



Jharkhand University of Technology, Ranchi
NEP-2020 based Syllabus w.e.f – 2025-26 batch

Branch- Automobile Engineering/ Mechanical Engineering (Automobile)

Vth –Semester

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
01		Electrical & Hybrid Vehicle Technology	3	0	0	6	3	100	40	30	70	
02		Entrepreneurship Development and Startups	2	0	0		2	100	40	30	70	
03		PROFESSIONAL ELECTIVE (ANY ONE) 1. Advances in Automotive Technology 2. Automation & Robotics 3. Transport Management & MV Act 4. Construction & Earth Moving Equipment 5. Automobile Body Engineering & Safety 6. Automobile Electronics 7. Farm Tractor & Special Type of Vehicle	3	0	0		3	100	40	30	70	
		OPEN ELECTIVE (ANY ONE) 1. AI & ML 2. Cloud Computing & Cyber Security 3. IOT 4. Block Chain Technology 5. Drone Technology & Robotics 6. Data Analytics										
04			3	0	0		3	100	40	30	70	
Total			11	0	0		11	400	--	--	--	--
Practical			L	T	P		Cr	FM	Overall Pass Marks	Internal	External	Categorization
05		ADVANCE LAB-I (Vehicle Diagnostic Lab)	0	0	3		1.5	50	25	30	20	
06		ADVANCE LAB-II (Fuel, Lubricant & IC Engine Testing Lab)	0	0	3	1.5	50	25	30	20		
07		Entrepreneurship Development and Startups Lab	0	0	2	1	50	25	30	20		
08		Seminar And Report Writing (On UN SUSTAINABLE DEVELOPMENT GOALS)	0	0	2	1	50	25	30	20		
Total			0	0	10	5	200	--	--	--	--	

Audit Course			L	T	P	Cr	FM	Overall Pass Marks	Internal	External	Categorization
09		FOREIGN LANGUAGE OR REGIONAL LANGUAGE (ANY ONE) FOREIGN LANGUAGE 1. GERMAN 2. JAPANESE 3. CHINESE 4. KOREAN 5. SPANISH 6. RUSSIAN REGIONAL LANGUAGE 7. MARATHI 8. KANNAD 9. TAMIL 10. TELUGU	0			0	100	40	--	100	
10		Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance	6			0	50	25	30	20	
Internship			L	T	P	Cr	FM	Overall Pass Marks	Internal	External	Categorization
11		FIELD PROJECTS/ COMMUNITY ENGAGEMENT PROJECTS/ MINI PROJECT	8 weeks			2	--	--	1/0	--	
Total			0	0	0	2		--	--	--	--
Grand Total			11	0	10	6	18	750	--	--	--

*AU- Audit Course; L: Lecture, T: Tutorial, P: Practice.

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

*Passing in Audit Course shall be mandatory.



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Branch- Automobile Engineering/ Mechanical Engineering (Automobile)

VIth –Semester

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
01		Industrial Internship/ Project	36 Hours per week / week Total 12-16 Weeks			6	12	--	--	--	--	
02		Seminar & Report Writing on IKS (Bhartiya Gyan Prampra)	0	0	4		2	--	--	--	--	
Total			0	0	0		0		--	--	--	--
Grand Total			0	0	2	6	14	--	--	--	--	--

L: Lecture, T: Tutorial, P: Practical.

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

**Jharkhand University of Technology
Ranchi, 834010**



TENTATIVE SYLLABUS

**For Diploma Program in
Automobile Engineering/Mechanical Engineering Automobile**

(Effective from 2025-26)

DEPARTMENT OF AUTOMOBILE ENGINEERING

(5th – SEMESTER)

Electric & Hybrid Vehicle Technology

Course Code :-

(3:0:0)

Introduction

Welcome to the curriculum for the Specialization Pathway – **Electric and Hybrid Vehicle Technology**. This specialization course is taught in Boot camp mode. Boot camps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur.

Vehicle is a fundamental requirement of modern life, but the CI engines are quickly becoming outdated. Petrol or diesel vehicles are highly polluting and are being quickly replaced by fully electric vehicles. Fully electric vehicles (EV) have zero tailpipe emissions and are much better for the environment and HEVs combine the benefits of high fuel economy and low tailpipe emissions with the power and range of conventional vehicles. The electric vehicle revolution is here, and you can be part of it. In this pathway the student will learn different subsystems in electrical & hybrid vehicle and service or troubleshoot it for any problems identified.

You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn different subsystems in electrical & hybrid vehicle and service or troubleshoot it for any problems identified.

Leading to the successful completion of this boot camp, you shall be equipped to either do an **Internship** in an organization working on **Electric and hybrid vehicles** or take up a **Project** in the related field. After the completion of your Diploma, you shall be ready to take up roles like Electric/hybrid vehicle technician, Shop floor technician, Production In-charge and also can become Entrepreneur in the related field and more.

Pre-requisite

Before the start of this specialization course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Drawing, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Mechanical Science & Engineering and Automotive Engines.

2nd year-Automobile Chassis and Transmission System, Automotive Electrical System, Thermal Engineering and Engine Testing, Automotive Manufacturing Processes, Advanced Automotive Systems, Design and Drafting, Vehicle Body Engineering and Dynamics and Fuel and Pollution Control. In this year of study, you shall be applying your previous years learning along with specialized field of study into projects and real-world applications.

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

CO-01	Analyze the different architectures in Electric and Hybrid Electric Vehicles, Technologies and test and repair to ensure that it provides the necessary output/result as required.
CO-02	Analyze the use of different energy storage systems used in electric vehicles, their control techniques, and select appropriate energy balancing technology.
CO-03	Demonstrate subsystems in electrical & hybrid vehicle and service or troubleshoot it for any problems identified.
CO-04	Explore different EV charging stations, its control and configurations and decide suitable station for particular EV.
CO-05	Test, diagnose and service the air conditioning system of a given EV.

Course Content

Unit	Course Content	Hours
1	<p>Introduction to the course. About Specialization –Future- Companies and Service sectors in India and outside India, Career opportunities. History of electric vehicle. Components of electric vehicle.</p> <p>Indian and global scenario: Technology Scenario. Market Scenario – Market overview, market trends. Market Scenario – Market overview, market trends. The future scope of electric vehicles.</p> <p>Policies and Regulations: Policies in India – Incentives, PLI (Production Linked Incentive) scheme, battery swapping policy, special E- mobility zone. Using Web browser, Practice to search and applying for PLI scheme.</p> <p>Regulations for EV in India: Need for regulation and standards, ARAI Regulations and standards, Category and Type of Approval Required for EVs.</p> <p>RTO Regulations for EVs: Electrical car registration and road tax, Driving license policies for EV, Number plate policy for EV, RTO permission for Advertising on EVs. Comparison- EV with IC engine vehicles technology, EV Configuration. EV classification and EV Terminology. Video demonstration.</p> <p>Basic Vehicle Performances: Introduction, Tractive Effort, Vehicle Resistance-Rolling Resistance Force, Aerodynamic Drag, Gradient resistance. Calculation of the Acceleration, Range, Grade ability and Maximum speed of BEV's</p>	

2	<p>Vehicle power plant: Compare typical performance characteristics of gasoline engines and typical performance characteristics of electric motor for traction (By showing the graph, traction motor characteristics)</p> <p>Battery Technology: Types of batteries - Lead Acid, Lithium Ion, Lithium Potassium, NiMH (Nickel metal hydride battery), Aluminum air. Battery terminologies - SoC, DoD, SoH. Battery charging and discharging calculation.</p> <ul style="list-style-type: none"> • Cell selection and sizing. • Battery layout design. • Battery pack configuration. • Battery selection criteria. • Battery pack construction. <p>Lithium battery manufacturing process. Practice to build battery pack with series and parallel configuration. Cell selection and sizing, handling cells, understanding cell charging and discharging curves. Voltage, Temperature & Current Measurement.</p> <p>Battery Management System: Need of BMS. Functions of BMS. BMS building blocks. Mode of power. Design consideration of BMS. Connecting battery to a charger for battery charging, Inspecting & testing a battery after charging. Battery Disposal, Storing Batteries, Battery recycling. Diagnose, Repair, and test high voltage battery systems. Battery degradation. Lifespan for EV battery. Extend lifespan for EV battery. Safety of EV battery. Check battery assembly sensors for proper functioning Diagnose, repair, and testing of EV battery controls. Battery cell balancing. Balancing methods – Active cell and Passive cell balancing. Conduct an experiment to measure Voltage, current and temperature with BMS. Balance cells with external circuits – Practical/Video demonstration.</p>	
3	<p>Fuel Cells: Fuel cell technologies: Operating principle -Proton exchange membrane. Solid oxide fuel cell. Hydrogen production methods – Electrolysis, POX reforming. Demonstration of (video) various hydrogen production methods.</p> <p>Fuel Cell Electric Vehicle</p> <ul style="list-style-type: none"> • Fuel Cell Electric Vehicle- Working of hydrogen engine 	

	<p>https://auto.economictimes.indiatimes.com/news/passenger-vehicle/cars/investment-in-hydrogen-fuel-falls-20-in-2020-fuel-cell-vehicle-demand-to-be-fragile/82575173</p> <ul style="list-style-type: none"> • Hydrogen Fuel Cell Bus <p>Filling up of fuel cell electric vehicle Hydrogen storage - Cryogenic liquid storage. Hydrogen Transportation. Demonstration of (video) hydrogen storage and transport. Hydrogen as Alternate fuel for motor vehicles.</p> <p>Electric Vehicle Architecture: Types of EVs – Battery EV, Hybrid EV, Photovoltaic EV, Fuel cell, Solar operated EV. Electric vehicle architecture powertrains - BEV, HEV, PHEV, FCEV, Solar.</p> <p>Electric Vehicle Chassis and Body Design: Body/chassis requirements. Body/chassis layout. EV body material selection. Effect of weight on efficiency and range. Comparison of different materials (features and safety). Body stability. Suspension for EVs – Types – Working principle - Electric, Electromagnetic, Air suspension.</p>	
4	<p>Brakes for EVs – Types - Regenerative braking, Plugging type braking. Dynamic braking - Working principle- Advantages – Disadvantages. Diagnose, repair, and test regenerative braking. Comparison between conventional and regenerative braking. Field visit/Video demonstration on regenerative braking.</p> <p>Steering System: Construction and working of Electrical Power steering. Fault diagnosis of electrical power steering. Perform Electronic Power Steering Identification of EPS components and related sensors. Troubleshooting and remedies for electrical power steering.</p>	
5	<p>Electric Propulsion System: Block diagram. DC motor drives – Principle of operation and performance – Separate shunt motor, series motor and cumulative compound wound field DC motors. Induction motor drives - Principle and working. Testing and servicing of DC motor drives. Permanent magnet BLDC drives – Principle of operation – Advantages and disadvantages. Video demonstration on working of BLDC. Control of BLDC motor drives – Block diagram: Torque control. Speed control. Switched Reluctance Motor drives (SRMs) – Principle of operation with block diagram. Basic magnetic structure of SRM-</p>	

	<p>6/4 SRM, 8/6 SRM Component sizing. Physical locations. Mechanical connection of motor. Electrical connection of motor. Selection and sizing of motor. RPM and Torque calculation of motor.</p>	
6	<p>Configuration of EVs: Illustration of general EV configuration. 1. Conventional driveline with multi- gear transmission and clutch. 2. Single gear transmission. 3. Integrated fixed gearing differential. 4. Separate motor and fixed gearing drive shaft. 5. Direct Drive. 6. Separating wheel motor drive. Traction motor characteristics with graph.</p>	
7	<p>Hybrid Electric Vehicles: Introduction. Concept of hybrid electric drive train. Types of HEVs, Torque-Coupling, speed coupling, torque and speed coupling parallel HEV. Complex HEVs, Dynamic Response of HEV. Degree of Hybridization. Architectures of Hybrid Electric Drive Train: 1. Series (electrically coupling)- Operation modes – Advantages and disadvantages. 2. Parallel (mechanical coupling)- Operation of drive train configuration with speed coupling. 3. Series-parallel (mechanical and electrical coupling). 4. Complex (mechanical and electrical coupling). Power flow Control: 1. Power flow control in series Hybrid 2. Power flow control in series Hybrid 3. Power flow control in series-parallel Hybrid 4. Power flow control in complex Hybrid Comparison between series-parallel and complex drive drain. (Video demonstration.) Vehicle Control Unit: Introduction - Development process- Software – Hardware. Data management. Sensor integration. CAN communication. Interfaces.</p>	
8	<p>EV Charging Technologies: Classification of different charging technology for EV charging station. Introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) operations. Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations.</p>	

	<p>Video demonstration/Field visit. Bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle. Wireless Power Transfer (WPT) technique for EV charging. Video demonstration/Field visit Diagnose, repair and test vehicle charging interface/ infrastructure. Operate standard chargers and determine charging time under various conditions. Requirement of charging inputs for different types of chargers. Diagnosis and remedy for charger not responding, charger not delivering expected current. Components of charging station block diagram of charging station. Terms associated with EV charging station.</p>	
9	<p>Testing and adjustment of EV sub- systems: Identify different location of various ECUs in vehicle. Identify Proximity sensor, Parking sensor, crash sensor, Rain and Light Sensor. Practice on Recognition of EV symbols. Practice of safety precautions and procedures to be observed while working with EV Kit and related tools. Practice on measuring voltage drop. Disassemble and assemble various components of EV using appropriate fasteners and hand tools. Trace the wiring circuit of lighting system. Troubleshoot and repair accelerator pedal. Diagnosis and remedy for charger not responding, charger not delivering expected current. Troubleshoot and repair brake. Drive an EV following safety rules for driving.</p>	
10	<p>EV Safety: Preventive measures for electrical accidents & steps to be taken in such accidents. Air Conditioning System Servicing: Identification of air conditioning system components. Working of Air-conditioning ECU. Preventive maintenance of FATC/HVAC machine. Adjustment of AC inside the cabin. Blower speed control and ventilation systems. Identification and testing of ambient temperature sensor, air temperature sensor- Working. Testing and servicing of Air- conditioning system. Testing and servicing of Air- conditioning system.</p>	

References:

S.No.	Name
1	Modern Electric, Hybrid Electric and Fuel Cell Vehicles by Mehrdad Ehsani, Yimin Gao and Ali Emadi, CRC Press.
2	Electric Motors and Drives BY AUSTIN HUGHES and BILL DRURY
3	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, by Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi
4	Hybrid Electric Vehicles, Principles and Applications with practical perspective: Chris Mi, Wiley publications
5	Modern Electric, Hybrid Electric and Fuel cell vehicles, Fundamentals, theory and Design: Mehrdad Ehasani. CRC press.
6	Electric and Hybrid Vehicles by Tom Denton, .Routledge, 2016.

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS

Course Code-

L:T:P-

Course Description:

This course provides polytechnic students with a foundational understanding of the entrepreneurial mindset, processes, and skills required to identify opportunities, develop innovative solutions, and create sustainable ventures. Throughout the semester, Critical Thinking, Excellent communicator (Good story teller), and Empathetic Leadership skills development for the students, through a blend of theoretical concepts, case studies, and practical exercises, students will learn to think like entrepreneurs, fostering creativity, problem-solving, and a proactive approach to career and economic development. The course emphasizes practical tools and methodologies applicable across various technical and vocational fields. This course will focus towards small Businesses including services and products

Course Learning Outcomes (CLOs):

Upon successful completion of this course, students will be able to:

1. **Define and explain** core concepts of entrepreneurship, innovation, and small business management.
 2. **Identify and evaluate** entrepreneurial opportunities using various ideation and market research techniques.
 3. **Develop a basic business model** using tools like the Business Model Canvas.
 4. **Understand fundamental aspects** of market analysis, competitive landscape, and target customer identification.
 5. **Articulate key considerations** in managing startup finances, legal structures, and intellectual property.
 6. **Develop and deliver a compelling pitch** for a new business idea.
 7. **Cultivate an entrepreneurial mindset**, including adaptability, resilience, and a willingness to take calculated risks.
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Course Content Outline (Weekly Breakdown):

Unit 1: Understanding Entrepreneurship and the Entrepreneurial Mindset (Weeks 1-2)

- **Week 1: What is Entrepreneurship? The Journey Begins.**
 - Definition of entrepreneurship, innovation, and intrapreneurship.
 - Dispelling myths about entrepreneurs.
 - The role of entrepreneurship in economic development and job creation (local and global context).
 - Types of entrepreneurs: lifestyle, scalable, social, tech, side-hustle.

