery charging

UNIT V Thermal management system for EV 3 + 6

Overview of EV thermal management system - Cooling techniques for power converters - Heating and cooling requirements of battery pack - Cooling methods and comparison

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Build and test the powertrain system of an EV
2. Selection of transmission system as per application
3. Implement the wiring of battery pack & battery management system
4. Perform experiments with the thermal management system of a battery pack

FOR FURTHER READING:

Electric Vehicle sizing- Identification of components- Hardware requirements- BMS- Power converter circuits

REFERENCES

1. Electric vehicle technology explained by James Larminine, John Lowry
2. Electric and Hybrid Vehicles Design [Iqbal Husain]
3. [Power engineering] Andrea, Davide - Battery management systems for large lithium battery packs
4. Power Electronics: Circuits, Devices, and Applications" by M H Rashid Power Electronics By P. S. Bimbhra, Khanna Publications.

Online References:

1. Udemy - Understanding electric vehicle technology
https://www.udemy.com/course/understanding-electric-vehicle-technology-2022-edition/

2. Udemy - Electric vehicle battery management system
https://www.udemy.com/course/battery-and-battery-management-system-design-simulation/

3. Udemy- Electrical engineering: Power Electronics
https://www.udemy.com/course/power-electronics-rectifiers/

SOFTWARE REQUIREMENT:

MATLAB and Simulink

HARDWARE REQUIREMENT:

1. Vehicle body: Single passenger - Scooter/Go-Cart/Bicycle
2. Motor drive: 24/36V, 1000W BLDC motor with a motor controller and transmission system with different gear ratios, Charger and DC-DC converter
3. Battery pack: 24/36V, 30 Ah Lithium-ion (NMC/LFP) assembled battery pack, BMS with configurable limits and communication, SoC indicator, Casing and mounting arrangement, Phase changing material for lithium battery, Connectors, Power supply for charge and discharge testing
4. Temperature sensors, Data logging device, DC energy meter, Brake load arrangement with torque measurement

INDUSTRY SCOPE:

Eligible for a job opportunity with OEM, Tier 1, and Engineering services company with the below skills:
Awareness of EV technology, Understanding of transmission system for EV - Technical specifications, compatibility & comparison, Operating range of Battery & Motor drive.

INDUSTRY USE CASES:

1. Carry out electrical wiring of EV components - power and energy estimation based on vehicle specifications and performance requirements - 2-Wheeler - Calculation - Modeling - Matching simulation results with a prototype vehicle
   Task 1: Determine the system specifications from the project definition
   Task 2: Estimate the power rating of motor & energy requirements of battery pack
   Task 3:Develop the Simulink model of vehicle & get the energy consumption in kWh/km for a selected driving cycle
   Task 4: Procure the required components and assemble them. Test the EV on road with the selected driving cycle and find the actual energy consumption
   Task 5: Compare the simulation and real world data
2. Carry out electrical wiring of EV components - power and energy estimation based on vehicle specifications and performance requirements - 3 Wheeler - Calculation - Modeling - Matching simulation results with commercially available vehicle
   Task 1: Determine the system specifications from the project definition
   Task 2: Estimate the power rating of motor & energy requirements of battery pack
   Task 3:Develop the Simulink model of vehicle & get the energy consumption in kWh/km for a selected driving cycle
   Task 4: Procure the required components and assemble them. Test the EV on road with the selected driving cycle and find the actual energy consumption

   Task 5: Compare the simulation and real-world data
3. Carry out electrical wiring of EV components - power and energy estimation based on vehicle specifications and performance requirements - 4 Wheeler - Calculation - Modeling - Matching simulation results with commercially available vehicle
   Task 1: Determine the system specifications from the project definition
   Task 2: Estimate the power rating of motor & energy requirements of battery pack
   Task 3:Develop the Simulink model of vehicle & get the energy consumption in kWh/km for a selected driving cycle
   Task 4: Procure the required components and assemble them. Test the EV on road with the selected driving cycle and find the actual energy consumption
   Task 5: Compare the simulation and real world data
4. Carry out electrical wiring of EV components - power and energy estimation based on vehicle specifications and performance requirements - Electric Bus - Calculation - Modeling - Matching simulation results with commercially available vehicle

   Task 1: Determine the system specifications from the project definition
   Task 2: Estimate the power rating of motor & energy requirements of battery pack
   Task 3:Develop the Simulink model of vehicle & get the energy consumption in kWh/km for a selected driving cycle
   Task 4: Procure the required components and assemble them. Test the EV on road with the selected driving cycle and find the actual energy consumption
   Task 5: Compare the simulation and real world data
5. Measure the overall efficiency of EV - Deriving the technical specifications for the Motor: speed, torque and power, Choose the suitable transmission system from different gearbox ratios - 2 Wheeler

Task 1: Determine the system parameters and specifications required regarding the project definition.

Task 2: Calculation of Vehicle characteristics (speed, torque and power) and propose the suitable type of transmission system and applicable gearbox ratio. Estimation of overall efficiency of the EV with the proposed transmission type.

Task 3: Developing the Simulation model of the EV with specified motor rating and including the proposed Transmission type and gearbox ratio for selected drive cycle.

Task 4: Procure necessary components proposed under the study and assemble them. Test the Vehicle on Road using the drive cycle selected for Simulation and obtain real time overall Efficiency of the model.

Task 5: Compare the Simulated data with the Real time data obtained for validation.

6. Measure the overall efficiency of EV - Deriving the technical specifications for the Motor: speed, torque and power, Choose the suitable transmission system from different gearbox ratios - 3 Wheeler

   Task 1: Determine the system parameters and specifications required regarding the project definition.

   Task 2: Calculation of Vehicle characteristics (speed, torque and power) and propose the suitable type of transmission system and applicable gearbox ratio. Estimation of overall efficiency of the EV with the proposed transmission type.

   Task 3: Developing the Simulation model of the EV with specified motor rating and including the proposed Transmission type and gearbox ratio for selected drive cycle.

   Task 4: Procure necessary components proposed under the study and assemble them. Test the Vehicle on Road using the drive cycle selected for Simulation and obtain real time overall Efficiency of the model.

   Task 5: Compare the Simulated data with the Real time data obtained for validation.

7. Measure the overall efficiency of EV - Deriving the technical specifications for the Motor: speed, torque and power, Choose the suitable transmission system from different gearbox ratios - 4 Wheeler

   Task 1: Determine the system parameters and specifications required regarding the project definition.

   Task 2: Calculation of Vehicle characteristics (speed, torque and power) and propose the suitable type of transmission system and applicable gearbox ratio. Estimation of overall efficiency of the EV with the proposed transmission type.

   Task 3: Developing the Simulation model of the EV with specified motor rating and including the proposed Transmission type and gearbox ratio for selected drive cycle.

Task 4: Procure necessary components proposed under the study and assemble them. Test the Vehicle on Road using the drive cycle selected for Simulation and obtain real time overall Efficiency of the model.

Task 5: Compare the Simulated data with the Real time data obtained for validation.

8. Measure the overall efficiency of EV - Deriving the technical specifications for the Motor: speed, torque and power, Choose the suitable transmission system from different gearbox ratios - Electric Bus

   Task 1: Determine the system parameters and specifications required regarding the project definition.

   Task 2: Calculation of Vehicle characteristics (speed, torque and power) and propose the suitable type of transmission system and applicable gearbox ratio. Estimation of overall efficiency of the EV with the proposed transmission type.

   Task 3: Developing the Simulation model of the EV with specified motor rating and including the proposed Transmission type and gearbox ratio for selected drive cycle.

   Task 4: Procure necessary components proposed under the study and assemble them. Test the Vehicle on Road using the drive cycle selected for Simulation and obtain real time overall Efficiency of the model.

   Task 5: Compare the Simulated data with the Real time data obtained for validation.

9. Fabricate the mechanical fixture for the in-wheel hub motor - CAD model development - Analyze the unsprung mass and vibrations the motor has to withstand with Simulation

   Task 1: Determine the specifications and dimensional requirement for the hub motor under the intended use.

   Task 2: Development of the mechanical fixture using CAD tool with respect to the Hub motor selected and estimate the overall mass of the Motor with fixture setup.

   Task 3: Development of simulation model to analyze the magnitude of vibrations to be handled by the in-wheel hub motor arrangement. Perform simulation of the model to check the durability of the fixture design.

   Task 4: Develop a prototype of fixture as designed, assemble the required components to develop an EV and perform a road test.

   Task 5: Compare the simulation results with the real time model results.

10. Develop the mechanical transmission system for 2 Wheeler with inner rotor motor - Fabrication of motor to wheel system -Verify the input and output speed and torque

    Task 1: Determine the output performance characteristics of the suggested motor.
    Task 2: Suggest an efficient transmission system capable of delivering the estimated power to the wheels.

    Task 3: Develop a simulation model of the Powertrain system to obtain the speed torque output data with respect to a selected drive cycle.

Task 4: Procure necessary components and assemble the same to develop a real time powertrain system with the specifications regarding the project definition and log the real time speed torque data.

Task 5: Compare the Simulated and Real time model data.

11. Constructing a 7S5P battery pack with the cells - Electrical connections - Mechanical housing

Task 1: Learn the cell manufacturer's datasheet and understand the cell characteristics.
Task 2: Procure 35 cells and connect the cells in series and parallel to make the battery pack in 7S5P configuration. Connect the 7S5P configuration to BMS as per guidelines.
Task 3: Determine the dimensions of the Battery pack assembled and develop CAD model as per the dimensions with proper tolerance. Tolerance to be considered for the bus bar, connectors, BMS system etc.Suggest a better material for the mechanical housing.

Task 4: Develop a real time Mechanical housing and test with a 7S5P real time battery pack with BMS.

12. Develop the mechanical transmission system for 3 Wheeler with inner rotor motor - Fabrication of motor to wheel system - Verify the input and output speed and torque

Task 1: Determine the output performance characteristics of the suggested motor.
Task 2: Suggest an efficient transmission system capable of delivering the estimated power to the wheels.

Task 3: Develop a simulation model of the Powertrain system to obtain the speed torque output data with respect to a selected drive cycle.

Task 4: Procure necessary components and assemble the same to develop a real time powertrain system with the specifications regarding the project definition and log the real time speed torque data.

Task 5: Compare the Simulated and Real time model data.

13. Develop the mechanical transmission system for 4 Wheeler with inner rotor motor - Fabrication of motor to wheel system - Verify the input and output speed and torque

Task 1: Determine the output performance characteristics of the suggested motor.
Task 2: Suggest an efficient transmission system capable of delivering the estimated power to the wheels.

Task 3: Develop a simulation model of the Powertrain system to obtain the speed torque output data with respect to a selected drive cycle.

Task 4: Procure necessary components and assemble the same to develop a real time powertrain system with the specifications regarding the project definition and log the real time speed torque data.
Task 5: Compare the Simulated and Real time model data.

14. Testing 7S5P battery pack for communications - Voltage/Current/Temperature monitoring

Task 1: Learn the cell manufacturer's datasheet and understand the charge and discharge curves
Task 2: Procure 35 cells of NMC chemistry and connect the cells in series and parallel to make the battery pack
Task 3:Connect the BMS as per the guidelines

Task 4: Connect the BMS with external data logger or host microcontroller
Task 5: Get the data set of voltage, current and temperature

15. Measure the temperature rise of the battery pack with cooling system and without cooling system - Comparing the results with simulation

    Task 1: Selection of an appropriate Battery pack configuration with and without a cooling system and collecting necessary specifications to develop a simulation model.