- Introduction to JUT's entrepreneurial ecosystem and local success stories
- **Activity: Ice-breaker: "What problem bothers you the most in your daily life/local community?"**
- **Week 2: The Entrepreneurial Mindset & Traits of Successful Entrepreneurs.**
 - Key entrepreneurial characteristics: passion, resilience, adaptability, creativity, risk-taking (calculated), problem-solving.
 - Growth mindset vs. fixed mindset.
 - Identifying personal strengths and weaknesses as potential entrepreneurs.
 - Importance of networking and mentorship.
 - *Case Study:* Analyze a local polytechnic graduate who started a successful business.
 - **Activity: Self-assessment quiz: "Are you ready for entrepreneurship?"**

Unit 2: Opportunity Identification & Ideation (Weeks 3-4)

- **Week 3: Finding Your Big Idea: Problem-Solving Approach.**
 - Sources of entrepreneurial opportunities: pain points, market gaps, trends, technological advancements, personal hobbies/skills.
 - Design Thinking principles for problem identification.
 - Techniques for observing and understanding customer needs (empathy mapping).
 - **Activity: Field observation exercise: Identify 3 problems in a chosen environment (e.g., campus, local market).**
- **Week 4: Ideation & Validation Techniques.**
 - Brainstorming methods: SCAMPER, S- Substitute, C-Combine, A- Adapt, M- Modify, P- Put to another Use, E-Eliminate, R- Reverse/Rearrange (Mind Mapping, Reverse Brainstorming)
 - Concept generation and prototyping
 - Introduction to Minimum Viable Product (MVP) concept.
 - Initial idea validation: informal surveys, interviews with potential customers.
 - **Activity: Group ideation session for a chosen problem; develop a basic MVP concept.**

Unit 3: Business Model Fundamentals (Weeks 5-6)

- **Week 5: Introduction to the Business Model Canvas (BMC).**
 - Understanding the nine building blocks of the BMC: Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, Cost Structure.
 - How the BMC provides a holistic view of a business.
 - *Activity:* Analyze the BMC of a well-known local or global company.
- **Week 6: Developing Your Value Proposition & Customer Segments.**
 - Deep dive into Value Proposition Design: understanding customer jobs, pains, and gains.
 - Defining your ideal customer segments: demographics, psychographics, behaviors.
 - Niche markets vs. broad markets.

- **Activity:** Students start populating the Customer Segments and Value Propositions blocks of their own business idea's BMC.

Unit 4: Market Analysis & Strategy (Weeks 7-8)

- **Week 7: Market Research Essentials.**
 - Importance of market research: primary vs. secondary research.
 - Basic tools for market research: online surveys (e.g., Google Forms), competitor analysis, industry reports.
 - Analyzing market size, trends, and growth potential.
 - **Activity: Conduct preliminary secondary market research for their chosen industry.**
- **Week 8: Understanding Your Competition & Marketing Basics.**
 - Competitor analysis: identifying direct and indirect competitors, SWOT analysis (Strength, Weakness, Opportunity, Threat).
 - Developing a competitive advantage.
 - Introduction to the Marketing Mix (4 Ps: Product, Price, Place, Promotion) in a startup context.
 - Branding basics for new ventures.
 - *Guest Speaker (Optional):* Local entrepreneur sharing marketing strategies.

Unit 5: Financial, Legal & Operational Foundations (Weeks 9-11)

- **Week 9: Startup Financial Basics.**
 - Understanding startup costs (fixed vs. variable).
 - Revenue models: how businesses make money.
 - Basic concepts of pricing strategies.
 - Sources of funding: bootstrapping, FFF (Friends, Family, Bootstrap), grants, basic loans, angel investors (brief overview).
 - **Activity: Calculate initial startup costs for their business idea.**
- **Week 10: Legal & Regulatory Aspects for Startups.**
 - Choosing a business structure: Sole Proprietorship, Partnership, LLC (simple overview, focus on local context).
 - Importance of business registration and licensing.
 - Basic understanding of contracts and agreements.
 - Introduction to Intellectual Property (IP): patents, trademarks, copyrights (relevance to polytechnic innovations).
 - *Guest Speaker (Optional):* Small business lawyer or a representative from a local business registration office.
- **Week 11: Operations & Team Building.**
 - Key operational considerations: supply chain, production/service delivery, quality control.
 - Building an effective founding team: complementary skills, roles, and responsibilities.
 - Importance of company culture in a startup.
 - **Activity: Define key activities and key partners for their BMC.**

Unit 6: Pitching, Growth, and Next Steps (Weeks 12-14)

- **Week 12: Crafting Your Pitch & Storytelling.**

- Purpose of a pitch deck.
 - Components of a compelling pitch: problem, solution, market, team, business model, ask.
 - Storytelling techniques for engaging an audience.
 - Verbal and non-verbal communication skills.
 - *Activity*: Students draft their initial pitch script.
 - **Week 13: Developing Your Business Plan (Lean Approach) & Refining Your Pitch.**
 - Overview of a lean business plan (as opposed to a traditional, lengthy one).
 - Refining the Business Model Canvas into a more comprehensive plan.
 - Peer feedback session on draft pitches.
 - **Workshop: Pitch practice session.**
 - **Week 14: Final Pitch Presentations & Future Directions.**
 - **Final Project**: Students present their business idea pitch (could be 5-7 minutes with Q&A).
 - Discussion on continuous learning, adaptation, and potential next steps for their entrepreneurial journey.
 - Resources available for aspiring entrepreneurs at JUT and in the local community.
 - *Activity*: Course wrap-up and Q&A.
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Assessment Methods:

To ensure a balance between theoretical understanding and practical application, the assessment for this course could include:

- **Participation & Engagement (10-15%)**: Active involvement in discussions, group activities, and case study analyses.
 - **Module Activities/Quizzes (20-25%)**: Short quizzes, completion of assigned BMC sections, market research exercises, ideation assignments.
 - **Individual/Group Assignments (30-35%)**:
 - **Mid-Term Assignment**: Developed Business Model Canvas for their chosen idea (could be individual or small groups).
 - **Research Report**: A brief report on their market research and competitive analysis.
 - **Final Project (30-35%)**:
 - **Business Pitch Deck**: A professional-looking presentation outlining their business idea.
 - **Oral Pitch Presentation**: Delivering a concise and compelling pitch to the class (and potentially invited faculty/local entrepreneurs).
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Recommended Resources & Tools:

- **Primary Textbook**
- **Online Platforms/Tools: Introduction to Entrepreneurship Dr Prakah Kumar, Raj Jaswa, Ramesh Yadava**

- Google Workspace (Docs, Sheets, Slides, Forms) for collaboration and surveys. Canva for creating visual aids and pitch decks. URL <https://www.canva.com/>
- [web.showreelapp.com](https://www.showreelapp.com) Sabeer Bhatia
- Online market research tools (e.g., Statista, government statistical websites, industry association sites).
- Whiteboards, sticky notes, and markers for brainstorming sessions.
- **Guest Speakers:** Local entrepreneurs, business development agencies, IP lawyers, startup mentors.
- **Case Studies:** A mix of successful and failed startups, particularly those relevant to polytechnic fields (e.g., tech, engineering, design, trades).

**PROFESSIONAL
ELECTIVE**

ADVANCES IN AUTOMOTIVE TECHNOLOGIES

Course Code-

(3-0-0)

RATIONALE

This course equips students with a solid foundation in understanding the transformative impact of technology on the automotive sector. By exploring recent trends, technological innovations, and emission regulations, students gain a holistic perspective essential for pursuing careers in automotive engineering and related fields. This course not only prepares students for current industry demands but also fosters a forward-thinking mindset necessary for adapting to future advancements in automotive technologies. Key technologies covered include Electric Vehicles (EVs), Hybrid Electric Vehicles (HEVs), Dual Clutch Transmission (DCT), Active Cylinder Management (ACM), and Electronic Stability Control (ESC).

COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 :	Identify advancements in Hybrid Electric Vehicle (HEV) and Fuel Cell Vehicle technologies influenced by emission standards.
CO2 :	Select suitable Electric Vehicle (EV) systems based on battery technologies and charging infrastructure.
CO3 :	Compare EV propulsion systems and advanced transmission technologies based on performance.
CO4 :	Relate and respond regarding contemporary issues in the electronic fuel systems.
CO5 :	Analyze vehicle dynamics, safety systems, and factors affecting ride comfort.

Course Content

Unit - I Hybrid Electric Vehicles

- 1.1 Environmental and Regulatory Considerations: Bharat stage (BS) Emission Standards influencing automotive technology development, hydrogen fuel, Use of CNG in two-wheeler vehicles.
- 1.2 Hybrid Electric Vehicles (HEV): Introduction to HEV, classification of HEV on the basis of Hybridization Level, Powertrain, Plug-in Capability, Vehicle Segment, Driving Mode
- 1.3 Common features of hybrid vehicles
- 1.4 Levels of Hybrid Vehicles: Mild, Medium and Full Hybrid vehicles.
- 1.5 Efficiencies of Electric motors and I.C. Engines.
- 1.6 Plug-in Hybrid Electric Vehicles (PHEVs): Differences from HEVs- ability to charge from external power sources, extended electric-only range, and operation modes (electric mode, hybrid mode)
- 1.7 Fuel Cell Vehicles (FCVs): Proton exchange membrane (PEM) fuel cells and solid oxide fuel cells (SOFCs).

Unit - II Electric Vehicles

- 2.1 Electric Vehicles (EVs): Introduction to electric vehicles system- propulsion systems, battery technologies, and charging infrastructure.
- 2.2 Layout of EV - Two, Three & Four Wheeler vehicles.
- 2.3 Battery: Types of battery (Lithium ion battery, nickel metal hydride, lead acid), capacity,

size, weight and power, Battery Characteristics

2.4 Battery Management System (BSM)- operation

2.5 Electric Motor: Types, components, functions and applications

2.6 Charging Infrastructure: Overview of charging technologies (AC Vs. DC charging), charging stations, connectors, and smart charging solutions.

Unit - III Powertrain Technologies

3.1 EV Propulsion Systems: Types of EV propulsion systems (single motor, dual motor, all-wheel drive) and their impact on vehicle performance

3.2 HEV Powertrains: Series Hybrid vehicle, Parallel Hybrid Vehicle, Series parallel Hybrid Vehicle, Comparison of different Powertrain Technologies

3.3 Advanced Transmission Technology: Dual- Clutch Transmission, Automated Manual Transmissions (AMTs), Intelligent Manual Transmission System

Unit - IV Advanced Engine Technologies

4.1 Active Cylinder Management (ACT): Principle and benefits

4.2 Start-Stop Systems: Belt Alternator Starter system- Operation & Benefits.

4.3 Downsizing: Concept of downsizing engines while maintaining or improving performance through turbocharging / supercharging and direct injection.

Unit - V Vehicle Dynamics and Control Systems

5.1 Handling Characteristics: Study of vehicle dynamics principles, including steering response, cornering behavior, and traction management: Traction Control System (TCS).

5.2 Stability Control System: Principles and operation of electronic stability control (ESC) systems to enhance vehicle stability during cornering and slippery conditions.

5.3 Ride Comfort: Factors affecting ride quality such as suspension design, damping characteristics, and vehicle weight distribution.

5.4 Active Safety Systems: Collision Avoidance System.

SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Approx. 280 authors from industry and the university and college sector	Automotive Handbook	11th Edition April 2022, Robert Bosch GmbH ISBN13: 9781119911906
2	Jack Erjavec	Automotive Technology A Systems Approach	7th Edition Year: 2010, Delmar ISBN13:9781337794213 ISBN10: 133779421X
3	James D. Halderman	Automotive Technology: Principles, Diagnosis, and Service	4th Edition Year: 2012, PEARSON ISBN10: 0132542617 ISBN13: 9780132542616
4	G. K. Awari, V. S. Kumbhar, R.B. Tirpude	Automotive Systems, Principles and practices	1st edition 2021, CRC Press, ISBN13: 9780367498429

5	Rajesh Rajamani	Vehicle Dynamics and Control	Second Edition 2012, ISBN13: 9781461414322
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LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	https://www.youtube.com/watch?v=nrxmQhbZUTc	The Battery Basics: Understanding Lithium-Ion, Lead-Acid and More
2	https://www.youtube.com/watch?v=pnw1_CIC5Uw	Making of Electric vehicle Battery in India.
3	https://nap.nationalacademies.org/read/25542/chapter/9#203	Hybrid EV Powertrain
4	https://www.youtube.com/watch?v=h8yXOdS7Cb0	Smart hybrid cars dual battery engine support SHVS
5	https://www.youtube.com/watch?v=w-s3BqLlJ4A	Hybrid Electric Vehicle E-Learning Module
6	https://www.youtube.com/watch?v=mNOYS-duUJY	EV Electrical Systems basics
7	https://www.youtube.com/watch?v=HfN5dEeUyuE	Electric Vehicle Powertrain Components - Basics
8	https://www.youtube.com/watch?v=q7D1SaQF1T8	The Future of Automotive Innovation
9	https://www.youtube.com/watch?v=yooHR8sar5g	ACT - Active cylinder management

AUTOMATION & ROBOTICS

Course Code-

(3-0-0)

Introduction:

Welcome to the curriculum for the Specialization Pathway – **Automation and Robotics**. This specialization course is taught in Boot camp mode. Boot camps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur.

Manufacturing industries are moving towards complete automation, also using robots to perform most of the operations. Industrial automation systems are used to control and monitor a process, machine or device in a computerized manner that usually fulfills repetitive functions or tasks. They are intended to operate automatically and systematically in order to reduce and improve human work in the industry. Automotive industries are switching to PLC technology for data acquisition and control. Industrial automation systems are used to control and monitor a process, machine or device in a computerized manner that usually fulfills repetitive functions or tasks. This course attempts to provide basic theoretical and practical aspects of automation technologies to develop operational competency, also gives knowledge on robotics. Hence this course is the foundation for diploma engineers who want to further specialize in the field of industrial automation and robotics.

You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to automate different activities in various applications and also incorporate Robots for required activities in an automation system.

Leading to the successful completion of this boot camp, you shall be equipped to either do an **Internship** in an organization working on **Automation and Robotics** or take up a **Project** in the related field. After the completion of your Diploma, you shall be ready to take up roles like Automation Engineer, Floor shop Manager, Production In-charge and also can become Entrepreneur in the related field and more.

Pre-requisite

Before the start of this specialization course, you will have prerequisite knowledge gained in the first two years on the following subjects

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Drawing, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Mechanical Science & Engineering and Automotive Engines.

2nd year-Automobile Chassis and Transmission System, Automotive Electrical System, Thermal Engineering and Engine Testing, Automotive Manufacturing Processes, Advanced Automotive Systems, Design and Drafting, Vehicle Body Engineering and Dynamics and Fuel and Pollution Control. In this year of study, you shall be applying your previous years learning along with specialised field of study into projects and real-

world applications.

Course outcome: A student should be able to

CO1	Select the right sensor and/or actuator for automating a given application and demonstrate process variables using sensors and/or transducers.
CO2	Perform specified control functions using a Programmable Logic Controller (PLC) and list various applications of embedded systems
CO3	Design and test an automation system for a required operational specification and troubleshoot to resolve any given issue
CO4	Identify the possibilities of automation in a production system
CO5	Develop, simulate, interface and Execute Robot Program for a specified process

Course Content

About Specialization – Future-Companies and Service sectors in India and outside India, Career opportunities. Importance and scope of automation & robotics in automobile industry.

About Automation & robotics- History- Importance- with an Example of a company (like Toyota, M&M, Volvo etc....) brief how/why the need for automation and use of robots evolved in automobile industry.

Detailed course plan

(Week 1):

Week	C O	P O	Day s	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1			1	<p>About Specialization – Future-Companies and Service sectors in India and outside India, Career opportunities.</p> <p>Importance and scope of automation & robotics in automobile industry.</p>	2		2	<p>About Automation & robotics- History- Importance- with an Example of a company (like Toyota, M&M, Volvo etc....) brief how/why the need for automation and use of robots evolved in automobile industry.</p>	3		
1	1	1		<p>Introduction:</p> <p>1. Need and benefits of Industrial Automation, Automation Hierarchy, Basic components of automation system, description of each component.</p> <p>2. Automation technology as a part of engineering sciences, Key development milestones in the history of automation technology, Effects of automation on people.</p> <p>3. Types of automation system :-Relay logic and PLC.</p>	4			<p><i>Study the following appliances/ automation systems and identify various elements used and their function in: automotive Air conditioning System/ autonomous car/ any automation related to automotive industry.</i></p>			3
	1	1	3	<p>Programmable logic controller:</p> <p>1. Introduction, Compare Relay Logic Control and PLC</p> <p>Logic Control, Internal Architecture of PLC</p>	4			<p>Input devices:</p> <ul style="list-style-type: none"> • Mechanical Switches • Proximity Switches 	3		

			2. I/O Modules (Interfaces), Memory organization.				2. Input devices: <ul style="list-style-type: none"> • Photo electric Sensors and Switches • Encoders • Temperature Sensors • Position/Displacement Sensors 		
1	1	4	<p><i>Demonstrate the working of below shown switches / Sensor.</i></p> <p><i>a. Various industrial Switches (Push Button, ON/OFF, Toggle, Emergency, Rotary Switches etc.)</i></p> <p><i>b. Proximity- Inductive, Capacitive and Optical Sensor</i></p> <p><i>Note: Connect each sensor directly to the LED/Lamp with appropriate power supply</i></p>			4	<p><i>Demonstrate the working of below shown switches / Sensor.</i></p> <p><i>a. Temperature Sensor</i></p> <p><i>b. Float Sensors</i></p> <p><i>Note: Connect each sensor directly to the LED/Lamp with appropriate power supply</i></p>		3
		5	Developmental Assessment				Assessment Review and corrective action		3
		6	<p>Industrial Class + Industrial Assignment Industry Class on:</p> <p>Arrange a talk from need for Industrial Automation and Programmable logic controller</p>	2		3			
(Week 2):									