    Task 2: Development of Simulation models of a battery pack with and without a cooling system.

    Task 3: Performing simulation and obtaining the temperature rise data of both the battery models.
    Task 4: Compare the performance results of Battery packs with and without the cooling system and comment on the effects of including a cooling system with a battery pack.
    Task 5: Procure necessary components , assemble them to obtain separate battery pack models , one with and other without a cooling system and perform charge and discharge cycles and log the data.
    Task 6: Compare the simulation results with the real time model results for validation.

16. Test the transmission system efficiency - mechanical transmission system for 2 Wheeler with inner rotor motor - Efficiency comparison of two gearbox with different gear ratio

    Task 1: Select the suitable motor and transmission system as per the project definition.
    Task 2: Develop a simulation model based on the selected powertrain component and simulate the same with multiple gear ratios. Estimate the efficiency values of the transmission system for the multiple gear ratios.
    Task 3: Procure necessary components and assemble the same to develop a real time powertrain system with 2 different gearboxes similar to the simulation model and log the real time data. Estimate the transmission system efficiency for the selected gear box.
    Task 4: Compare the Simulated results and real time model results, Validate the results.

17. Test the transmission system efficiency - mechanical transmission system for 3 Wheeler with inner rotor motor - Efficiency comparison of two gearbox with different gear ratio

    Task 1: Select the suitable motor and transmission system as per the project definition.
    Task 2: Develop a simulation model based on the selected powertrain component and simulate the same with multiple gear ratios. Estimate the efficiency values of the transmission system for the multiple gear ratios.
    Task 3: Procure necessary components and assemble the same to develop a real time powertrain system with 2 different gearboxes similar to the simulation model and log the real time data. Estimate the transmission system efficiency for the selected gear box.
    Task 4: Compare the Simulated results and real time model results, Validate the results.

18. Test the transmission system efficiency - mechanical transmission system for 4 Wheeler with inner rotor motor - Efficiency comparison of two gearbox with different gear ratio

    Task 1: Select the suitable motor and transmission system as per the project definition.
    Task 2: Develop a simulation model based on the selected powertrain component and simulate the same with multiple gear ratios. Estimate the efficiency values of the transmission system for the multiple gear ratios.

Task 3: Procure necessary components and assemble the same to develop a real time powertrain system with 2 different gearboxes similar to the simulation model and log the real time data. Estimate the transmission system efficiency for the selected gear box.
Task 4: Compare the Simulated results and real time model results, Validate the result

19. Vehicle integration testing - Battery pack + BMS + Motor controller + Motor - No load losses - Bench testing with various brake loads - Peak efficiency estimation - Comparison with simulated results

    Task 1: Select the suitable motor and motor controller for the project and develop the simulink model
    Task 2: Connect the battery pack along with the BMS to motor controller
    Task 3: Run the motor on no load by applying the throttle. Measure the efficiency of motor + motor controller + transmission system
    Task 4: Vary the load condition and establish the peak efficiency condition
    Task 5: Compare the actual results with simulated and find the reasons for difference

20. On-road testing of prototype vehicle from fully charged to discharged battery condition - real-world drive cycle data logging - True range - Comparison with simulated results
    Task 1: Select the suitable EV components for the project and develop the simulink model
    Task 2: Connect the battery pack along with the BMS to motor controller
    Task 3: Run the motor on no load by applying the throttle
    Task 4: Connect the motor with transmission system and wheels
    Task 5: Run the vehicle for a fully charged battery to fully discharged battery level and compare the range with simulated results

SB8037 **FULL STACK DEVELOPMENT** **L T P C**
1 0 2 2

COURSE OBJECTIVE

The objective of this course is to provide conceptual understanding of how full stack development can be used to innovate and improve tech processes. This course will allow you to learn how to create full-stack web applications using frontend and backend JavaScript technologies. Learn both the theoretical and practical implementation of full stack web development solutions.

This Full Stack Java Developer Course is designed to give you the essence of front-end, middleware, and back-end Java web developer technologies. You will learn to build an end-to-end application, test and deploy code, store data, and much more.

COURSE CONTENT

UNIT I Software Development Process (Agile & Scrum) 3 + 6
Software Lifecycle Models - SRS (Software Requirement Specification) - SPS (Software Project Scheduling) - GITHub (End to End Journey) - Project Management Frameworks like Scrum, Agile etc.

UNIT II Introduction to Development Frameworks 3 + 6

Project Bucketing - Different Shades of Fullstack development - Angular.Js (Introduction) - Vue.Js (Introduction) - React.Js (Introduction) - React.Js - Components and Props - State and Lifecycle - Handling Events - Hooks & Forms

UNIT III Front End Development Framework & Tools 3 + 6

Web client server architecture - HTML Structure Tags – Forms field - Bootstrap – React.Js - jQuery-ajax - Promises - API integration

UNIT IV Back End Development Frameworks & Tools 3 + 6

API Development services - Express.Js -nNode.js – mongoDB - Manual Authentication using JWT, Passport.Js etc

UNIT V Full Stack Application Development and Deployment in Cloud (Web, Mobile) 3 + 6

Computer Networking - Basic Linux Commands - Cloud hosting using AWS - DevOps

TOTAL : 45 PERIODS

COURSE OUTCOME

- Planning and implementing the software lifecycle models to have a hands-on understanding with GIThub, agile & Scrum methodologies.
- Implementing the framework i.e react.js to align state & lifecycle, conditional rendering, Hooks etc.
- Inplementing the frontend technologies to build client architecture, to integrate APIs using react js.
- Implementing the tech stack like mongoDB, Express.Js & Node.js to build the back-end services.
- Hosting & deployment to ensure the microservices using DevOps, Cloud hosting using AWS.

FOR FURTHER READING:

- Full Stack Web Development for Beginners: Learn Ecommerce Web Development Using HTML5, CSS3, Bootstrap, JavaScript, MySQL, and PHP - By Riaz Ahmed
- A full stack data acquisition, archive and access solution for J-TEXT based on web technologies by Wei Zheng, Yuxing Wang Ming, Zhang Feiyang Wu, Zhou Yang
- Design and development of software stack of an autonomous vehicle using robot operating by Abhisek Omkar Prasada, Pradumn Mishraa, Urja Jaina, Anish Pandey, Anushka Sinhaa, Anil Singh Yadav, Rajan Kumar, Abhishek Sharma, Gaurav Kumar

REFERENCES:

1. The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer - Chris Northwood
2. Hands-On Full Stack Development with spring root 2 and react by Jua Hinkula
3. React and React Native, Third Edition by Adam Boduch, Roy Derks

ONLINE REFERENCES:

1. Beginner Full Stack Development Course: HTML, CSS, React and Node
https://www.udemy.com/course/ultimate-web/
2. Full Stack Web Developer: MEAN Stack https://intellipaat.com/full-stack-web-developer-mean-stack-certification-training/

SOFTWARE REQUIREMENT:

Javascript, HTMS, CSS, Bootstrap, JQuery, Node Js, MongoDB, SQLite

INDUSTRY SCOPE:
By completion of this course, the students can get industry scope in website development, frontend and backend development across industries and domains.

20 INDUSTRY USE CASES
1. E-Commerce Website

An e-commerce website or app is one of the best full-stack development projects you can practice at the advanced level. It is a vast project involving front and back-end technologies and database knowledge for efficient execution and implementation. The project takes time and effort because you must maintain a huge database with multiple product categories and prices.

Learning outcome:
- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the Items selected.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the articles, especially for those who may have difficulty physically going to market to purchase some.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered items are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the buyer seller Journey and reduce the time and resources required to complete the process
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for aligning the E-commerce web page at one place with proper categorisation with the help of development scripting.

Task 2: Enable the data with the customer manifestation to enroute the requisite web development with the help of suitable programming language.

Task 3: Design the web server to engage with the operating system user is using.

Task 4: Develop a system which showcases the inserted result on the ground of inputs user made over the webpage.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

2. Video Conferencing Website and Application
You can try your hands on the video conferencing website and application projects and help develop features like textual chatting, audio-video interactions, video recording, etc. The project requires you to implement your ideas and ensure a creative application or website.

Learning outcome:
- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the time-zones according to the countries.

- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to plan their meetings, especially for those who may have difficulty physically going to meet them in person.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the caller & receiver Journey and reduce the time and resources required to complete the process.

- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as registration is verified electronically.

Task1: Develop the framework for creating the video conferencing application/website with the project management tools like JIRA & Trello.

Task 2: Enable the data with the system control of version based servers like GIT & Grunt .

Task 3: Design the database server to resemble the implementation of MongoDb, MySQL etc.

Task 4: Develop a frontend framework which showcases the inserted result Jquery, Javascript and HTML.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

3. Social Media Website and Application

The present-day world revolves around social media, and we already use many websites and applications. You can try your hands on an efficient full-stack project and develop a social media app or website with unique features to attract users.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the legitimacy of the users onboarded
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to add, remove, post etc. , especially for those who may have difficulty expressing their well-being in terms of words.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered people are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the mutual interaction between two or more individuals and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the social media application/website with the proper implementation of web technologies.

Task 2: Enable and enhance the data with the system control of version based servers i.e MySql & others

Task 3: Build and Nourish the database server to resemble the implementation of NoSql.

Task 4: Design a unique frontend framework which showcases the valued results with the use of Express JS & IONIC

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

4. Content Management Tool and System

Content Management Tool or System is a significant factor that plays a crucial role in creating blogs. You can use the full stack development items and other drag-and-drop interfaces to create a web page that helps you add text, images, videos, and other elements required to create a blog.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the articles written.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the articles, especially for those who may have difficulty physically going to market to purchase books.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more enriching, as all the written articles are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the traction and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the content management website using the tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite & NOSql etc.

Task 4: Develop a frontend framework which showcases the inserted result with Express JS & IONIC

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

5. Project Management Tool

A project management tool is one of the toughest full-stack projects and requires many features for proper execution. The project includes a framework of social media sites where users can

communicate with one another. The users also get the functionality to assign tasks to others and comment on the dashboard at their convenience.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the basics of the projects and their guidelines.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for users to select the project, especially for those who may have difficulty physically going on-site or doing remote work.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the user & UI Interaction and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the project management application/website with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

6. To-Do List Projects

A to-do list is one of the simplest and best full-stack projects for beginners. You can create a to-do list efficiently with the feature to add items to the list. You can also provide functionalities to move content from the list after completing the task. The project will help you improve your front-end development skills and learn crucial database operations.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the time & task aligned.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select their time & manually design their planner especially for those who usually are not able to manage their time efficiently.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the day to day activities of the user and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the To-Do List Project management application/website with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the To-Do List Project.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the To-Do List Project.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

7. Chat Application and Website

Everyone chats with their family members and friends daily, and because of this, chatting applications have become an inevitable part of our lives. Chatting apps are one of the best full-stack beginner projects. You can create a chat application or website to serve the purpose of individual or group chats between networks.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and reply instantly.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to chat & connect especially for those who may have difficulty physically connecting with people.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the users Journey and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the Chat application/website with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for creating the Chat application/website.