2	1	1	1	Tutorial (Peer discussion on Industrial assignment)	-	4	-	<ul style="list-style-type: none"> 1. Input devices: <ul style="list-style-type: none"> • Strain Gauges • Pressure Sensors • Liquid level detectors 2. Input devices: <ul style="list-style-type: none"> • Fluid flow measurement • Smart Sensors 3. Output Devices: <ul style="list-style-type: none"> • Relay • Directional control Valve 	2	1
	1	1	2	<ul style="list-style-type: none"> 1. ADC and DAC 2. Motors- DC motor, Synchronous motor, Servo motor, 3. Induction motor, Stepper motor 	4			<i>Demonstrate the Forward and Reversal of Stepper, Servo and DC Motors with the help of Drivers. Note: Demonstrate the above without using any controllers</i>	1	2
	2	2	3	PLC Programming: <ul style="list-style-type: none"> 1. Programming standards, List Different PLC Programming, Ladder diagram, 2. Standard IEC 1131-3 Symbols used for I/O Devices 3. Ladder diagram for logic gates. AND, OR, NOT, NAND, NOR, XOR, XNOR 	2	2		Write the ladder diagrams for different applications Ex: A system where there has to be no output when any one of four sensors gives an output, otherwise there is to be an output		3
	2	2	4	<i>Write ladder diagram to test digital logic gates and Execute/Simulate the same.</i>			4	<i>1. Writing Equivalent ladder diagram for Electric Switch, Belt drive, motor circuit Latching, Sequential O/P</i>		3
			5	Developmental Assessment				Assessment Review and corrective action		3

			6	Industry Class on selection parameters of PLC for a given application	2		2	Industry Weekly Assignment(1PM-2PM)			1
(Week 3):											
3	2	1	1	Tutorial (Peer discussion on Industrial assignment)		4		Introduction to Timer functions. Applications of timing functions in process control - - On Delay Timer Function, Off-delay Timer Function	3		
	2	1	2	PLC counter functions, Applications of PLC counter function in process control	2	2		Write a Ladder Program to count the number of Items moving on a conveyor Belt and Execute/Simulate the same			3
	3	2	3	Develop a PLC ladder diagram to construct an alarm system which operates as follows. - If one input is ON nothing happens. - If any two inputs are ON, a red light goes ON. - If any three inputs are ON, an alarm sirens sound. - If all are ON, the relevant department is notified.			4	Simulate the PLC ladder diagram developed for an alarm system and also Demonstrate by interfacing with PLC	3		
	3	2	4	Develop automatic door system using optical sensor and linear actuator			4	Execute automatic door system using optical sensor and linear actuator			3
			5	CIE 1 – Written and Practice Test				Assessment Review and corrective action			3
			6	Industrial Class + Industrial Assignment Industry Class on prevailing PLC Simulation software's and its merits and demerits	2		3				
(Week 4):											
4	3	2	1	Tutorial (Peer discussion on Industrial Visit), Report submission on visit.		4		<i>Design ladder diagram for car parking.</i> (Hint: car is to be detected and enter the parking space)			3

								to a particular location if space is available. If there is no space, a lamp should indicate that parking is full)			
	2	3	2	Simulate a ladder diagram for car parking.			4	Design ladder diagram for operating and controlling the Lift.			3
	2, 4	2, 7	3	Write a ladder diagram and simulate a circuit for a process control application in which a paint spray has to run for 40 seconds when the count reaches the value of 25.			4	Embedded System- Block Diagram of Embedded System	3		
	2, 4	2, 7	4	2)Applications of Embedded System • Robotics Drones • Braking System • Air conditioning, Refrigerator • Engine control System	3		1	Applications of Embedded System • Keyless entry in Automobiles. You tube Presentation on Applications of Embedded System	1		2
			5	Developmental Assessment				Assessment Review and corrective action			3
	2		6	Industrial Class + Industrial Assignment Industry Class on prevailing PLC Simulation software's and its merits and demerits	2		3				
(Week 5):											
5	4	1	1	Tutorial (Peer discussion on Industrial assignment)		4		Demonstrate the selection criteria, specification and Application: of Optical (Photoelectric) Sensors, Capacitive proximity sensors, Inductive proximity Sensors, optical proximity sensors, Pressure sensors, Resistive Temperature Detectors (RTDs), Thermocouples, Thermistors, Light Dependant Resistors (LDR) (Refer manufacturer's catalogue)			3

4	1	2	Select a suitable type of sensor used to recognize the Presence or absence of an object as they pass along a conveyor. Explain your choice and then draw a wiring diagram that shows how it will be wired to an appropriate PLC			4	Explain the importance of Flexible Manufacturing systems Explain the types of FMS <ul style="list-style-type: none"> • Single-machine cell • Flexible Manufacturing Cell • Flexible Manufacturing system • Dedicated FMS • Random Order FMS 	3		
4	1	3	Explain the Components of FMS <ul style="list-style-type: none"> • Work stations • Material Handling and Storage System • Computer control system Explain the FMS Layout Configuration <ul style="list-style-type: none"> • Inline Layout • Loop Layout • Open Field Layout • Robot Centered Cell 	4			You Tube Videos on FMS Systems + Discussion+ Report Writing			3
4	1	4	Explain an Overview on <ul style="list-style-type: none"> • AGV Guided Technology • AGV Management • AGV Safety Systems You Tube Videos on AGVs	2		2	Explain an Overview on <ul style="list-style-type: none"> • Automated storage/Retrieval systems • Components of AS/RS <ol style="list-style-type: none"> 1. Storage structure 2. S/R machine 3. storage modules (e.g., pallets for unit loads) 4. Pickup-and-deposit stations 		1	2
		5	CIE 2 – Written and Practice Test				Assessment Review and corrective action			3
4		6	Industrial Class + Industrial Assignment Industry Class on communication protocols in automation	2		3				

(Week 6):

6	5	1	1	Tutorial (Peer discussion on Industrial assignment)		4		Virtual tour on industrial Application of a Robot			3
	5	1, 2, 4	2	1.INTRODUCTION-Robotics, Industrial robot 2.Automation and robotics: Types of Automation 3.Reasons for implementation of automated systems in manufacture industries, need for using robotics in industries. 4.CAD/CAM & Robotics, Specifications of robotics	4			Explain the overview of Robots & Its Importance in Production system 1. Types of robots: Manipulators, Mobile robots- Wheeled & legged robots, Aerial robots. 2. Basic components of Robots: Base, Link & joint, Wrist, End effector, Actuator, sensor, Controller.	3		
	5	1, 2, 4	3	1.Configurations of robots – Articulated Robot, Polar configuration, SCARA, Cartesian Co-ordinate Robot, Delta Robot. 2. Wrist configuration 3. Work Volume 4. Degree of Freedom- Forward and Back, Up and Down, Left and Right, Pitch, Yaw, Roll	4			1. Joint Notation & Type of joints in robot- Linear Joint (L Joint), Orthogonal Joint (O Joint), Rotational Joint (R Joint), Twisting Joint (T Joint), Revolving Joint (V Joint) 2. Types of sensors used in industrial robot & their application- Tactile Sensor, Proximity Sensors, Optical Sensors, Other Sensors (Temperature, Pressure, Voltage, Current, Acoustics sensors etc.)	3		
	5	1, 2, 4	4	1.End Effectors- Grippers, Tools 2.Types of grippers 3.Factors to be considered for selecting a Gripper 4.Robotic Drives- Electric Drive, Pneumatic Drive, Hydraulic Drive	2		2	Explain the Robot Control systems- <ul style="list-style-type: none"> • Point- to Point control Systems • Continuous Path Control • Intelligent control 	1		2
	5		5	Developmental Assessment				Assessment Review and corrective action			3
	5		6	Industrial Class + Industrial Assignment Industry Class on smart manufacturing	2		3				

(Week 7):										
7	5	1, 2, 4	1	Tutorial (Peer discussion on Industrial assignment)		4		<p>Present a Robotic Coordinate system using a robot</p> <ul style="list-style-type: none"> • Joint co-ordinate system • Rectangular co-ordinate system • User or object coordinate system • Tool coordinate system. <p>Steps to define user co-ordinate system.</p> <ul style="list-style-type: none"> • Defining X, Y, Z co-ordinate system • Verifying co-ordinate system by multiple motion movements. 	1	2
	5	1, 2, 4	2	<p>Present an overview of the Robotic Cell</p> <ul style="list-style-type: none"> • Identify the Robotic Cell Components & Application tools 			4	<p>Perform Mechanical Installation check of robot</p> <ul style="list-style-type: none"> • Checking of proper installation of the safety sensors • Checking of Physical grouting of robot and other peripheral devices (cable trays, fences, fixtures, electric boxes etc.). 		3
	5	2, 4	3	<p>Perform Electrical Installation check of robot</p> <ul style="list-style-type: none"> • Checking of the electric connections- Earthing cable, power cable, Pneumatic pipes etc 	2		2	<p>Powering on the Robot and making the cell Healthy for programming</p> <ul style="list-style-type: none"> • Turning in the main supply to robot, turn on the stabilizers, Robot Controller. • Check the pneumatic clamps in fixtures, Grippers on robots. • Starting Up and Shutdown Steps in Robot • Check the Booting of the teach pendant 		3

	5	1, 2, 4	4	Demonstrate and practice Robot Programming Methods <ul style="list-style-type: none"> • Teach pendant Programming • Programming by using Languages • Offline Programming and Simulations 			4	Demonstrate and practice Robot Programming Methods <ul style="list-style-type: none"> • Teach pendant Programming • Programming by using Languages • Offline Programming and Simulations 			3
	5		5	CIE 3 – Written and Practice Test				Assessment Review and corrective action			3
	5	1, 2, 4	6	Industrial Class + Industrial Assignment Industry Class on Robotic Programing + Industry Assignment	2		3				
(Week 8):											
	5	2, 4	1	Tutorial (Peer discussion on Industrial assignment)			4	Able to work with Teach Pendant key functions & user interface for teach pedant <ul style="list-style-type: none"> • Run Teach mode: Play mode, Remote mode • Run Steps to define Tool co-ordinate system: • Run TCP (Tool center point definition). 			3
8	5	2, 4	2	Able to work with Teach Pendant key functions & user interface for teach pedant <ul style="list-style-type: none"> • Tool/ work object definition and their calibration • Creating user defined work objects • Create Box, circle, triangle work object definition • Multi-mode selection in virtual programming pendant 			4	Demonstration and practice of existing program & execution techniques <ul style="list-style-type: none"> • Understanding Robot Program Structure. • Different Motion Types used in Programming (PTP, Linear, Circular, Spline) Via Point and Process Points. 			3

	5	2, 4	3	Demonstration and practice of existing program & execution techniques Understanding Different Motion Parameters used in Program Point Recording			4	<ul style="list-style-type: none"> • Identify the program motion command movements • Practice on Teach table or fixture for all move commands 			3
	5	2, 4	4	1. Identify the program motion command movements 2. Practice on Teach table or fixture for all move commands			4	1. Identify the program motion command movements 2. Practice on Teach table or fixture for all move commands			3
	5		5	Developmental Assessment				Assessment Review and corrective action			3
	5	2, 4	6	Industrial Class + Industrial Assignment Industry Class on Robotic Programing + Industry Assignment	2		3				

(Week 9):

9	5	2, 4	1	Tutorial (Peer discussion on Industrial assignment) & Report Submission on mines visit.			4	Demonstrate and practice the Pick & Place Application commands used in material handling and its Parameters settings			3
	5	2, 4	2	Create a robot program for pick & place by using move commands	1		3	Create a robot program for pick & place by using move commands			3
	5	2, 4	3	Explain and Present the Arc Welding Application commands used in welding and also, weld Parameter's settings			4	Create a robot program for welding application			3
	5	2, 4	4	Create a Robot program for welding application			4	Create a Robot program for welding application			3
	5		5	CIE 4 – Written and Practice Test				Assessment Review and corrective action			3

	5	2, 4	6	Industrial Class + Industrial Assignment Industry Class on interfacing of Robots with peripheral devices	2		3			
(Week 10):										
10	5	2, 4	1	Tutorial (Peer discussion on Industrial assignment)		4		Simulate a welding program with the help of simulation software & compare the tool path with manual program	1	2
	5	2, 4	2	Simulate a welding program with the help of simulation software & compare the tool path with manual program	2		2	Simulate a welding program with the help of simulation software & compare the tool path with manual program		3
	5	2, 4	3	Execution of Welding process by using Robot <ul style="list-style-type: none"> • Selection of Welding tool for robot • Assembling of welding torch to manipulator. 			4	Execution of Welding process by using Robot <ul style="list-style-type: none"> • Identify the PLC and robot communication for communicate with HMI. • Build the conveyor system and its communication with PLC. 		3
	5	2, 4	4	Execution of Welding process by using Robot <ul style="list-style-type: none"> • Selection of welding source programming file • Adjust the Voltage and Amps rating Start ending and main conditions • Identify architecture of welding robot system • Power source connection with robot controller. 			4	Execution of Welding process by using Robot <ul style="list-style-type: none"> • Working using ARCON, ARCOFF. Working using WEAVON, WEAVOFF • Practical welding demonstration • Quality check of welding and improvement with changing weld parameters 		3

	5		5	Developmental Assessment				Assessment Review and corrective action			3
	5	2, 4	6	Industrial Class + Industrial Assignment Industry Class on prevailing Robot simulation software's	2		3				
(Week 11):											
11	5	2, 4	1	Tutorial (Peer discussion on Industrial assignment)		4		Execution of Welding process by using Robot <ul style="list-style-type: none"> • Practical welding demonstration • Quality check of welding and improvement with changing weld parameters 			3
	5	2, 4	2	Execution of Welding process by using Robot <ul style="list-style-type: none"> • Practical welding demonstration • Quality check of welding and improvement with changing weld parameters 			4	Simulate a Pick & Place program with the help of simulation software & compare the tool path with manual program			3
	5	2, 4	3	Simulate a Pick & Place program with the help of simulation software & compare the tool path with manual program			4	Simulate a Pick & Place program with the help of simulation software & compare the tool path with manual program			3
	5	2, 4	4	Execution of Pick & Place process by using Robot <ul style="list-style-type: none"> • Mounting the suitable Gripper on Robot Flange • List out gripper application in robot program & develop machine setting to assign the operation 			4	Execution of Pick & Place process by using Robot <ul style="list-style-type: none"> • Identify the basic Pick & Place Program structure in robot with the help of teach pendant • Creating a program of pick and place with the help of gripper. 			3

			<ul style="list-style-type: none"> • Interfacing Grippers to Robot using robot I/O • Interfacing Grippers to Robot using PLC I/O 				<ul style="list-style-type: none"> • Understanding HAND INSTRUCTIONS in Robot • Understanding HANDLING WINDOW in Robot • Low Air Pressure Interlock • Creating the program with gripper application Practice for program creation with gripper application			
5		5	Weekly Assessment CIE 5 – Written and Practice Test				Assessment Review and corrective action			3
5	2, 4	6	Industrial Class + Industrial Assignment Industry Class on prevailing Robot simulation software's	2		3				

(Week 12):

12	5	2, 4	1	Tutorial (Peer discussion on Industrial Visit) & report submission on Industry visit		4		<ul style="list-style-type: none"> • Creating the program with gripper application • Practice for program creation with gripper application 			3
	5	2, 4	2	<ul style="list-style-type: none"> • Creating the program with gripper application • Practice for program creation with gripper application 			4	Simulate a spray-painting program with the help of simulation software & compare the tool path with manual program	1		2
	5	2, 4	3	Simulate a spray-painting program with the help of simulation software & compare the tool path with manual program	2	2		Execution of spray-painting process by using Robot <ul style="list-style-type: none"> • Mounting the suitable Gripper on Robot Flange 			3

								<ul style="list-style-type: none"> List out gripper application in robot program & develop machine setting to assign the operation 		
5	2, 4	4	Execution of spray-painting process by using Robot <ul style="list-style-type: none"> Identify the basic spray-paint Program structure in robot with the help of teach pendant Creating a program to spray-paint with the help of gripper. Understanding HAND INSTRUCTIONS in Robot Understanding HANDLING WINDOW in Robot 			4	Execution of spray-painting process by using Robot <ul style="list-style-type: none"> Identify the basic spray-paint Program structure in robot with the help of teach pendant Creating a program of spray-paint with the help of gripper. 			3
5		5	Developmental Assessment				Assessment Review and corrective action			3
5	2, 4	6	Industrial Class + Industrial Assignment Industry Class on prevailing Robot simulation software's	2		3				

(Week 13):

Student can choose either Internship/ Project

13			Internship a) Secondary research on various industries and their operations to identify at least 3 companies along with the areas of work interest and develop an internship plan that clearly highlights expectations from the industry during the internship. b) Design and develop a cover letter for an internship request to all 3 identified companies and the resume to be submitted to potential companies.				Project: a) Identification of the problem statement (from at least 3 known problems) the students would like to work as part of the project – either as provided by faculty or as identified by the student. Document the impact the project			40Hrs
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			<p>c) Prepare for an internship interview to highlight your interests, areas of study, career aspirations and personnel competence – including the areas of learning you expect to learn during internship.</p>	<p>will have from a technical, social and business perspective.</p> <p>b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified.</p> <p>c) Prepare a project plan that will include a schedule, WBS, Budget and known risks along with strategies to mitigate them to ensure the project achieves the desired outcome.</p>	
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References