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the Chat application/website.
Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the Chat application/website.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

8. Portfolio Website

Developers build portfolio websites as full-stack developer sample projects to showcase their skills and impress clients. As a student or professional learning web development, you must practice making portfolio websites to gain knowledge and experience in efficient front-end web development technology.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the portfolios selected.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the portfolios.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all the created portfolios are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the buyer seller Journey and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the portfolio website with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the portfolio website.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the portfolio website.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

9. Blog Website and Application

A blog website allows users to opine their thoughts and comment on anything and everything. You can make a creative website or application using full-stack technology and take inspiration from other blogs. Ensure that you add proper authentication features so individuals with valid credentials can log in to the platform.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the articles written.

- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the articles, especially for those who may have difficulty physically going to market to purchase books.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more enriching, as all the written articles are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the traction and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the blogging website with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for creating the blogging website.

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the blogging website.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the blogging website.

T**ask 5:** Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

10. Application For Grocery Delivery

A grocery delivery website or application is among the best projects for full-stack developers to showcase their talent and skills. You can learn multiple factors related to large-scale full-stack apps or websites by making the grocery delivery application project. It involves back-end knowledge and helps you excel in making major projects in the future.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily select and verify the accuracy of the Items selected.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the articles, especially for those who may have difficulty physically going to market to purchase some.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered items are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the buyer seller Journey and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the grocery delivery application with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for creating the grocery delivery application.

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the grocery delivery application.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the grocery delivery application.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

11. Food Delivery Website and Application

A food delivery website or application is slightly different from grocery delivery. However, it also works on the same grounds as the latter and may require full-stack development. You can practice and improve your front- and back-end development skills when making food delivery websites or applications.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the Items selected.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the dishes, especially for those who may have difficulty physically going to market to purchase some.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered items are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the buyer seller Journey and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the food delivery application with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the food delivery application.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the food delivery application.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

12. Workout Tracker Application

A workout tracking website or application is slightly different from a to-do project framework. However, it also works on the same grounds as the latter and may require full-stack development. You can practice and improve your front- and back-end development skills when making workout tracking applications.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the inputs made.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the workout style especially for those who may have difficulty to track their workout routine.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all workout style & patterns are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the UI & user Interaction and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the workout tracking application with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for creating the workout tracker application

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the workout tracker application

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the workout tracker application.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

13. Calendar Scheduler Application

A calendar scheduler application is slightly different from a to-do project framework. However, it also works on the same grounds as the latter and may require full-stack development. You can practice and improve your front- and back-end development skills when making calendar scheduler applications.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the time & task aligned.

- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select their time & manually design their planner especially for those who usually are not able to manage their time efficiently.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the day to day activities of the user and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the calendar scheduler application with the project management tools like Java & kotlin.

Task 2: Enable the data with the system control of version based servers like SQL for creating the calendar scheduler application

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the calendar scheduler application.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the calendar scheduler application.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

14. Money Transfer Application

A Money Transfer application is slightly different from a chat project framework. However, it also works on the same grounds as the latter and may require full-stack development. You can practice and improve your front- and back-end development skills when making money transfer applications.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily check and verify the accuracy of the payments made.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to make the transactions, especially for those who may have difficulty physically going in-person to do the needful.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the Journey between receiver sender and the bank and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the money transfer application with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for creating the money transfer application

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating the money transfer application.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for creating the money transfer application.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

15. Internet Banking Application and Website

An Internet Banking application and website is slightly different from a money transfer project framework. However, it also works on the same grounds as the latter and may require full-stack development. You can practice and improve your front- and back-end development skills when making internet banking applications and websites.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily check and verify the accuracy of the payments made.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to make the transactions, especially for those who may have difficulty physically going in-person to do the needful.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the Journey between receiver sender and the bank and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the internet banking application with the project management tools like Java & kotlin for Internet banking application

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for Internet banking application.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for Internet banking application.

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

16. Astrology Application and Website

An Astrology application and website is slightly different from a social media project framework. However, it also works on the same grounds as the latter and may require full-stack development. You can practice and improve your front- and back-end development skills when making astrology applications and websites.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the predictions made.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the sunshine.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the UI & user Interaction and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task1: Develop the framework for creating the astrology application with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for creating astrology application

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for creating astrology applications.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

17. Horoscope Application and Website

A Horoscope application and website is slightly different from a social media project framework. However, it also works on the same grounds as the latter and may require full-stack development. You can practice and improve your front- and back-end development skills when making horoscope applications and websites.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the predictions made.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the sunshine.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the UI & user Interaction and reduce the time and resources required to complete the process.

- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task 1: Develop the framework for creating the horoscope application with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for horoscope application and website

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for horoscope application and website

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for horoscope application and website

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

18. Stock Inventory Application

Stock Inventory Tool or System is a significant factor that plays a crucial role in managing the stock reviewed. You can use the full stack development items and other drag-and-drop interfaces to create a web page that helps you add text, images, videos, and other elements required to create an Inventory.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the accuracy of the items selected.
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to select the articles, especially for those who may have difficulty physically maintaining their sale & purchase some.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered items are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the Inventory & user Journey and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task 1: Develop the framework for creating the Stock Inventory application with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for stock inventory application

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for developing the application

Task 5: Implement industry specific data modeling frameworks to enhance the backend specification like Ruby on rails, Laravel for stock inventory application

19. News Media Application

News Media application is a significant factor that plays a crucial role in keeping yourself updated. You can use the full stack development items and other drag-and-drop interfaces to create a web page that helps you add text, images, videos, and other elements required to create a news media application.