Sl. No	Description
1	Programmable logic Controllers By W. BOLTON
2	Digital electronics By FLYOD
3	Automation , Production systems and Computer integrated Manufacturing By MIKELL GROOVER
4	Sensors Hand book-SABRIE SOLOMAN-MC-GRAW HILL publications
5	Electric Motors and Drives BY AUSTIN HUGHES and BILL DRURY
6	Exploring PLC with applications By PRADEEP KUMAR SRIVATSAVA
7	Hand book of Modern Sensors” Physics , Designs and Applications- JACOB FRADEN-Springer Publications
8	Automating Manufacturing Systems with PLC by Hugh Jack
9	Thomas Braunl, Embedded Robotics: Mobile Robot Design and Application with Embedded Systems, 2nd ed., Springer, 2006.
10	John M. Holland, Designing Autonomous Mobil Robots: Inside the Mind of an Intelligent Machine, Newnes, 2003.
11	Industrial Robotics technology, programming and Application by Mikelle P Groover
12	Springer Handbook of Automation by Shimon Y. N

TRANSPORT MANAGEMENT AND MOTER VEHICLE ACT

Course Code-

L:T:P

I. RATIONALE

This course enables students to understand the transportation system as a whole, including the various modes of transportation, their advantages and disadvantages, and how they work together. Transport Management provides knowledge of government rules, regulations and standards, essential for those entering the transportation industry. The transport industry offers excellent employment opportunities for Automobile Diploma Engineers, such as service engineers, fleet managers, depot managers, and insurance surveyors etc. To excel in these roles, they require in-depth knowledge of the Motor Vehicle Act, taxation, insurance, record-keeping, vehicle estimation and valuation, standard operating procedures, and effective driving skills. This knowledge is crucial for developing transport- related policies, ensuring safety regulations, and meeting environmental and legal standards while providing quality services.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply legal aspects related to motor vehicle act in effective transport management.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following Cos on completion of course based learning

CO1 – Interpret the Motor Vehicle Act and Traffic Rules

CO2 – Implement concept of Taxation and Insurance in vehicle

registration CO3 – Manage the business processes involved in buying and selling vehicles

CO4 – Select suitable mode of transportation and vehicle according to specific requirements

CO5 – Distinguish the role of various research organizations in technological advancements and innovations in the motor industry

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Unit	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Hours
1	<p>Unit – I Introduction to Motor Vehicle Act</p> <p>1.1 Transport systems in ancient India: Trade logistics (IKS)</p> <p>1.2 Motor Vehicle Act: Brief description, Short titles and Definitions of terms used.</p> <p>1.3 Licensing of Drivers and conductors of Motor Vehicle: a) Driver's Licence – Necessity, Eligibility criteria, Documents required, or's Licence, Power to disqualify conductor's licence, Renewal of conductor's licence. C) Duties and responsibilities of driver and co Procedure to obtain Learner's Licence and Permanent Driving Licence, Driving Test, Validity and Renewal of driving licence, Restriction on use of learner's licence as a driving licence, Addition of class to the driving licence, Suspension or cancellation of driving licence. B) Conductor's License – Necessity, Eligibility criteria, Application for grant of conductor's licence, Revocation of Conductor's Licence, Power to disqualify conductor's licence, Renewal of conductor's licence. C) Duties and responsibilities of driver and conductor.</p> <p>1.4 Registration of Vehicles: Necessity of registration, Exemption from registration, Procedure of registration of motor vehicles, Display of Registration mark, Validity of certificate of registration, Renewal of registration, Temporary registration, Transfer of Ownership of Motor Vehicle, Suspension and cancellation of registration.</p> <p>1.5 Offences, Penalties and Procedures: - Regarding driving of vehicle and violation of laws.</p> <p>1.6 Transport Authorities and Control of Transport: a) Transport authorities and their functions, motor vehicle department Maharashtra, b) Necessity of Permits, Types of Permit –Stage Carriage Permit, Contract Carriage Permit, Private Service Vehicle Permit, Goods Carriage Permit, Tourist permit, National Permit, Temporary Permit, Exemption from Permit</p> <p>1.7 Control of Traffic: Traffic Signs and Signals, Vehicle navigation system, vehicle tracking system, Advance traffic control devices, intelligent transport system, Smart card.</p>	

Unit	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Hours
2	<p>Unit – II Construction of Motor Vehicle, Taxation and Insurance</p> <p>2.1 Construction of Motor Vehicle: Overall dimensions, General provision regarding construction and maintenance of motor vehicle, Power of state and central government to make rules.</p> <p>2.2 Taxation: Objectives, Basis of taxation, Methods of levying tax to motor vehicle, Tax structure for motor vehicles in Maharashtra, Modes of payment of the tax, Tax exemption, Refund of tax.</p> <p>2.3 Insurance: Types of Motor Vehicle insurance – Comprehensive and Third-Party insurance, Procedure to claim compensation, Motor Accident Claim Tribunal, Liability without fault in certain cases, Provision of compensation in Hit and Run case.</p>	
3	<p>Unit – III Estimation and Valuation of Vehicle</p> <p>3.1 Role of surveyor: Eligibility for surveyor, Procedure to obtain surveyor's licence, Duties and responsibilities of Surveyor.</p> <p>3.2 Procedure of accident survey and valuation of vehicle, Claim investigation and Accident Survey Report.</p> <p>3.3 Importance of warranty system and protection of law.</p> <p>3.4 Buying a new vehicle: Factors to be considered – Ex-showroom price and on road price, use of vehicle, when and where to buy.</p> <p>3.5 Buying used vehicles: When and where to buy – Dealers, used car firms, Private sellers, Garages, Auctions.</p> <p>3.6 Sale of used vehicles: Procedures – Before, During and after sale of vehicle, Auctions, Garages, Private sale, preparing the vehicle documents, selling price.</p>	

Unit	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Hours
4	<p>Unit – IV Passenger and Goods transport operation.</p> <p>4.1 Terms used in transportation: Transport vehicle, Public service vehicle, Goods vehicle, Public place, Depot, Route, Trip, Crew, Time table, Vehicle schedule, Fare, Freight charges.</p> <p>4.2 Modes of transportation and comparison of urban and rural transport.</p> <p>4.3 Basic elements in Transport Management – Market Potential, Selection of vehicle, Organization setup, Legal compliance, Policies of transport organization towards Passenger and employee service.</p> <p>4.4 Bus and Crew scheduling: Basic factors in bus, crew (staff) scheduling.</p> <p>4.5 Bus depot layout: Site selection for depot, Layout, Passenger amenities and infrastructural facilities required.</p> <p>4.6 Fare and Freight charge calculation in transport organization.</p> <p>4.7 Record Keeping: Log book, Trip operational sheet, Vehicle ledger, Truck history card, Monthly operational sheet, Goods consignment note, Types of bookings.</p>	
5	<p>Unit – V Motor Transport and Research organizations</p> <p>5.1 Structure and working of Transport Organizations – MSRTC, BEST</p> <p>5.2 Functions and Role of Research Organizations: Central Institute of Road Transport (CIRT), Automotive Research Association of India (ARAI), Vehicle Research Development and Establishment (VRDE), Central Road Research Institute (CRRI), Petroleum Conservation and Research Association (PCRA).</p>	

V. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Prepare a report on registration Process of Motor Vehicle – Steps involved in registration process of given class of motor vehicle.
- Modern traffic management: Case study of implemented modern traffic management system.
- Prepare a report on transfer of ownership: Formalities involved in the given case of transfer of ownership (Examples- Within state/region, Interstate, Class of vehicle, change of owner)
- Transport Organization Management: Prepare a case study report on passenger transport organizations
- Visit Saarthi website to prepare a report on faceless services available on motor vehicle department Maharashtra containing relevant application forms and required documents
- Prepare a visit report on Central Institute of Road Transport/ Automotive Research Association of India/Vehicle Research Development and Establishment/Central Road Research Institute/ Petroleum Conservation and Research Association.
- Prepare a record of forms required for the different activities carried out in transport industries.
- Prepare an accidental survey report for accidental vehicle.
- Prepare a report on various e-platforms used in motor vehicle department.
- Prepare a case study on goods transport organizations like VRL logistics Ltd., GATI, TCI, CONCOR etc.
- Prepare a case study on app-based taxi/ rikshaw services.

VI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned Cos	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Motor Vehicle Act	CO1	16	2	8	10	20
2	II	Construction of Motor Vehicle, Taxation and Insurance	CO2	6	2	4	6	12
3	III	Estimation and Valuation of Vehicle	CO3	6	2	4	6	12
4	IV	Passenger and Goods transport operation.	CO4	8	2	8	6	16
5	V	Motor Transport and Research organizations	CO5	4	2	4	4	10
Grand Total				40	10	28	32	70

VII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Ministry of Transport, Government of India	Central Motor Vehicle Rules 1989	Government of India
2	KLR Publications	The Motor Vehicles Act, 1988 (Bare Act) With Notes	Karnataka Law Reporter Publications
3	Dr.L.P.GUPTA	Insurance Claims Solutions	2016 th edition (1 January 2013) ISBN-13 978-9383303038
4	Government of India	Annual Report:Motor Vehicle Accident Fund & Compensation to Victims of Hit and Run Motor Accidents Scheme, 2022	Motor Vehicle Accident Fund Trust General Insurance Council
5	IRDA	Insurance Act,1938 – incorporating all amendments till 2021	Insurance Regulatory and Development Authority of India(IRDAI)
6	Sudarsanam Padam	Bus Transport in India: The Structure, Management and Performance of Road Transport	South Asia Books, ISBN-13 978-8120202221
7	G. John Gunaseelan	Public Sector Road Transport Corporation A Comparative Study with Private Sector	Deep & Deep Publications ISBN-13 978-8176290814

VIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://morth.nic.in/	Ministry of road transport and highways
2	https://parivahan.gov.in/parivahan/	Intelligent Transport Systems
3	https://parivahan.gov.in/parivahan//node/2702	motor vehicle related services by transport department of government of India
4	https://parivahan.gov.in/parivahan//node/2697	Tourist Permit
5	https://parivahan.gov.in/parivahan//node/2699	Intelligent Transport Systems
6	https://transport.maharashtra.gov.in/1035/Home	Motor vehicle related services in Maharashtra state
7	https://parivahan.gov.in/parivahan//node/2702	Next generation mParivahan
8	https://parivahan.gov.in/parivahan//node/2700	Vehicle location tracking system
9	https://parivahan.gov.in/parivahan//node/2696	BH series
10	https://irdai.gov.in/	motor vehicle insurance related services

CONSTRUCTION AND EARTH MOVING EQUIPMENT

Course Code-

L:T:P

Introduction:

Welcome to the curriculum for the Specialisation Pathway – **Construction and Earthmoving Equipment**. This specialisation course is taught in Bootcamp mode. Bootcamps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur.

Earthmoving equipment is heavy duty vehicle outlined to perform constructional and mining operations which requires earthworks. The Asia-Pacific has the huge global market share of about two fifth of the global market for earthmoving equipment, which is followed by North America and Europe. Raising urban population demands for better facilities are proving greater opportunity for construction and mining industry, which in turn increases the demand for heavy machines like earthmovers, especially in developing countries such as India and China. In this course the student will be exposed to build, troubleshoot and maintain the hydraulic systems of the earthmovers, Selection of right type of earthmovers based on the requirement, service and maintenance of different earth moving equipment and also to troubleshoot hydraulic components of the earthmovers.

You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to build, troubleshoot and maintain the hydraulic systems of the earthmovers, Selection of right type of earthmovers based on the requirement, service and maintenance of different earth moving equipment and also to troubleshoot hydraulic components of the earthmovers.

Leading to the successful completion of this bootcamp, you shall be equipped to either do an **Internship** in an organisation working on **Construction and Earthmoving Equipment** or take up a **Project** in the related field. After the completion of your Diploma, you shall be ready to take up roles like Service Engineer, Shopfloor Manager, Production In-charge and also can become Entrepreneur in the related field and more.

Pre-requisite

Before the start of this specialisation course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Drawing, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Mechanical Science & Engineering and Automotive Engines.

2nd year-Automobile Chassis and Transmission System, Automotive Electrical System, Thermal Engineering and Engine Testing, Automotive Manufacturing Processes, Advanced Automotive

Systems, Design and Drafting, Vehicle Body Engineering and Dynamics and Fuel and Pollution Control. In this year of study, you shall be applying your previous years learning along with specialised field of study into projects and real-world applications.

Instruction to the Course coordinator:

1. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. One faculty from the Core Discipline shall be the Cohort Owner, who for teaching and learning in allied disciplines can work with faculty from other disciplines or industry experts.
3. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.
4. The Industry Class shall be addressed by Industry experts (in contact mode/online / recorded video mode) in the discipline only.
5. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial/mines/site visits.
7. Cohort owner shall maintain and document the industrial assignments, weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom teaching can augment or use for supplementary teaching online courses available through reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM, etc.
10. Report should be maintained for industrial/field visit, such report shall be considered as industrial assignment.

Course outcome:

At the end course the student will be able to

1. Select the right equipment by analyzing different criteria, perform cost Estimation and analysis of the earthmovers based on given criteria.
2. Build the hydraulic and Pneumatic circuits manually and through any open-source simulation software.
3. Trouble shoot and service the hydraulic system, steering system, Brakes, under carriage and suspension system of earthmovers.
4. Troubleshooting/ servicing of different mining truck, Industrial truck, Material handling and other construction equipment's.

Detailed course plan

Learning outcomes (Week 1):

At the end of the week the students will be able to:

1. Understand, explain various types of equipment's to be used in the constructions projects and different Earth Moving Operations.
2. Estimate and plan the operating and ownership cost of the equipment.
3. Perform comparative cost analysis for owning and operating heavy equipment
4. Analyse Depreciation, Replacement cost of the equipment and Maintenance & safety Management

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	1	3	1	<ul style="list-style-type: none"> • About Specialization – Future • Companies and Service sectors in India and outside India along with their location • Career opportunities. 	4			<ul style="list-style-type: none"> • About Earth moving equipment- History- Importance- with an Example of a company (like Caterpillar, TATA Hitachi, L&T Komatsu/Ajax/BEML/Eicher, JCB....) • Brief how the need for construction equipment evolved. 	2	1	
			2	Fundamentals of Earth Work Operations: <ul style="list-style-type: none"> • Earth Moving Operations- Application. • Difference between Construction and Mining process/operation. • Types of Earth Work Equipment. • Mining Equipment – Types, application, load carrying 	4			Constructional & earth moving equipment – Types, application, load carrying capacity – motor graders, loaders, cranes, conveyors and rollers. https://www.youtube.com/watch?v=Ev1wa0wRpqk https://www.youtube.com/watch?v=79esC_pkrEs	3		

			capacity – excavators, power shovels, bulldozers and mining trucks.							
	3	Construction equipment’s Planning and management: <ul style="list-style-type: none"> • Planning process of Equipment Criterion for Selection of equipment: <ul style="list-style-type: none"> • Selection of machines based on type of soil • Haul distance • Weather condition 	4			Soil Stabilization Methods and Equipment for: <ul style="list-style-type: none"> • Compaction • Additives • Dewatering • Freezing. Maintenance Management	3			
	4	<ul style="list-style-type: none"> • Equipment costs • Ownership cost • Operating cost • Safety Management. • Using right power tools for right job • Vehicle usage register for tracking • <i>Estimation of Ownership cost- (Practice Using spreadsheets)</i> 	2		2	<ul style="list-style-type: none"> • Estimation of -Cost of Operating Constructional Equipment – (<i>Practice Using Spread sheet</i>) 			3	
	5	Developmental Assessment			4	Assessment Review and corrective action	-		3	
	6	Industrial Class + Industrial Assignment Industry Class on Planning and Management of construction Construction equipment	2		3					

				or Talk on requirement of earthmoving equipment and their scope by the Earthmover manufacturing company							
Learning outcomes (Week 2): At the end of the week the student will be able to: <ol style="list-style-type: none"> 1. Explain purpose, applications, types, construction and working of different Hydraulic components of like actuators, Valves, Pumps. 2. Determine the coefficient of discharge through experiments. 3. Build the hydraulic circuits manually/ through automation studio Note: Use Hydraulic circuit rig up/ Automation studio/ Using Pneumatic circuit rig up/ Video Demonstration any of the above in Practical classes											
2	2	1,2,4	1	Tutorial (Peer discussion on Industrial assignment)	-	4	-	<ul style="list-style-type: none"> • Depreciation Analysis, Replacement analysis. <i>(Practice Using Spread sheets draw the graphs)</i> 	2	1	
			2	Hydraulics System: 1. Leading Industries of hydraulics system used for earthmovers. https://www.youtube.com/watch?v=YrYdZ6J8QxI 2. Hydraulic system used in different types of earthmovers. 3. Fluid- Properties of fluid with definition & formula. Pascal's law. Methods of Transmission of power. 4. Fluid power system, Symbols of various Hydraulics & Pneumatic elements.	3		1	Hydraulic pumps: 1. Basic components of hydraulic systems like pumps - Types of pumps- Rotary Pumps, Reciprocating Pumps, Positive displacement flow pump. 2. <i>Illustration of Pascal's Law (P)</i>	1		2
			3	Hydraulic Valves: 1. Function of Control Valves, Classification of Control valves.	3	1		1. Application (and working) of flow control valves- Non return valve- pilot operated sequence valve, Sequence valve.	2		1

				2. Application (and working) of: directional control valves- Sliding spool type, Rotary spool type, 2/2, 3/2, 4/2, 5/2, 5/3, Poppet valve.				2. Hydraulic accumulator.			
			4	. Application and working of Pressure control valves- Pressure relief valve- Pressure reducing valve	2		2	Actuators: Application and working of different types of hydraulic components like actuators: cylinder type-ram type and piston type- single acting cylinder, double acting cylinder.	1		2
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	Industrial Class + Industrial Assignment Industry Class on: Hydraulic System used in earthmovers and need for hydraulic system in earthmovers. Or Talk on any one type of earthmovers showing its complete hydraulic system.	2		3				

Learning outcomes (Week 3):

At the end of the week the student will be able to:

1. Explain purpose, applications, types, construction and working of different Pneumatic components.
2. Build the hydraulic circuits / Pneumatic circuits manually or through automation studio
3. Perform maintenance of different components of hydraulic and pneumatic system.