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily react and verify the legitimacy of the users onboarded
- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to add, remove, post etc. , especially for those who may have difficulty expressing their well-being in terms of words.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered people are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the mutual interaction between two or more individuals and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task 1: Develop the framework for creating the news media application with the project management tools like Java & kotlin for developing the application

Task 2: Enable the data with the system control of version based servers like SQL

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite for the application

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for developing the application

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

20. Job Search Application

Job Search application is a significant factor that plays a crucial role in keeping yourself updated. You can use the full stack development items and other drag-and-drop interfaces to create a web page that helps you add text, images, videos, and other elements required to create a job search portal

Learning outcome:

- Develop a full stack-based system that can offer high-end webpage through the use of front-end techniques, as well as the visibility to easily post and verify the accuracy of the candidates.

- Develop a full stack-based system that can offer Improved accessibility and can make it easier for people to apply for the jobs, especially for those who may have difficulty physically hustling for applying resumes.
- Develop a full stack-based system that can offer enhanced transparency and can make the user journey more transparent, as all registered users are recorded and verified on a publicly-available ledger.
- Develop a full stack-based system that can offer greater efficiency and can streamline the candidate and recruiter journey and reduce the time and resources required to complete the process.
- Develop a full stack-based system that can offer enhanced accuracy and can reduce the risk of faults and errors in the Journey, as the registration is recorded and verified electronically.

Task 1: Develop the framework for creating the job search portal with the project management tools like Java & kotlin

Task 2: Enable the data with the system control of version based servers like SQL for developing job search application

Task 3: Design the database server to resemble the implementation of MongoDb, SQLite.

Task 4: Develop a frontend framework which showcases the inserted result with IONIC for the application

Task 5: Implement industry specific hosting using cloud at AWS, to ensure the microservices functionality and deployment.

SB8038 SMART AND ADVANCED MANUFACTURING – DESIGN & SIMULATION L T P C
1 0 2 2

COURSE OBJECTIVE:
The Plant Simulation course introduces users of Plant Simulation professional, standard, or application licenses to Plant Simulation and its basic functionality. Students will learn how to build, run and evaluate simulation models. The definition of custom logic (methods) will also be discussed.

COURSE CONTENT:

UNIT I Overview of Plant Simulation Basics, Modelling 3+6
In this chapter, you begin the modelling process by considering different modelling techniques and managing folders in the class library.

UNIT II Create a simple model 3+6
In this chapter, you create a model of simple manufacturing line and simulate it.

UNIT III Prepare to create a new model from the previous model 3+6
In this chapter, you distinguish basic material flow objects, view common material flow attributes, and basic preferences.

UNIT IV Create a more detailed model to produce a better result 3+6
In this chapter, you distinguish basic material flow objects, view common material flow attributes, and basic preferences

UNIT V Implement basic objects to analyze results 3+6

In this chapter, you discover simulation bottlenecks, produce statistics, and create charts.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Perform Simulation for a plant
- Creating GUC Model
- Analyzing GUC Results
- Building multiple scenarios for plant simulation

SOFTWARE REQUIREMENT:

- NX Design
- Tecnomatix Plant Sim

HARDWARE REQUIREMENT:

- Processor - CPU. Core i3 2.7 Ghz.
- Memory RAM. 8 GBB or More.
- Hard Disk. 500 GB SATA.
- Graphic Card. 2 GB RAM (NVIDIA GeForce)

INDUSTRY SCOPE:

As an Advanced Manufacturing Engineer, the student can rightly fit to the industry requirement for a resource which can work with their plant planning team to design and simulate the plant which has to handle production as per the manufacturing processes.

REFERENCES

1. Ullman, David G. *The mechanical design process*. Vol. 6. New York: McGraw-Hill, 2017.
2. Gausemeier, J. and Moehringer, S., 2002. VDI 2206-A new guideline for the design of mechatronic systems. IFAC Proceedings Volumes, 35(2), pp.785-790.
3. Adam, A., Binder, B., Bretz, L., DiMaio, M., von Dungern, O., Hooshmand, Y., Kaufmann, U., Muggeo, C., Munker, F., Pfenning, M. and Priglinger, S., 2015. 10 theses about MBSE and PLM–Challenges and Benefits of Model Based Engineering. PLM4MBSE Working Group Position Paper, Gesellschaft für Systems Engineering eV http://gfse.de/Dokumente_Mitglieder/ag_ergebnisse/PLM4MBSE/PLM4MBSE_Position_paper_V_1_0. pdf.

20 INDUSTRY CASES

1. Develop a simulation model of a manufacturing facility to optimize production schedules and identify bottlenecks.
2. Create a simulation of a warehouse to design an efficient layout and determine the optimal number of workers and material handling equipment.
3. Simulate the flow of materials through a chemical plant to optimize the design of the plant and improve safety.

4. Design a simulation model of a power plant to optimize the use of energy resources and reduce emissions.
5. Develop a simulation of an oil refinery to optimize the production of various fuels and chemicals.
6. Create a simulation of a water treatment plant to optimize the design of the plant and improve the efficiency of the treatment process.
7. Simulate the flow of materials through a food processing plant to optimize the design of the plant and improve food safety.
8. Design a simulation model of an automotive assembly line to optimize the production process and reduce waste.
9. Develop a simulation of a packaging facility to optimize the layout and design of the plant and improve efficiency.
10. Create a simulation of a pharmaceutical manufacturing plant to optimize the production of drugs and improve quality control.
11. Simulate the flow of materials through a mining operation to optimize the design of the mine and improve safety.
12. Design a simulation model of a paper mill to optimize the production process and reduce waste.
13. Develop a simulation of a lumber mill to optimize the layout and design of the plant and improve efficiency.
14. Create a simulation of a plastics manufacturing plant to optimize the production process and reduce waste.
15. Simulate the flow of materials through a textile mill to optimize the design of the plant and improve efficiency.
16. Design a simulation model of a furniture factory to optimize the production process and reduce waste.
17. Develop a simulation of a glass manufacturing plant to optimize the layout and design of the plant and improve efficiency.
18. Create a simulation of an electronics assembly facility to optimize the production process and reduce waste.
19. Simulate the flow of materials through a metal fabrication plant to optimize the design of the plant and improve efficiency.
20. Design a simulation model of a construction materials plant to optimize the production process and reduce waste.