Note: Use Hydraulic circuit rig up/ Automation studio/ Using Pneumatic circuit rig up/ Video Demonstration any of the above in Practical classes

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
3	2	1,4	1	Tutorial (Peer discussion on Industrial assignment)		4		Application and working of : Rotary actuators- Gear- vane- piston- Unidirectional – Bidirectional actuators.	2	1	

			2	1.Oil reservoir- Parts of reservoir. 2. Basic Hydraulic circuits: <i>Control of a Hydraulic cylinder- Single acting hydraulic cylinder, Double acting hydraulic cylinder.</i>	1		3	Building and Demonstration of <i>Regeneration Circuit</i>	1		2
			3	Building and Demonstration of <i>Flow control system: Meter-in, Meter-out, Bleed-off circuits.</i>	1		3	Building and Demonstration of <i>Accumulator Circuit: Accumulator as a shock absorber.</i>	1		2
			4	Building and Demonstration of Accumulator Circuit: 1. <i>Accumulator as an auxiliary power source.</i> 2. <i>Accumulator used for leakage compensator.</i>	1		3	<i>Building and Demonstration of Pressure reduction Circuits.</i>	1		2
			5	CIE 1 (Written and Skill test)				Assessment Review and corrective action			3
			6	Visit any earthmover service center or showroom Note-down different type of hydraulic system used in different type of earthmover.			5				
Learning outcomes (Week 4):											
At the end of the week the student will be able to:											
1. Draw the hydraulic circuits, simulate and analyze the working of hydraulic and pneumatic systems.											
4	2	3	1	Tutorial (Peer discussion on Industrial Visit), Report submission on visit.		4		1.Practice on <i>Control of actuators by simple hydraulic circuits.</i> 2.Port Markings - ports and positions			3

			2	Maintenance of hydraulic system: Its common faults - <i>visual checks of oil-causes of contamination- preventive measures – maintenance schedule.</i>			4	Drafting and Simulation using any opensource simulation software: <i>Introduction to simulation software and tools. (Any simulation open software)</i> Practice on software tools			3
			3	<i>Practice on software tools</i>			4	<i>Using software tools: Hydraulic circuit drawing, hydraulic piping drawing</i>			3
			4	Building of oil power fluid circuits (software): <i>Control of a hydraulic cylinder</i>			4	Using software tools Building of: <i>Pump unloading circuit.</i>			3
			5	Developmental Assessment				Assessment Review and corrective action		3	
			6	Industry Class on Use of the simulation software to develop hydraulic circuits in earthmoving equipment Industry. Or Any relevant topic on uses of simulation software in automobile industry	2		2	Weekly Assignment(1PM-2PM)			1

Learning outcomes (Week 5):

At the end of the week the student will be able to:

1. Review the Engine and other features related to engine.
2. Trouble shoot and service the steering system of earth moving vehicles.

Demonstrate the Controls of the shovel

5	3	1,2,4	1	Tutorial (Peer discussion on Industrial assignment)		4	Using software tools Building of: <i>Hydraulic cylinder sequencing circuit.</i> Build combination circuit (using Any simulation software.)	2		1
			2	Steering System in earthmovers: 1.Power steering - linkage or semi- integral type - integral power steering	2	2	1. <i>Steering fault finding and remedies</i> 2. <i>Checking/ Inspection of Steering mechanism and necessary repair.</i>			3

			<p>2. Steering of tracked vehicles - Skid steering - clutch /brake steering system- construction and working</p> <p>3. Planetary steering system - construction and working.</p> <p>4. Differential steering system - construction and working of each type.</p> <p>5. Articulated steering– construction & working.</p>							
		3	<p>Power shovels:</p> <p>1. Introduction to power shovels and its basic parts- Specifications.</p> <p>2. Types and sizes of power shovels.</p> <p>3. Selecting the <u>Types and Size of Power shovels.</u></p> <p>4. Optimum Depth of Cut.</p>	2		2	<p><u>Factors affecting the output of power shovel-</u></p> <ul style="list-style-type: none"> • Class of material. • Depth of cut. • Angle of swing. • Job conditions. • Management condition. • Size of hauling units. • Skills of operator. • Physical condition of the shovel 	2		1
		4	<p>Shovel Controls:</p> <ul style="list-style-type: none"> • <i>Typical control</i> • <i>Bucket controls.</i> • <i>Operating mechanism of the bucket in the power shovel.</i> • <i>Pedals</i> 			4	<p>Operation of Power shovel-</p> <ul style="list-style-type: none"> • Planning to Work, • Filling the Bucket, • filling the Bucket from a Stockpile, • To Fill a Bucket When Digging and Loading on Level Ground, • Transporting with a full Bucket, • loading a Truck 	1		2
		5	CIE 2 (Written and Skill test)	1		3	Assessment Review and corrective action			3

			6	Industrial Class + Industrial Assignment Industry Class on Engines/ Braking system/ Steering system/ Rear axle / Tyres & Track in earthmovers.	2		3			
Learning outcomes (Week 6): At the end of the week the student will be able to: 3. Explain the specification, attachments, working of the power Shovel. 4. Troubleshoot/ Service the different parts of the power shovel.										
6	4	1,2,4	1	Tutorial (Peer discussion on Industrial assignment)		4		Operation of Power shovel- <ul style="list-style-type: none"> • Levelling and Pushing operations • Traveling on Sloping Ground https://www.youtube.com/watch?v=tldOKQiMvAk	1	2
			2	Pre-operational checks and maintenance of power shovel – <ol style="list-style-type: none"> 1. Tyres and wheels- Practice on wheel changing 2. Checking Lubrication and hydraulic system 3. Checking Oil levels – engine sump, transmission and differential case 		4	Pre-operational checks and maintenance of power shovel – <ol style="list-style-type: none"> 1. Hydraulic oil level reservoir. 2. Engine coolant level 3. Air filter and air intake 4. Fan belt 5. Battery condition 		3	
			3	1.Start- up and shut-down procedures of shovel.		4	Fitting and removal of attachments– <ul style="list-style-type: none"> • Front Attachment- General purpose excavating bucket, General purpose (operation)penetration bucket, Multipurpose bucket. 		3	

				2.Adjusting working attachment for correct functioning during field operation.							
			4	Fitting and removal of attachments– <ul style="list-style-type: none"> Rear attachments- Augers, Grabs, Rippers Fitting and remove common attachments- Front attachment, Rear attachment.			4	1. OLSS in shovel- Circuit diagram, Working, Advantages. 2. Trouble shooting of Hydraulic circuits.	1		2
			5	Developmental Assessment			4	Assessment Review and corrective action			3
			6	Industrial Class + Industrial Assignment Industry Class on OLSS system in power shovel Or On any topics related to power shovel	2		3				

Learning outcomes (Week 7):

At the end of the week the student will be able to:

1. Explain the specification, attachments, working of the excavator.
2. Troubleshoot/ Service the different parts of the excavator.

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
7	4	1,2,4	1	Tutorial (Peer discussion on Industrial assignment)		4		Excavators: 1. Excavators – Types- Specifications - Working principle 2.Parts & attachments (outline drawing), working of each part and attachment.	1		2
			2	Engine – EGR system (Servicing and troubleshooting)	1		3	1. Power train, Final drive, swing circle.	1		2

							3. Demonstrate the <i>Swing gear and bearing maintenance</i> . https://www.youtube.com/watch?v=iZbFTa_4Sc https://www.youtube.com/watch?v=gKUrPUB0eXQ (Swing bearing replacement)				
			3	1.Perform <i>Pre- operational Inspection</i> . 2. Demonstrate the <i>Operating procedure of excavator</i> .			4	1.Excavator lifting attachments, lifting operation, lifting capacity. https://www.youtube.com/watch?v=VUhWXtiEUII https://www.youtube.com/watch?v=41Qb4bDrjmU 2.Hydraulic system- CLSS, OLSS 3.closed-centre load sensing system (CLSS) in excavators- Circuit diagram, Working, Advantages.	3		
			4	<i>Servicing of hydraulic system in excavator.</i>	1		3	<i>Servicing of hydraulic system in excavator.</i>			3
			5	CIE-3 (Written and Skill test)				Assessment Review and corrective action			3
			6	Industrial Class + Industrial Assignment Industry Class on CLSS system in excavators Or On any topics related to excavators	2		3				

Learning outcomes (Week 8):

At the end of the week the student will be able to:

1. Troubleshoot/ Service the different parts of the excavator.

8	4	2,4	1	Tutorial (Peer discussion on Industrial assignment)		4		1. Excavator bucket: <ul style="list-style-type: none"> • Types- Rock, General purpose- Construction • Bucket teeth options • Common Blade type. 2. Operating mechanism of bucket in excavator. https://www.youtube.com/watch?v=mFsbdMioawM https://www.youtube.com/watch?v=rFsA3Nf93fs	2		1		
			2	Excavator bucket capacity- <ol style="list-style-type: none"> 1. Different capacities/ types 2. Bucket capacity calculation based on the purpose of job the excavator is used. 3. Identification of the capacity of the bucket by looking into its model no. of the vehicle (Ex. Get a brochure of L&T Komatsu Excavator if in Model no. is PC130 then what does 13 mean). 4. Track frame and shoe 	2	1	1	1	Servicing of bucket, frame, swing.			3	
			3	Practice on <i>Under Carriage Track adjustment</i>			4		4	Practice on changing the track/ Remove and refit Track chain assembly. https://www.youtube.com/watch?v=1vclSITTqI0			3
			4	<i>Adjusting working attachment for correct functioning during field operation.</i>			4		4	Maintenance and Regular check-up of excavators https://www.youtube.com/watch?v=-9qdCjSgJ-8			3

			5	Developmental Assessment			4	Assessment Review and corrective action		3	
			6	<i>Construction site Visit</i>			5				

Learning outcomes (Week 9):

At the end of the week the student will be able to:

1. Explain the specification, attachments, working of the Bull Dozer.
2. Troubleshoot/ Service the different parts of the Bull Dozer.

9	4	2,4	1	Tutorial (Peer discussion on Industrial assignment) & Report Submission on mines visit.		4		Bull-Dozer: 1. Dozer parts and functions-Types-Working/Operation of each type-Specification. 2. Bulldozer blades- types-Explanation. 3. Rippers- types-Explanation	3		
			2	1. Operating procedure of Bull dozer. 2. Types of Dozer attachments and blades- Front attachments, Rear attachments.	3		1	1. Demonstrate Dozer Controls- typical control, bucket controls. 2. Controlling the blades			3
			3	1. Demonstrate Adjustment of the blades- angle adjustment, Tilting adjustment.			4	<ul style="list-style-type: none"> • Adjusting working attachment for correct functioning during field operation. 			3
			4	Demonstrate Adjusting the track-undercarriage.			4	Demonstrate Adjusting the track-undercarriage.			3
			5	CIE-4 (Written and Skill test)	1		3	Assessment Review and corrective action			3
			6	Industrial Class + Industrial Assignment Industry Class on: Any topic related to Bull Dozer.	2		3				

Learning outcomes (Week 10):

At the end of the week the student will be able to:

1. Troubleshoot/ Service the different parts of the Mining truck. 2. Review a given Fault Codes to determine the faults in the mining truck											
10	4	2,4	1	Tutorial (Peer discussion on Industrial assignment)		4		Mining truck: <ul style="list-style-type: none"> • Mining trucks – Types- Specifications - Working principle (outline drawing). • Truck capacity calculation • Guidelines for reducing the vibrations in earthmoving equipment. 	1		2
			2	<ul style="list-style-type: none"> • Operational restrictions on the dumper trucks. • Articulation lock • <i>Understand the Fault Codes to determine the faults in the mining truck.</i> 	2		2	Mining truck repair & maintenance: <ul style="list-style-type: none"> • <i>Battery maintenance</i> • <i>Lubricating system</i> 			3
			3	Mining truck repair & maintenance: <ul style="list-style-type: none"> • <i>Steering system troubleshooting</i> • <i>Rear axle and front axle</i> 			4	Mining truck repair & maintenance: <i>Transmission system service & troubleshoot</i>			3
			4	Mining truck repair & maintenance: <ul style="list-style-type: none"> • <i>Hydraulic System</i> 			4	Mining truck repair & maintenance: <ul style="list-style-type: none"> • <i>Braking system</i> 			3
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	Industrial Class + Industrial Assignment Industry Class on:	2		3				

				Any topic related to Concrete mixing truck. Or Any topic related to Rollers and finishing equipment.							
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Learning outcomes (Week 11):

At the end of the week the student will be able to:

1. Review a given Fault Codes to determine the faults in the Industrial truck.

1. Troubleshoot/ Service the different parts of the Industrial truck.

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
11	4	2, 4	1	Tutorial (Peer discussion on Industrial assignment)		4		Industrial Trucks: <ul style="list-style-type: none"> Understand the Fault Codes to determine the faults in the truck. Repair and maintenance. 			3
			2	Practice on Tyre maintenance- Replacement of the tyre.			4	Practice on Steering system troubleshooting			3
			3	Repair and maintenance of truck			4	Repair and maintenance of truck			3
			4	MATERIALS HANDLING EQUIPMENT: <ul style="list-style-type: none"> Forklifts and related equipment—Need, Parts, Structure Repair and maintenance. 	1		3	Repair and maintenance of forklifts			3
			5	CIE-5 (Written and Skill test)				Assessment Review and corrective action			3
			6	Showroom/Service station visit			5				

Learning outcomes (Week 12):

At the end of the week the student will be able to:

1. Repair and maintenance of material handling equipment's.

2. Explain different types of construction equipment other than hauling equipment's.

12	4	2, 4	1	Tutorial (Peer discussion on Industrial Visit) & report submission on Industry visit		4		Material Handling Conveyors- types – Material Handling Cranes- -- <i>Repair and maintenance of conveyors and cranes.</i>	1		2	
			2	<i>Repair and maintenance of conveyors and cranes.</i>			4		<i>Repair and maintenance of conveyors and cranes.</i>	1		2
			3	OTHER CONSTRUCTION EQUIPMENT: Operating methods and working of <ul style="list-style-type: none"> • Crane • Mobile crane • Equipment for Dewatering and Grouting • Equipment for demolition. • Under water concreting equipment 	2		2	1.Operating methods and working of <ul style="list-style-type: none"> • Equipment for Dredging • Trenching • Drag line and clamshells 2.Operating methods and working of <ul style="list-style-type: none"> • Tunnelling • Equipment for Drilling and Blasting • Pile driving Equipment • Erection Equipment 	2	1		
			4	Aggregate production <ul style="list-style-type: none"> • Different Crushers • Feeders • Screening Equipment • Handling Equipment Batching and Mixing Equipment	2		2	Videos on different types & application of <ul style="list-style-type: none"> • Materials handling equipment • Other construction equipment 			3	

			<ul style="list-style-type: none"> • Pumping Equipment • Ready mix concrete equipment • Concrete pouring equipment 						
		5	Developmental Assessment				Assessment Review and corrective action		3
		6	Construction site visit/ Mines visit		5				

REFERENCES:

Sl. No	Description
1	Deodhar, S.V. “Construction Equipment and Job Planning” , Khanna Publishers, New Delhi,1988.
2	“Construction Machines: Excavators” by Murray Julie, North Star Editions
3	“Excavators” by Marcos Victoria, Publisher: Xist Publishing
4	Power Shovels: The World's Mightiest Mining and Construction Excavators by Eric C Orlemann, Publisher : MBI (August 12, 2003)
5	Fluid power Engineering by RK Hegde & Niranjana Murthy
6	Construction Machines: Dump Trucks by Murray Julie, Publisher: North Star Editions
7	Fluid power transmission and control system by P.G. Mudas
8	Construction Planning, Equipment, and Methods, 9th Edition, Publication Date & Copyright: 2018, McGraw-Hill Education By Robert L. Peurifoy, P.E., Clifford J. Schexnayder, P.E., Ph.D., Robert L. Schmitt, P.E., Ph.D., Aviad Shapira, D.Sc.
9	Oil Hydraulic System By S R Majumdar.

AUTOMOBILE BODY ENGINEERING AND SAFETY

Course Code-

L:T:P

I. RATIONALE

This course equips students with essential knowledge and skills in Vehicle Body Technology, preparing them for significant employment opportunities in auto service stations and body building workshops. As supervisors or self-employed technicians, diploma holders are expected to fabricate and repair various vehicle bodies. Mastery in vehicle body technology and safety is crucial for managing these tasks. With the rapid growth in auto body field, including advancements in materials, repair systems, and enhanced safety features, there is a high demand for well-trained technicians.

II. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select an appropriate auto body for a given application.
- CO2 - Choose relevant materials for different parts of the auto body and for body refinishing work.
- CO3 - Use appropriate tools and equipment for auto body repair work.
- CO4 - Repair damaged auto body parts using relevant tools, instruments, and machine tools.
- CO5 - Follow safety practices and standards in auto body repair work.

III. COURSE CONTENT

Unit	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Hours
1	Unit - I Auto Body Construction and Aerodynamics 1.1 Purpose and requirements of automobile bodies 1.2 Classification of auto body (shape, construction and application) 1.3 Body Terminology 1.4 Purpose and location of body parts - a) Front section (bumper, grille, frame rails, floor pan and fender panel) b) Center section (roof panel, cowl, doors, door pillars and glass) c) Rear section (rear quarter panel, rear floor pan, rear frame rails, trunk or deckled and rear bumper) 1.5 Loads on vehicle body – Static load, acceleration and braking load, moments and torque due to driving conditions (torsion and bending moments) 1.6 Body Aerodynamics – Concept, effect of aerodynamic drag on vehicle performance, methods to reduce aerodynamic drag	

Unit	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Hours
2	<p>Unit - II Auto Body Materials</p> <p>2.1 Types, properties and applications of body materials - Sheet Metal, Glass (tempered and laminated glass), Resins, Plastic, Composite Materials (Glass Reinforced Plastic and Fiber Reinforced Plastic)</p> <p>2.2 Body Paint -</p> <p>a) Basic composition of paints (pigments, binder, thinner and additives),</p> <p>b) Types of paints (cellulose synthetic, oil paints, synthetic paints, stoving paints, two pack paints)</p> <p>2.3 Body Refinishing Materials - Fillers, Primers, Sealers (standard, isolating and bleed inhibiting sealers), Additives and Other compounds common to body shop</p>	
3	<p>Unit - III Auto Body Shop Planning</p> <p>3.1 Basic Hand Tools -</p> <p>a) General Purpose Tools (Wrenches, Screwdrivers, Pliers, Miscellaneous Hand Tools),</p> <p>b) Body Working Tools (Hammers, Mallets, Dollies, Spoons, Picks, Dent Pullers, Pull Rods, Suction Cups, Punches, Chisels, Panel Cutters and Rivet Gun),</p> <p>c) Body Surfacing Tools (Metal Files, Sanding Board, Spreaders and Squeegees)</p> <p>3.2 Power Tools -</p> <p>a) Air Powered Tools (Air Compressor, Air Wrenches, Air Drills, Air Chisels, Grinders, Polishers/Buffers, Spray Gun and Air Sanders),</p> <p>b) Electric Power Tools (Power Screwdrivers, Drill Press, Bench Grinders, Vacuum Cleaners, Power Washers, Heat Gun and Welding Machine),</p> <p>c) Hydraulic Power Tools (Power Jacks, Vehicle Lift, Hydraulic Hoist for Engine and Transmission)</p> <p>3.3 Body Shop Planning - Pre planning, Choosing a site, Legal requirements of planning stage, Planning areas of workshop layout, Basic principles and dimension for body shop.</p> <p>3.4 General safety rules and measures in body shop</p>	

Unit	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Hours
4	<p>Unit - IV Auto Body Repairs</p> <p>4.1 Classification of Body Damage- Direct, Indirect and Concealed damage</p> <p>4.2 Minor Damage Repair -</p> <p>a) Standard Procedure,</p> <p>b) Straightening Dents with Hammers, Hammers and Dolly, Hammers and Spoons,</p> <p>c) Other Metal Straightening Techniques (Washer Welder, Body Fillers and Dent Pullers)</p> <p>4.3 Accident Damage Repair-</p> <p>a) Types of major damages,</p> <p>b) Factors to be considered in diagnosis of accident damage,</p> <p>c) Accident repair standard procedure,</p> <p>d) Rust damage repair procedure,</p> <p>e) Panel replacement procedure,</p> <p>f) Fiber Glass repair procedure</p> <p>4.4 Body Repainting Processes-</p> <p>a) Preventive and Anti-corrosive Treatment (Hot Dip Galvanization, Cavity Wax Injection, Barrier Coating, Cathodic Protection and Soap and Water),</p> <p>b) Standard Repainting Procedure</p>	
5	<p>Unit - V Auto Body Safety</p> <p>5.1 Basic design considerations for auto body safety</p> <p>5.2 Auto body structure, its system and parts - Safety features of Doors, Window glasses, Windshield, Bumper, Seat (back & head restraints), Ventilation and Rear view mirror.</p> <p>5.3 Safety Ratings - New Car Assessment Program</p> <p>a) Globally (Global NCAP),</p> <p>b) Nationally (Bharat NCAP)</p>	

IV. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Pawlowski, J.; Tidbury, G.H.	Vehicle body engineering	Century Publications, Century, 1970 ISBN-13: 9780220689162
2	Andre, G. Deroche	The Principles of Auto body repairing and Repainting	Prentice Hall, Inc. London, 1976 ISBN-13 : 9780137056996
3	Adrew Livesey; Alan Robinson	The Repair of Vehicle Bodies	7th edition. Boca Raton : Routledge, 2018 ISBN 13 : 9781351230643
4	Ramlingam, K.K	Automobile Engineering	Scitech Publication, Delhi, 2011 ISBN-13: 9788188429486
5	Chikara, Anil	Automobile Engineering Vol.5 Paint Techniques	Satya Prakashan, New Delhi, 2015, Editon, ISBN 13 : 9788176840774
6	Gupta, R.B	Automobile Engineering	First Edition, Satya Prakashan, New Delhi, 2016 ISBN 13: 9788176848589
7	William H, Crouser: Anglin Donald L	Automotive Mechanics	9th Edition, McGraw- Hill Publication, 2017, ISBN 13 : 9780070148604
8	Giri, N. K.	Automobile Mechanics	Khanna Publication, Delhi, 2014, 8th Edition, ISBN 13: 9788174092168
9	James E., Duffy	Auto Body Repair Technology	Fifth Edition, Delmar Cengage Learning, ISBN 13: 9781418073534

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=LZ82iANWBL0&list=PLbMVogVj5nJTW50jj9_gvJmdwFWHaqR5J&index=1&t=1s	Introduction to Vehicle Dynamics
2	https://youtu.be/wiyT8LBdQ5Q?si=diFkVlzzNFwkH107	Global New Car Assessment Program Testing
3	https://www.youtube.com/watch?v=VebCTdI0EYY	Bharat New Car Assessment Program Testing
4	https://www.globalncap.org/resources	Global New Car Assessment Program
5	https://www.bncap.in/notifications/	BNCAP Procedure
6	https://www.youtube.com/live/vYj1FhQwvFY?si=UMt6aCTxBa4JYNjh	Advanced Materials for Automotive Application

AUTOMOBILE ELECTRONICS

Course Code-

L:T:P

Pre requisites

This course requires the basic knowledge of Fundamentals of Electrical & Electronics, Automobile Electrical Systems at 3rd and 4th Semester level.

Course outcomes

At the end of course student should be

CO1 :	Identify the various sensors suitable for efficient vehicle operation and control.
CO2 :	Explain the applications of various actuators in vehicle systems.
CO3 :	Comprehend the fundamentals of Microcontrollers and PLC circuits.
CO4 :	Relate and respond regarding contemporary issues in the electronic fuel systems.
CO5 :	Explain Electronically controlled Steering, Brakes and Suspension systems that are use in an automobile.
CO6:	Comprehend the working of vehicle safety systems.

Course Content

1. Fundamentals of Electronic Circuits and Sensors: - Periods 10

Duration:

Advantages of using of electronic systems in Automobiles - Electronic systems: Types, Block diagrams - Analog system - Digital system - Components of electronic system- Sensor – Actuator – Display – Signal - Signal processing - Digital signal processing – Sampling - Sample time - Quantization.

Vehicle electronic control system description with block diagram-Engine control unit description with block diagram-Sensors: Definition, Classification of sensors, Types of throttle position sensor, Crankshaft sensor, Combustion knock sensor, Temperature sensor, MAP sensor, MAF sensor, Ride height sensor, EGO sensor and construction and working of each type of these sensor.

2. Actuators: Periods 8

Duration:

Actuators used in engine control system-pulse width modulation and duty cycle- applications-solenoid-ON/OFF solenoid-applications-proportional solenoid-applications- stepper motor –types-working –advantages and disadvantages-servo motor-working principle of D.C. servo motor-servo motor control-servo mechanism-applications-Relay- construction and working.

3. Fundamentals of PLC Circuits: - Periods 10

Duration:

Logic circuits - NOT gate - AND gate - OR gate - Define Combinational circuit and Sequential circuit, Micro controller, Microprocessor - Integrated circuits: Types – block diagram of micro controller (8051) - Types of micro controllers – Applications of Micro controllers - CAN bus

communication: Types, Applications – Multiplexing - MUX- DEMUX.

Introduction and history of Programmable Logic Controller (PLC) – Need of PLC's – Definition of PLC – Advantages and Limitations of PLC – Block diagram of PLC – Main components of PLC: Central Processing Unit (CPU), Programmer/Monitor device and Input / Output modules. – Working function of each part of PLC – Ladder Diagram: Rules for representing Input and Outputs in a ladder diagram, Contacts and Coils used in PLC Ladder Diagram – Ladder diagram for AND, OR, NOT Gates – Ladder diagram for NAND and NOR – Logic XOR- Timer / Counter instructions. – Applications of PLC.

**4. Electronically controlled fuel supply system:
Periods 12**

Duration:

Advantages of electronic petrol injection system–classification of fuel injection systems- MPFI system description with block diagram- operation-types of MPFI system-petrol injectors- construction and working- petrol direct injection system-types-working.

Need for electronic diesel injection system – advantages and disadvantages –Diesel electronic control injection description with block diagram-operation-CRDI description with block diagram-electronic CRDI injector-working-electronic distributor pump- working-description with block diagram.

**5. Electronically controlled Steering, Braking and Suspension systems:
Periods 10**

Duration:

Draw backs of conventional steering- merits of electronic power steering-components of electronic power steering-sensor-motor- working of electronic rack and pinion power steering- purpose of Antilock braking system -classification of ABS- working of ABS components-working of ABS description with block diagram- advantages of ABS- components of electronically controlled suspension system-working of electronically controlled suspension system description with block diagram-advantages-electronic solenoid controlled shock absorber-working-types.

**6. Safety systems and Instrumentation:
Periods 10**

Duration:

Airbag system-components-principle of operation of airbag system-low tyre pressure warning system description with a block diagram-cruise control system- need and operation with a block diagram- traction control system-operation-electronic stability program-operation-description with a block diagram.

Electronic engine Speed measurement - Fuel quantity measuring system - Oil pressure gauge – Coolant temperature measuring system - Automatic wiper - Automatic Head lamps – Electronic vehicle speed measurement- Trip information- Navigation systems- Block diagram of modern automobile computer based instrumentation system.

Recommended Books for Reference;

- | | | |
|---|----|------------------|
| 1. Understanding Automotive Electronics | by | William Ribbens. |
| 2. Microcontroller & application (8051) | by | Mazdi & Mazdi. |
| 3. Digital Electronics | by | Morris Mano |
| 4. Instrumentation | by | A.K.Sawhaney |

Suggested E-Learning references

- <https://www.youtube.com/watch?v=Bjn-tGKPvc>
- https://www.youtube.com/watch?v=NWAkLQUNNVE&list=PLzFsvFEQrrJa0r_XNu_7mWZw4-BzakjcsW
- https://www.youtube.com/watch?v=4M0_x0aIHHo
- https://www.youtube.com/watch?v=w_ENU0rE5DI

CO PO Mapping Matrix:

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1
CO1	Identify the various sensors suitable for efficient vehicle operation and control.	2	1	-	1	2	-	3	1
CO2	Explain the applications of various actuators in vehicle systems.	3	1	1	1	2	1	2	2
CO3	Comprehend the fundamentals of Microcontrollers and PLC circuits.	2	2	-	2	1	2	2	1
CO4	Relate and respond regarding contemporary issues in the electronic fuel systems.	3	1	1	2	2	1	3	2
CO5	Explain Electronically controlled Steering, Brakes and Suspension systems that are use in an automobile.	2	2	1	1	1	1	2	1
CO6	Comprehend the working of vehicle safety systems.	2	2	1	1	2	1	2	2

FARM TRACTORS AND SPECIAL TYPES OF VEHICLES

Course Code :-

(3-0-0)

Pre requisites:

This course requires the basic knowledge of Basic Automobile engineering, Fluid Mechanics and servicing and maintenance of automobiles.

Course Outcomes:

On successful completion of the course student should able to

CO1 :	Recognize an earth moving machine or a crane and state the application.
CO2 :	Comprehend the basics of a hydraulic system.
CO3 :	State the components a hydraulic control system.
CO4 :	Comprehend the working of general mechanisms in a Farm tractor.
CO5 :	Draw the general layout of hydraulic system in an earth moving machinery
CO6 :	Outline the working of steering in a crawler tractor.

COURSE CONTENT:

1. Introduction to Earth Moving Machinery and Construction Equipment 15 Periods

Types of Earth movers: Farm tractors – Excavators - Shovel: - Types of shovels – Operation – Applications and Limitations – Backhoe: Types of backhoes – Constructional details of backhoe-Applications- Advantages and limitations – Dragline: Types of dragline – Operation – Applications – Factors affecting dragline production – Advantages and Limitations – Scrapers: Types of scrapers- Operation – Applications – Motor Graders: Applications – Operations of Grader – Wheel Loader: Types, Operations - Bull Dozers: Types- Operation – Comparison between wheel dozer and Crawler dozer – Types of dozer blades. - Mobile cranes: Types of mobile cranes – Dumpers: Types of dumpers.

2. Basics of Hydraulic Systems 10 Periods

Introduction to hydraulic system – Pascal’s law – Merits and Limitations of hydraulic control systems – Essential Components of a hydraulic circuit and their functions – Accumulators - Types of pumps – Constructional details of pumps – Hydraulic pumps: External gear pump, Vane pump, Radial piston pump, Axial piston pump —Actuators: Linear and Rotary actuators – Oil Reservoir and its elements - Oil Filters: Edge, Surface and Depth filters.

3. Components of Hydraulic Control Systems 15 Periods

Valves: Functions, Classification – Types of pressure control valves - Classification of hydraulic controls - Open loop control and Closed loop control - Control valves: Types of control valves – Pressure Control Valves:

Relief valves, Pressure reducing valves, Speed control valves – Direction Control valves: Designation of D.C Valves, Sliding spool valve, Pilot Check valve, Solenoid Control valve – Flow control valves: Pressure compensated flow control valve, Gate valve, Plug valve, Butterfly valve, Non-return valve, Needle valves.

4. Farm Tractors

10 Periods

Farm Tractors - Classification - types of tractors with their application – Features of a tyre tractor and track or crawler tractor –Advantages and limitations of tyre tractors - Advantages and limitations of crawler tractors - Power take off shaft – purpose of P.T.O. shaft – Classification of PTO shafts - Types of drive for P.T.O. shafts – Belt pulley drive - Precautions to be taken while using belt pulley and P.T.O. shaft - Draw bar- Types of drawbar: Regular Drawbar, Three point linkage drawbar – Types of hitching systems: Two point linkages & Three point linkages.

5. Hydraulic systems & Maintenance of Special Purpose Vehicles

10 Periods

Purpose of hydraulic system in a tractor - General layout of hydraulic system of a tractor– Position or Depth control system – Draft control system - Automatic depth and draft control in tractors - Hydraulic system of a tipper or dump truck - Hydraulic operation of a bulldozer blade – Maintenance of Farm Tractors, Excavators, Backhoes, Forklifts etc.,.

6. Chassis and Steering in Crawler tractors

15 Periods

Track Mechanism in Crawlers: Parts of under carriage like Track frame, Track rollers, Track chain and Sprocket, Types of track chains, Track shoes, Types of track shoes.

Principle of steering mechanism in tracked vehicles – Design considerations for steering of tracked vehicles - Types of steering systems used in tracked vehicles: Dual drive system, Twin transmission or Geared steering system, Clutch-Brake system, Differential braking system, Controlled differential system, Double differential system, Triple differential system.