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SB8039	**SMART AND ADVANCED MANUFACTURING – PROCESS SIMULATION**	**1**	**0**	**2**	**2**

COURSE OBJECTIVE:

With this program, a system level simulation engineering can be virtually assessed and optimized for the performance of mechatronic systems. This will boost overall systems engineering productivity from the early development stages until the final performance validation and controls calibration. Through this program we will enable the learners to use multi-physics libraries with the

application and industry-oriented solutions that are supported by software platform, to let them rapidly create models and accurately perform analysis.

COURSE CONTENT:

UNIT I Presentation of Simcenter Amesim
Positioning behind Simcenter Amesim and the applications.

UNIT II The Simcenter Amesim environment
Building the first system in Simcenter Amesim from sketch up to simulation - Important concepts behind Simcenter Amesim: multiport approach, causality rules, sign convention,
Standard libraries: Mechanical and Control -Overview of the different basic menus and options

UNIT III Pre-processing tools
Import data, table editor parameters settings

UNIT IV Analysis tools
Plotting capabilities, Dashboards and Animations - Batch runs / Parallel processing
Simulation options - Design of exploration

UNIT V Design and Simulate Systems
Design and Simulate Thermal Fluid Systems - Hydraulic Control Systems - Introduction to Hydraulic Simulation - Multi Domain Simulation

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Design and simulate a thermal fluid system
- Design and simulate exhaust and exhaust after-treatment
- Perform engine simulation
- Design and simulate Hydraulic Control System with one degree of freedom
- Perform multi domain or multi physics simulation

SOFTWARE REQUIREMENT:

- Simcentre Amesim

HARDWARE REQUIREMENT:

- Processor - CPU. Core i3 2.7 Ghz.
- Memory RAM. 8 GBB or More.
- Hard Disk. 500 GB SATA.
- Graphic Card. 2 GB RAM (NVIDIA GeForce)

INDUSTRY SCOPE:
As a System Engineer, the student can rightly fit to the industry requirement for a resource which can work with their system engineering team to perform 1D Simulation for the plant.

REFERENCES

- Wikipedia.org, Product Lifecycle; https://en.wikipedia.org/wiki/Product_lifecycle
- Salehi, Vahid. Introduction to SDPD.
- Salehi, Vahid. Simulation of Mechatronic Product
- Friedenthal, S., Moore, A. and Steiner, R., 2014. A practical guide to SysML: the systems modeling language. Morgan Kaufmann.

20 INDUSTRY USE CASES

1. Design and Simulate Exhaust and Exhaust After-Treatment
2. Engine Simulation
3. Free Response of a System with One Degree of Freedom
4. Hydraulics – Pressure Transducer
5. Mechanics – Vertical Throw
6. Mechanics of a Simple Pendulum
7. Response of a System with One Degree of Freedom
8. Thermodynamics-Steel Ball in Water
9. Transmission Systems
10. Vehicle Simulation
11. Simulating the energy consumption of a residential building
12. Modelling and simulating an electric vehicle charging station
13. Analyzing the performance of a photovoltaic system
14. Simulating an HVAC system for a small commercial building
15. Modelling a simple microgrid system
16. Evaluating the energy savings potential of LED lighting retrofit
17. Simulating a small wind turbine
18. Analyzing the energy consumption of an industrial machine
19. Modelling a district heating and cooling system
20. Simulation of energy consumption of an electric vehicle under different driving scenarios

SB8040 PROFESSIONAL READINESS FOR INNOVATION, EMPLOYMENT AND ENTREPRENEURSHIP

L	T	P	C
1	0	2	2

COURSE LEARNING OBJECTIVES

- To empower the students with technical skills to require solving a real-world challenge
- To train the students on the approach to building solutions by applying critical thinking and problem-solving capabilities in a collaborative environment.
- To mentor the students in building proof-of-concept solutions by applying design thinking concepts.
- To introduce the standard project development methodologies followed in the industry to the students
- To develop the professional skills like teamwork, leadership qualities, communication in the students
- To enhance the employability of students in order to get them internships and job opportunities

Course Content:

Artificial Intelligence

- Introduction to Artificial Intelligence
- Python for Artificial Intelligence
- Data Wrangling Techniques
- Introduction to Neural Networks
- Tensorflow & Keras
- Convolutional Neural Networks
- Natural Language Processing
- Build and Deploy AI Applications

Data Science

- Introduction to Data Science
- Python for Data science
- Data Wrangling Techniques
- Data visualization
- Supervised Learning - Regression
- Supervised Learning – Classification
- Unsupervised Learning
- IBM Cloud & Watson Services Build and Deploy Machine Learning Applications

Data Analytics & Visualizations

- Introduction to Data Analytics
- Python for Data Analysis
- Extract data from database, txt files, webscrapping
- Data Visualization using Matplotlib, seaborn
- Data Visualization using Plotly
- Data Visualization using Pygal, Bokeh etc.
- Build Visualization Dashboards & Stories

Internet of Things (IoT)