Recommended Books for Reference:

1. Farm Machines and Equipment - C.P.Nakra
2. Farm Tractor Maintenance and Repair - S.C.Jain and C.R. Rai
3. Truck Cranes - A. Astakhov (MIR Publishers, Moscow)
4. Motor Graders - E.G.Ronioson (MIR Publishers, Moscow)
5. Construction equipment operation & maintenance - Y.Pokras & M.Tushnyakov
(MIR Publishers, Moscow)
6. Hand book of Earth moving Machinery - Central water and Power Commission
7. Tractors and Automobiles – V.Rodichev, G.Rodicheya (MIR Publishers, Moscow)
8. A Text book of Hydraulic machines – R.K.Rajput – S.Chand
9. Fluid power engineering – Venkatesh Naik – Sunstar publishers
10. Hydraulic Control Systems - Noah D. Manring, Roger C. Fales - Wiley

Suggested E-Learning references

1. <https://nptel.ac.in/courses/108/106/108106170/>
2. <https://www.equipmentandcontracting.com/a-complete-guide-to-earthmoving- equipment/>
3. <https://www.youtube.com/watch?v=bUUBHg7bpO4&t=4s>
4. <https://lkdfacility.org/wp-content/uploads/2016-06-30-BASIC-MECHANICS6 EM- Equipments-FINAL-WEB.pdf>
5. https://en.wikipedia.org/wiki/Category:Heavy_equipment
6. <https://careertrend.com/about-5583871-types-construction-vehicles.html>
7. <https://www.fueloyal.com/14-popular-types-construction-vehicles/3/>
8. https://en.wikipedia.org/wiki/Power_shovel
9. <https://www.explainthatstuff.com/tractors.html>
10. <https://www.tractoragriculture.com/types-of-tractors/>
11. <https://www.hobbyfarms.com/4-tractor-types-to-consider-for-your-farm/>
12. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2274>
13. <https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=17335&context=rtd>
14. <https://www.youtube.com/watch?v=FA-bJGTqtvI&t=119s>
15. <https://www.youtube.com/watch?v=W8oNTcsA6c4>
16. <https://www.youtube.com/watch?v=FCU2t3fTv-k>
17. Automatic Draft and Depth Control System in Tractors
<https://youtu.be/ufs6TtuEjJU>
18. P.T.O Technology in Tractors
<https://www.youtube.com/watch?v=bkKEHbtFWHg&t=226s>

CO- PO Mapping Matrix:

S.No.	Course Outcome	List of PO or PSO Mapping
CO1 :	Recognize an earth moving machine or a crane and state the application.	PO 1,5,7 & PSO 1
CO2 :	Comprehend the basics of a hydraulic system.	PO 1,5,7 & PSO 1
CO3 :	State the components a hydraulic control system.	PO 1,5,7 & PSO 1
CO4 :	Comprehend the working of general mechanisms in a farm tractor.	PO 1,5,7 & PSO 1
CO5 :	Draw the general layout of hydraulic system in an earth moving machinery	PO 1,5,7 & PSO 1
CO6 :	Outline the working of steering in a crawler tractor.	PO 1,5,7 & PSO 1

OPEN ELECTIVE

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Course Code-

L:T:P

Introduction:

Welcome to the curriculum for the Artificial Intelligence and Machine Learning (AI&ML) Specialisation. This specialisation course is taught in Bootcamp mode. Bootcamps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to produce a computer- assisted solution when data is too complex for humans to find answers as they combine both data science and machine learning skills that are needed for today's job market.

Some common examples include; Amazon Alexa - converting spoken audio into language; Google Image Search – uses image recognition to return specific search results; Samsung Smart Fridges – uses data and machine learning to produce intuitions about your behavior. Leading to the successful completion of this bootcamp, you shall be equipped to either do an internship at an organization working in AI or do a project in AI. After the completion of your Diploma, you shall be ready to take up roles like Machine Learning Engineer, Data Scientist, Data Analyst, and more.

This course will teach you Fundamentals of AI, Python and Python libraries, data visualization, machine learning models, maths like linear algebra, data interpretation, deep learning, Version control system, cloud deployment and more. Details of the curriculum is presented in the sections below.

Pre-requisite

Before the start of this specialisation course, you would have completed the following courses;

In the 1st year of study, you would have studied Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Computer, Fundamentals of Electrical and Electronics Engineering, Project Management skills and Multimedia & Animation.

In the 2nd year of study, you would have studied Python Programming, Computer Hardware, Maintenance and Administration, Computer Networks, Database System Concepts and PL/SQL, Data Structures with Python, Operating System and Administration, Object oriented programming and Design with Java, Software Engineering principles and practices.

In this year of study, you shall be applying your previous years learning along with specialised field of study into projects and real-world applications.

Course outcome: A student should be able to

CO1	Explain the concept of AI, its applications, constituents and challenges of ethics in AI.
CO2	Analyze and visualize any given dataset
CO3	Evaluate, optimize, build and test an AI model for a given requirement
CO4	Perform comparative analysis of methods or algorithms for a given requirement
CO5	Select the appropriate tools, production environment and deploy the model.

Detailed Course Content

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	1. AI based movie (Screening)			4	<ul style="list-style-type: none"> - AI influence in companies viz, Amazon, Microsoft, Google, IBM - Latest developments in AI domain <ul style="list-style-type: none"> - Google's DeepMind AI Just Taught Itself To Walk - YouTube - Introducing Amazon Go and the world's most advanced shopping technology - YouTube - IBM Watson - Understanding the evolution of AI and HMI (human machine interface) - Discussion on how AI will Impact of daily life, work life, work force, jobs, products and services – T 	2		1
	1	1	2	Fundamentals of AI <ul style="list-style-type: none"> - What is artificial intelligence? - How AI works - Purpose of AI - Types of Artificial Intelligence - Goals of AI - Applications of AI 	3		1	<ul style="list-style-type: none"> - Significance of data in AI - AI Software Development life cycle - Compare traditional software development with AI Software Development - Example – Game rules (Chess) Explore and prepare a report on all popular AI cloud services (ML & DL) offered by vendors - T	2		1

				- Ethics in AI Examples of AI in real world - T							
	5	4,5	3	Why Do We Need a Version Control System? Fundamentals of Git Git installation and setup basic local Git operations <ul style="list-style-type: none"> ▪ creating a repository, ▪ cloning a repository, ▪ making and recording changes ▪ staging and committing changes, ▪ viewing the history of all the changes ▪ undoing changes 	1		3	Git Branching and merging Basic <ul style="list-style-type: none"> ▪ Creating and switching to new branches ▪ Switching between branches ▪ Merging local branches together 			3
	5	4,5	4	GitHub <ul style="list-style-type: none"> - Basics of distributed git - Account creation and configuration - Create and push to repositories - versioning - Collaboration - Migration 	1		3	Create repository – named mini project-1 Push the same to GitHub <u>TOC - Git Essentials: Become a Git and GitHub Ninja Infosys Springboard (onwingspan.com)</u>			3
			5	Developmental Assessment				Assessment Review and corrective action			3
	1	1,5	6	Real industry experience of AI	2		3	Weekly Assignment(1PM-2PM)			
2	1	1	1	Peer Review		4		Machine Learning	2		1

							<ul style="list-style-type: none"> - Fundamentals - Machine learning types - Machine learning workflow - Machine learning applications - Challenges in ML - Building a model – steps involved - Pipelines <ul style="list-style-type: none"> ▪ Data engineering ▪ Machine learning ▪ Deployment - What is Data Science? - How Data Science works? - Data Science uses <p>Group discussion - Examples of ML in everyday life / Use of Machine Learning in Daily Life Machine</p> <p>Learning Terminologies - T</p> <p><u>TOC - Machine Learning Fundamentals Infosys Springboard (onwingspan.com)</u> <u>Prediction – continuous value</u></p>			
1,5	1,4	2	<p>Introduction to Cloud Computing</p> <ul style="list-style-type: none"> - Essentials of Cloud Computing - Cloud Deployment Models - Cloud Service Models 	2	2	<p>Introduction to Containers</p> <p>Cloud Native application development Explore AI (ML and DL) services across public cloud platforms</p>	1		2	

			<ul style="list-style-type: none"> - Serverless Services - Major Cloud service Providers - Virtualization <p>Explore the cloud service providers and services offered by them - T</p>			<p>Note : teacher has to choose a public cloud platform to perform the following activities</p> <ul style="list-style-type: none"> - Getting to know cloud platform - Creating an account 			
1,5	4,5	3	<ul style="list-style-type: none"> - Walking through the administrative console and Cloud SDK - Explore Virtual machines (PaaS, IaaS and SaaS) and storage options - Deploy a simple application on the cloud - AI Platform overview 	1	3	<p>Essentials of cloud billing SLA TOC - Essentials of Cloud Computing Infosys Springboard (onwingspan.com) Tutorial - Automatically Create Machine Learning Models - Amazon Web Services Tutorial - Automatically Create Machine Learning Models - Amazon Web Services</p>	1		2
1	1,3 4	4	<p>Big Data</p> <ul style="list-style-type: none"> - What is Big Data? - Vs of Big Data - Sources of data - Role of Big Data in AI&ML <p>Python Packages for Machine Learning and Deep Learning</p> <ul style="list-style-type: none"> - Scientifics computing libraries - Visualization Libraries - Algorithmic libraries <p>Environment setup: install required packages</p>	1	3	<p>Python recap Database connectivity</p>	1		2

				Explore above listed packages						
			5	Developmental Assessment				Assessment Review and corrective action		3
	1,5	2,3,4	6	Build applications using AI cloud services	2		3	Weekly Assignment		
3	1,5	2,3,4	1	Peer review		4		Explore NumPy Module - Array Aggregation Functions - Vectorized Operations - Use Map, Filter, Reduce and Lambda Functions with NumPy - <u>TOC - Pandas and NumPy Tips, Tricks, and Techniques Infosys Springboard (onwingspan.com)</u>		3
	1,5	2,3,4	2	Explore Pandas modules - Aggregation and Grouping - Time Series Operations - Pivot and melt function - Use Map, Filter, Reduce and Lambda Functions with Pandas dataframes - <u>TOC - Unpacking NumPy and Pandas Infosys Springboard (onwingspan.com)</u>	1		3	Contd.		3
	2,5	2,3,4	3	Data visualization with python - Visualization fundamentals - Why visualization	2		2	- Visualizing Amounts - Visualizing distributions		3

			<ul style="list-style-type: none"> - Coordinate Systems and Axes - Directory of Visualizations <p>Amounts, Distributions, Proportions, x-y Relationships, Uncertainty</p> <p>Basics of python visualization with Matplotlib</p> <ul style="list-style-type: none"> - Understand the anatomy of a figure - Plot creation - Plotting routines - Basic plot customizations - Saving plots 			<ul style="list-style-type: none"> - Visualizing proportions - Visualizing associations - Visualizing time series <p>Consider a dataset and infer the relations with the help of different plots.</p>			
2,5	2,3,4	4	<ul style="list-style-type: none"> - Visualizing trends - Visualizing uncertainty - Visualizing categorical data - visualize proportions - visualize data on multi-plot grid - Composite views for informative summaries of data 	1	3	<p>Basics of python visualization with Seaborn</p> <p>The Course Overview - Viewer Page Infosys Springboard (onwingspan.com)</p>			3
		5	CIE 1 – Written and Practice Test			Assessment Review and corrective action			3
1	4	6	<p>How to create project plan and product backlog for AI project</p> <p>Create Git Repository for following Regression Project - ML / deep learning</p>	2	3	Weekly Assignment			

				Classification Project – ML / deep learning Clustering project – ML / deep learning Natural Language Processing – ML / deep learning						
4	2	2,3,4	1	Peer review Mini Project Activity (2) <ul style="list-style-type: none"> - Regression - Classification (Individual/ Team of 2) <ul style="list-style-type: none"> - Define Problem statement (solution to be presented at the semester end) - Create project plan and product backlog - Create git repository for the project - Work progress should be monitored weekly 	4		Data engineering pipeline Data Collection <ul style="list-style-type: none"> - Population and sample - Types of data <ul style="list-style-type: none"> ▪ Data type (type 1 (cross sectional, time series), type 2 (univariate, multivariate)) ▪ Variable types (categorical, ordinal, ratio, interval) - Data Collection Key terminologies in Statistics – T Mini Project Activity <ul style="list-style-type: none"> - Data collection for the stated problem 	2		1
	2	1,3	2	Probability <ul style="list-style-type: none"> - Basic concepts - Conditional and Joint probability - Bayes' Theorem Probability Distributions <ul style="list-style-type: none"> - Discrete 	2	2	Exploratory data analysis <ul style="list-style-type: none"> - overview - EDA goals and benefits Univariate data analysis <ul style="list-style-type: none"> - Characterizing data with descriptive statistics - Univariate distribution plots 	1		2

			<ul style="list-style-type: none"> - Continuous - Central Limit Theorem <p>Infosys Springboard (onwingspan.com)</p> <p>TOC - Probability Distribution using Python Infosys Springboard (onwingspan.com)</p> <p>Use relevant python packages to compute Central tendency for the parameters Dispersion for the parameters data distribution</p> <p>Visualize above computation with various techniques</p>			<ul style="list-style-type: none"> - Univariate comparison plots - Univariate composition plots <p>Mini Project Activity</p> <p>Data Exploration and analysis for the stated problem</p>			
2	2,3,4	3	<p>Univariate analysis tests</p> <p>Hypothesis testing</p> <p>Error, Test statistic, type, interpreting test statistics.</p> <p>Understanding p-value</p>	1	3	<p>Multivariate analysis</p> <p>Finding relationship in data</p> <ul style="list-style-type: none"> - Covariance - Correlation 	1		2
2	2,3,4	4	<ul style="list-style-type: none"> - Multivariate distribution plot - Multivariate comparison plot - Multivariate relationship plot - Multivariate composition plot 		4	<p>Linear algebra using python</p> <ul style="list-style-type: none"> - Scalars - Vectors - Matrices - Tensors - Gradients 	1		2

				<ul style="list-style-type: none"> - TOC - Exploratory Data Analysis with Pandas and Python 3.x Infosys Springboard (onwingspan.com) <p>Mini Project Activity – Status review (Data Exploration and analysis for the stated problem)</p>				<ul style="list-style-type: none"> - Eigen values and eigen vectors - Norms and Eigen decomposition <p>Use relevant python packages to perform operations over vectors and matrices.</p> <p>TOC - Basics of Linear Algebra using Python Infosys Springboard (onwingspan.com) Interactive Scenario: Introduction to Vector Algebra Using Python (oreilly.com)</p>			
			5	Developmental Assessment				Assessment Review and corrective action			3
	2	2,3,4	6	Statistics and Linear algebra	2	3		Weekly assignment			
5	2,5	2,3,4	1	<p>Peer review</p> <p>Mini Project Activity – Status review</p>		4		<p>Data Preprocessing</p> <p>Importance of data preprocessing</p> <p>Data cleaning</p> <ul style="list-style-type: none"> - Assess Data quality - Data anomalies - Detect missing values with pandas dataframe functions: .info() and .isna() - Diagnose type of missing values with visual and statistical methods (eg. chi-squared test of independence) <p>Approaches to deal with missing values</p> <ul style="list-style-type: none"> ▪ Keep the missing value as is 	1		2

							<ul style="list-style-type: none"> ▪ Remove data objects with missing values ▪ Remove the attributes with missing values ▪ Estimate and impute missing values 			
2,5	2,3,4	2	<p>Practice: Dealing with missing values with different approaches</p> <p>Outliers Detecting outliers</p> <ul style="list-style-type: none"> ▪ univariate outlier detection ▪ bivariate outlier detection ▪ Time series outlier detection 	1	3	<p>Dealing with outliers</p> <ul style="list-style-type: none"> - Do nothing - Replace with the upper cap or lower cap - Perform a log transformation - Remove data objects with outliers <p>Practice: Dealing with outliers with different approaches</p> <p><u>TOC - Data Preprocessing Infosys Springboard (onwingspan.com)</u></p> <p><u>TOC - Data Cleaning and Transformation Infosys Springboard (onwingspan.com)</u></p>			3	
2,5	2,3,4	3	<p>Data Integration</p> <ul style="list-style-type: none"> - Overview - data integration challenges - Approaches <ul style="list-style-type: none"> - Adding attributes - Adding data objects <p>Practice: data integration</p>	1	3	<p>Data reduction</p> <ul style="list-style-type: none"> - Distinction between data reduction and data redundancy - Objectives - Methods <ul style="list-style-type: none"> ○ numerosity data reduction ○ dimensionality data reduction 	1		2	

							Practice: Data reduction with numerosity data reduction method			
	2,5	2,3,4	4	Data transformation Need for data transformation. - Normalization - Standardization Data transformation with - binary coding - ranking transformation - discretization	1	3	Data transformation with - ranking transformation - discretization			3
			5	CIE 2 – Written and Practice Test			Assessment Review and corrective action			3
	2,5	2,3,4	6	Feature engineering	2	3	Weekly Assignment			
6	2,3,5	2,3,4	1	<u>Peer review</u> Mini Project Activity – Status review	4		Data Splitting Importance of data splitting - Training set - Validation set - Testing set Underfitting and overfitting Practice : split training and testing data sets in Python using train_test_split() of sci-kit learn. Explore the options of train_test_split()	1		2

2,3,5	2,3,4	2	<p>Machine Learning pipeline: Model training</p> <ul style="list-style-type: none"> - Supervised Learning: Regression - What is Regression? - Types of regression - Regularization in ML - Real-Life Applications - T - Linear regression Overview Types <ul style="list-style-type: none"> - simple linear regression - Multiple linear regression - Polynomial linear regression Applications of Linear Regression - T 	2	2	<p>Understanding Simple linear regression</p> <ul style="list-style-type: none"> - Regression equation - Assumptions - Gradient descent - Setting up the regression problem <p>Practice: student score based on study hours</p> <p>Problem statement:</p> <ul style="list-style-type: none"> • Create a model to analyses the relation between CIE and SEE result • Create a model to analyze the relation between crop yield and rain fall rate <p>Build linear regression model using</p> <ul style="list-style-type: none"> - Stats model - Scikit learn 	1	2
2,3,5	2,3,4	3	<p>Model Evaluation & testing</p> <p>Evaluate regression model:</p> <p>Evaluation Metric</p> <ul style="list-style-type: none"> - Coefficient of Determination or R-Squared (R²) - Root Mean Squared Error (RSME) - Optimize regression model - Gradient descent 	2	2	<p>Cross-validation</p> <p>Why do we need Cross-Validation?</p> <p>Techniques</p> <ul style="list-style-type: none"> - Hold out method - Leave One Out Cross-Validation - K-Fold Cross-Validation 	1	2