- Introduction to Internet of Things (IoT)
- Building Blocks of IoT
- Design an IoT Device
- Getting Started with Arduino UNO & Tinkercad Platform
- Getting started with ESP32
- Integrate TMP36 Sensor with Arduino UNO
- Integrate Ultrasonic Sensor with Arduino UNO
- Integrate Servo Motor with Arduino UNO
- IoT Communication Technologies
- IoT protocols

- HTTP & MQTT Practical's
- Introduction to Python
- Python - Collection Data Types, Functions
- Modules Files I/O
- Getting started with Raspberry PI
- Raspberry Pi as a Gateway
- Introduction to Cloud
- IBM Cloud & IoT Platform Architecture
- Create and Configure IBM IoT Platform
- IBM Watson IoT Platform Hands-on with online simulator
- Getting Started Node-RED Service
- Web Application Development using Node-RED Service
- Mobile Application Development using MIT App Inventor
- IBM Cloudant DB & its Practical's
- Introduction to Computer Vision with Python
- Introduction to IBM Watson AI & Building Intelligent Devices

Cloud Application Developer Modern Application Development

- Hands-on with web application development
- Python – Flask Framework
- IBM DB2
- IBM Object Storage
- IBM Watson Assistant
- Containers & Kubernetes
- IBM Container Register

TOTAL : 45 PERIODS

Course Outcomes

- Understand the leading technologies and apply them for solving real-world problems
- Understand the concepts of design thinking and agile methodologies
- Develop professional skills like teamwork, time management, communication and project management skills
- Understand various digital tools & best practices followed in the industry
- Develop the products from scratch i.e. idea to working prototype
- Industry course completion certificate from IB

REGISTRAR

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Letter No. AU/ Naan Mudhalvan / TNSDC / 2023 Date: 21.07.2023

To
The Dean of CEG, ACT, MIT Campus
Deans of constituent colleges
Principals of Non-autonomous affiliated colleges of Anna University

Dear Professor

Greetings!!!

Government of Tamil Nadu through the Tamil Nadu Skill Development Corporation (TNSDC) has launched "Naan Mudhalvan" scheme for the benefit of 12.5 Lakh youths studying in the Engineering, Arts & Science and other professional courses across the state of Tamil Nadu. It is one of the prestigious and massive skilling programme in which Anna University is partnering with TNSDC to conduct certain credit courses and value added courses to Engineering students studying in the University Departments, Constituent colleges and Non autonomous affiliated colleges of Anna University. The courses offered through these initiatives are based on the industrial expectations and to bridge the gap between the academia and industry in terms of skill set expectations. This skilling initiatives will enhance the employability skills of the individuals and to get placed in the Multi-nationals, R & D and National level organisations. These courses are being delivered by the Industry training partners.

For the forthcoming 2023 – 2024 ODD semester, 27 unique courses (List of courses enclosed and the syllabus will be uploaded in Anna University website shortly) are going to be offered for the 7th semester students. In order to mentor the students, it is proposed to conduct one week Faculty Development Programmes (FDP) for the faculty members working in the above – mentioned institutions from 24.07.2023, Monday onwards. The details of the Host institution, participating zone / college, venue and other details will be shared shortly.

The "Naan Mudhalvan" team has done a meticulous planning in executing this FDP without any hassle. The team deserves a special encomium. Now it's our turn to support by sending the faculty members to the designated venue for FDP and providing them with "ON-DUTY" and to speak with the management to provide any additional support for their travel and accommodation. We also request the host institutions to support the faculty members of other institutions in the form of hostel accommodation and other support. A special mention to the host institution to provide necessary infrastructure including seminar hall with SA system, Computer lab if required.

Kindly note the following instructions that are given by the TNDSC::

1. Each hosting Institution is eligible for Rs.250/day, per faculty for lunch, snacks and tea.
2. Each faculty will be given Rs.250/day for incidental expenses per day for each day of attendance and will be paid at the end of FDP.
3. All faculty members must bring their laptops for the sessions. (Please don't ask support from the host institutions)
4. Faculty logistics must be completely taken care by the concern institutions/ Individuals. (Please don't ask support from the host institutions)

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5. College management can support physical infrastructure systems with required specification (RAM, HDD, Graphics Card, OS, Internet connectivity) as per ANNA University affiliation/Accreditation norms.

We solicit your kind cooperation for the smooth conduct of this FDP.

Thanking you

Regards

Yours faithfully

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CHENNAI-600 025.

List of courses to be offered in the 7th Semester for the Academic year 2023 - 2024

Sl. No.	Course	Faculty to be Nominated
1	Digital Marketing	All Departments
2	Block Chain	All Departments
3	Sales Force Developer	All Departments
4	Machine Learning	All Departments
5	Concrete Building System Design	CIVIL
6	Architecture Visualization using AR/VR	CIVIL
7	Integrated Building Services	Civil, EEE & MECH
8	ChatGPT	CS & IT
9	Full Stack with Python Programming	CS & IT
10	Full Stack Development with JAVA	CS & IT
11	Cyber security and applications	CS & IT
12	DevOps	CS & IT
13	Artificial Intelligence and applications	CS & IT
14	Data Analytics with TABLEU	CS & IT
15	Red Hat - LinuX	CS & IT
16	ICT Engineer -5G Network	ECE
17	System Architect - Foundation - 5G - Cloud - RAN	ECE
18	PLC using SIMATICS	EEE
19	Design of On Off - Grid Solar PV System	EEE
20	Industry 4.0 (Digital Twin)	EEE/ TECH
21	Drone design and testing	EEE/ MECH
22	Industry 4.0 and its application MECH	Mech
23	3D Printing using NX	Mech
24	Electric Vehicle Technology and Manufacturing	Mech
25	Manufacturing of Mechanical Components using CNC Turning and Milling	Mech
26	Surface Modelling	Mech
27	Applied ML For Health Care Industry	TECH

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