	2,3,5	2,3,4	4	<p>Multiple Linear Regression</p> <ul style="list-style-type: none"> - Overview - Assumptions - Normal Equation - Applications <p>Identification and collection of regression dataset - T</p> <p>Perform data exploration, preprocessing and splitting on datasets like</p> <ul style="list-style-type: none"> - Boston housing price from sci-kit learn datasets - Cricket match result - past data - Performance of a cricket player - past data - Crop yield - past data 	2	2	<p>Implementation in python</p> <ul style="list-style-type: none"> - Build regression model - Evaluate the model - To minimize the cost function 			3
			5	Developmental Assessment			Assessment Review and corrective action			3
	2,3,5	2,3,4	6	Optimization and performance matrices for regression	2	3	Weekly Assignment			
7	2,3,5	2,3,4	1	<p>Peer Review</p> <p>Mini Project Activity – Status review</p>		4	<p>Explore other regression algorithms - T</p> <p>Rebuild the model with other regression algorithms such as</p> <ul style="list-style-type: none"> - Random Forest Regressor - Support Vector Regression - Lasso regression 			3

							Evaluate and compare the performance of each.			
2,3,5	2,3,4	2	<p>Supervised learning – classification</p> <p>What is classification?</p> <p>Types:</p> <ul style="list-style-type: none"> - Binary classification - Multi-Label Classification - Multi-Class Classification - Imbalanced Classification <p>Classification models</p> <p>Applications - T</p> <p>Practice: Iris dataset from sci-kit learn</p> <p>Perform data exploration, preprocessing and splitting</p>	2	2	<p>Decision trees</p> <ul style="list-style-type: none"> - What is decision tree? - Understanding Entropy, information gain - How to stop overfitting - Pruning <p>DecisionTreeClassifier</p> <ul style="list-style-type: none"> - How it works? - Understanding the parameters - Applications 	3			
2,3,5	2,3,4	3	<p>Build decision tree-based model in python for like</p> <p>Breast Cancer Wisconsin (diagnostic) dataset from sci-kit learn Or any classification dataset from UCI , Kaggle</p>		4	<p>Evaluation Metrics for Classification</p> <ul style="list-style-type: none"> - confusion matrix, - Accuracy - Precision and Recall - Specificity - F1-score - AUC-ROC <ul style="list-style-type: none"> ▪ How to compute ▪ How does it work 	1		2	

							▪ When to use			
	2,3 ,5	2,3 ,4	4	Evaluation Metrics for Classification- contd. Evaluation of decision tree model with different metrics		4	Hyper parameter tuning for DecisionTreeClassifier			3
			5	CIE 3 – Written and Practice Test			Assessment Review and corrective action			3
	2,3 ,5	2,3 ,4	6	Hyper parameter tuning for classification	2	3	Weekly Assignment			
8	2,3 ,5	2,3 ,4	1	Peer review Mini Project Activity – Status review		4	Logistic regression - Overview - Types - How does logistic regression work? - Assumptions - Understanding sigmoid function - Applications Practice: build Logistic regression model in python	1		2
	2,3 ,5	2,3 ,4	2	build Logistic regression model in python Evaluation and optimization of the model	2	2	Support Vector Machine - Introduction to SVM - How does it work? - Applications Practice: Build a SVM Model in python for Fish dataset from Kaggle	2		1
	2,3 ,5	2,3 ,4	3	Build a SVM Model in python		4	Ensemble Learning			3

			How to optimize SVM?			<p>Introduction</p> <p>Basic Ensemble Techniques</p> <ul style="list-style-type: none"> - Max Voting - Averaging - Weighted Average <p>Advanced Ensemble Techniques</p> <ul style="list-style-type: none"> - Stacking - Blending - Bagging - Boosting <p>Explore and list the Ensemble Algorithms - T Random Forest</p> <ul style="list-style-type: none"> - Introduction - How does it work? - Hyper parameters - Applications 			
2,3,5	2,3,4	4	Build Random Forest-based model in python for Breast Cancer Wisconsin (diagnostic) dataset from sci-kit learn Or dataset from UCI , Kaggle		4	Evaluation and optimization			3
		5	Development Assessment			Assessment Review and corrective action			3
2,3,5	2,3,4	6	Comparison of classification algorithms with real world scenario	2	3	Weekly Assignment			

9	3	2,3	1	Peer review Mini Project Activity – Status review	4	Unsupervised learning – - What is unsupervised learning? - Common approaches - Challenges - Clustering Types Applications of unsupervised learning - T K-means – Working of K-means How to Choose the Right Number of Clusters?	2	1
	2,3,5	2,3,4	2	Implementation in python Evaluation Metrics - Inertia - Dunn Index Evaluate the model using mentioned metrics	1	3 Contd.		3
	2,3,5	2,3,4	3	Dimensionality Reduction - Importance of Dimension Reduction in machine learning Common methods to perform Dimension Reduction - T Dimensionality Reduction using PCA in python	2	2 Dimensionality Reduction using PCA in python		3
	5	4,5	4	MLOps - Overview	2	2 - Monitoring - Deployment		3

				<ul style="list-style-type: none"> - Why MLOps? - ML pipeline - Versioning - Model registry 				<ul style="list-style-type: none"> - Model monitoring 			
			5	CIE 4 – Written and Practice Test				Assessment Review and corrective action			3
	4	2,3	6	Compare various clustering techniques	2		3	Weekly Assignment			
10	1	3,4	1	Peer review <u>Mini Project Activity (2)</u> <ul style="list-style-type: none"> - Regression - Rebuild with deep learning model - Classification - Rebuild with deep learning model - Analyze the performance of ML and DL (Individual/ Team of 2) <ul style="list-style-type: none"> - Define Problem statement (solution to be presented in the 13th week CIE – 6) - Create project plan and product backlog - Create git repository for the project Work progress should be monitored weekly			4	Deep learning <ul style="list-style-type: none"> - Limitations of Machine Learning - What is deep learning? - Deep learning models - Deep Learning Applications - Deep learning frameworks Group discussion – T Future -Impact deep learning will likely to have on a variety of industries in the next few years. Environment setup <ul style="list-style-type: none"> - Local - Cloud <u>TOC - Deep Learning with TensorFlow Infosys</u> <u>Springboard (onwingspan.com)</u>	2		1
		2,3	3,4	2	Introduction to Neural Networks <ul style="list-style-type: none"> ▪ Understanding 	2		2	Introduction to TensorFlow <ul style="list-style-type: none"> - What is TensorFlow? 	1	

			<ul style="list-style-type: none"> - Biological Neurons - Artificial neuron /Perceptron - Working of perceptron ▪ Neural network <ul style="list-style-type: none"> - Architecture - Working of NN - Forward propagation - Back propagation ▪ Activation function <ul style="list-style-type: none"> - Sigmoid - Tanh - ReLU - LeakyReLU ▪ Cost function <ul style="list-style-type: none"> - How to measure loss? - How to reduce Loss? - Gradient Descent <p>Get data, and explore</p> <p>Eg. Stroke Prediction Dataset Kaggle or dataset from any other source</p> <p>Prepare data: Dealing with</p> <ul style="list-style-type: none"> - missing values - Categorical values 			<ul style="list-style-type: none"> - Why TensorFlow? - TensorFlow ecosystem - TensorFlow architecture - Program Elements in TensorFlow <p>Keras</p> <ul style="list-style-type: none"> - What is Keras? - Keras APIs – three programming models <ul style="list-style-type: none"> - Sequential Model - Functional API and - Model Subclassing - Keras layers - Custom Keras Layers <p>TOC - Deep Learning with TensorFlow Infosys</p> <p>Springboard (onwingspan.com)</p> <p>TOC - TensorFlow for Beginners Infosys</p> <p>Springboard (onwingspan.com)</p>			
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			<ul style="list-style-type: none"> - Labeled encoding - One hot coding <p>Prepare data : Feature scaling with StandardScalar() or other method</p> <p>Dropping unnecessary features Data splitting</p> <p>Dealing with imbalanced dataset</p>						
3	2,3,4	3	<ul style="list-style-type: none"> - Why do we have to flatten the input data? - Understand Keras Dense Layer <ul style="list-style-type: none"> - Overview - Parameters - Operation - Building Shallow Neural Network with Keras Dense Layer - Building Deep Neural Network with Keras Dense Layers - Create a complete end to end neural network model using Keras Sequential Model and Keras Layer API <p>Eg. MNIST dataset (classify handwritten numerals) or fashion-MNIST dataset or dataset from other source</p>	1	3	<p>Keras optimizers</p> <p>Keras Metrics</p> <p>Keras Losses</p> <p>Create a complete end to end neural network – Contd.</p> <p><u>TOC - Learning TensorFlow 2.0 Infosys Springboard (onwingspan.com)</u></p>	1	2	

	3	3,4	4	<p>Keras</p> <ul style="list-style-type: none"> - Callbacks - Commonly used callbacks <p>Monitor neural network performance with TensorBoard</p> <ul style="list-style-type: none"> - TensorBoard Basics - TensorBoard Setup <p>Understand Model Behavior During Training Reduce overfitting with Dropout Layer</p>	1	3	<p>How to save trained model</p> <p>Local deployment with TensorFlow ModelServer</p>			3	
			5	Development Assessment			Assessment Review and corrective action			3	
	2,3	3,4	6	Building deep learning model with TensorFlow and Keras for use cases	2	3	Weekly Assignment				
11	1,5	2,3,4	1	<p>Peer Review</p> <p>Mini Project Activity – Status review</p>		4	<p>Natural Language Processing Understanding natural language processing NLP approaches</p> <ul style="list-style-type: none"> – rule based, statistical NLP use cases <p>How to use dictionary?</p> <p>Commonly used NLP tools & libraries</p> <p>Setup environment (spaCy or similar nlp package)</p>	2		1	
	2,3	2,3,4	2	Text processing tasks (Processing Words)	1		Spell Correction	1		2	

				Document Assembler Annotation Tokenization <ul style="list-style-type: none"> - Sentence tokenization - Word tokenization - Visualize frequency distribution of words - Visualize with word cloud Stop word <ul style="list-style-type: none"> - Dropping stop words - Dropping punctuations 			3	Normalization <ul style="list-style-type: none"> - Stemming - Lemmatization 			
	2,3	3	3	Parts of speech tagging Named Entity Recognition	1		3	Vectorizer N-Gram	1		2
	2,3	2,3, 4	4	TF-IDF Build a pipeline for text processing	1		3	Contd.			3
			5	CIE 5 – Written and Practice Test				Assessment Review and corrective action			3
	3	2,3	6	NLP – text summarization	2		3	Weekly Assignment			
12	1	2,3, 4	1	Peer review Mini Project Activity – Status review				NLP use case – Sentiment Analysis (SA) What is sentiment analysis? Why is SA important? Business applications for SA How does sentiment analysis work? Transformers	1		2

							Conduct Sentiment analysis to classify movie reviews with			
	1,2, 3,4,	2,3, 4,6	2	NLP use case – Sentiment Analysis (SA) Contd.		4	Ethics in AI - Importance of AI ethics - Ethical challenges of AI - AI code of ethics Group Discussion: Discussion on the Ethics of AI Ethics of AI: Safeguarding Humanity Professional Education (mit.edu)	1		2
5	2,3, 4	3	Containers Why containers? What is a docker? How docker works? Components of docker - Docker container - Docker client - Docker daemon - Docker image - Docker registry Install docker on desktop and start the docker tool.	2	2	Publish the container in Registry				3

			<p>TOC - Containers & Images Infosys Springboard (onwingspan.com)</p> <p>Docker file</p> <p>Docker image</p> <p>Commands to create docker file.</p> <p>Build docker image with docker file</p> <p>create docker container from docker image Run the docker container</p> <p>TOC - Deploying and Running Docker Containers Infosys Springboard (onwingspan.com)</p> <p>TOC - Docker, Dockerfile, and Docker-Compose (2020 Ready!) Infosys Springboard (onwingspan.com)</p>							
5	3,4	4	Deployment strategies	1		3	Contd.			3
		5	Development Assessment				Assessment Review and corrective action			3
1,3	5	6	Using cloud service for MLOps	2		3	Weekly Assignment			

References

Sl. No	Description
1	Hands-On Artificial Intelligence for Beginners By Patrick D. Smith
2	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, By Aurélien Géron
3	Machine Learning with Python for everyone, Mark E Fenner
4	Hands on Data processing in Python , Joy Jafari
5	Deep Learning with TensorFlow2 and Keras , Antonio Gulli, Amita Kapoor,Sujith Pal
6	Cloud Computing, Concepts, Technology and Architecture by Thomas Erl
7	Khan Academy
8	Fundamentals of Data Visualization, Claus O. Wilke
9	Pro Git ,Scott Chacon, Ben Straub
10	Mathematics for Machine Learning, A. Aldo Faisal, Cheng Soon Ong, and Marc Peter Deisenroth
11	Machine Learning, Pipelines, Deployment and MLOps Tutorial DataCamp
12	MLOps Python Tutorial for Beginners -Get Started with MLOps (projectpro.io)

Cloud Computing and Cyber Security

Under Preparation.....

Internet of Things (IoT)

Pre-requisites

Knowledge of basic programming skills in python, networking concepts and basic electronic components

Course Outcomes

Upon completion of the course, the student shall be able to

C01	Familiarize with Internet of Things Physical and Logical Design and Levels.
C02	Understand IoT System Management with NETCONF-YANG
C03	Understand Internet of Things, its hardware & software components and applications.
C04	Interpret IoT Application Development
C05	Discuss Security, Privacy and Governance in IoT
C06	Explain IIoT and Case studies for IoT Design

Course Contents

UNIT - 1: Introduction to Internet of Things

8 Periods

IoT – Definition, characteristics, Physical design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT functional blocks, IoT communication Models, IoT communication API's IoT enabling Technologies – Wireless sensor networks, Cloud Computing, Big Data Analytics, Communication protocols, embedded systems. IoT Levels and Deployment templates – IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6, Popular IoT platforms, Domain specific IoTs

UNIT - 2: M2M, IoT System Management with NETCONF-YANG

6 Periods

M2M, Difference between IoT and M2M, SDN and NFV for IoT, Need for IoT Systems Management, Simple Network Management Protocol, Network Operator requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG

UNIT - 3: Elements of IoT

8 Periods

Overview of IoT components-basic building blocks of IoT, Hardware Components- IoT Devices: Raspberry PI, Arduino; Sensors, Actuators, Smart objects and RFID, Software Components-Python Packages of interest for IoT, Networking Protocols

UNIT – 4: IoT Application Development

6 Periods

IoT Design Methodology, Linux on Raspberry PI, Raspberry PI interfaces, Programming Raspberry PI with Python, Data storage on cloud/local server

UNIT - 5: IoT Privacy, Security and Governance

6 Periods

Overview of Governance, Security and Privacy issues, Security, Privacy and Trust in IoT, IoT security life cycle, use of Blockchain in IoT security

UNIT - 6: IIoT and Case Studies on IoT Design

6 Periods

Industrial Internet of Things (IIoT), Differentiate IoT and IIoT, Case Studies-Home Automation, Urban Cities, Environment, Agriculture, Health Care, Transportation.

Reference Books

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
4. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill

Suggested E-learning referencess

1. <https://internetofthingsagenda.techtarget.com/>
2. <https://dzone.com/iot-developer-tutorials-tools-news-reviews>
3. <https://blog.bosch-si.com/>
4. <https://www.hackster.io/>
5. <https://www.libelium.com/>
6. <https://www.ibm.com/blogs/internet-of-things/>
7. <https://azure.microsoft.com/en-us/blog/topics/internet-of-things/>
8. <https://blog.arduino.cc/>
9. <https://www.raspberrypi.org/blog/>
10. www.lemalabs.com/iot

BLOCK CHAIN TECHNOLOGY

OBJECTIVES:

- To understand the concepts of block chain technology
- To understand the consensus and hyper ledger fabric in block chain technology.

OUTCOMES:

- State the basic concepts of block chain
- Paraphrase the list of consensus and Demonstrate and Interpret working of Hyper ledger Fabric
- Implement SDK composer tool and explain the Digital identity for government

UNIT - I

History: Digital Money to Distributed Ledgers -Design Primitives: Protocols, Security, Consensus, Permissions, Privacy- : Block chain Architecture and Design-Basic crypto primitives: Hash, Signature- Hash chain to Block chain-Basic consensus mechanisms.

UNIT - II

Requirements for the consensus protocols-Proof of Work (PoW)-Scalability aspects of Block chain consensus protocols: Permissioned Block chains-Design goals-Consensus protocols for Permissioned Block chains.

UNIT - III

Decomposing the consensus process-Hyper ledger fabric components-Chain code Design and Implementation: Hyper ledger Fabric II:-Beyond Chain code: fabric SDK and Front End-Hyper ledger composer tool.

UNIT - IV

Block chain in Financial Software and Systems (FSS): -Settlements, -KYC, -Capital markets-Insurance-Block chain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting.

UNIT - V

Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system / social welfare systems: Block chain Cryptography: Privacy and Security on Block chain.

TEXT BOOKS:

1. Mark Gates, "*Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money*", Wise Fox Publishing and Mark Gates 2017.
2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "*Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer*", 2018.
3. Bahga, Vijay Madiseti, "*Block chain Applications: A Hands-On Approach*", Arshdeep Bahga, Vijay Madiseti publishers 2017.

REFERENCE BOOKS:

1. Andreas Antonopoulos, “*Mastering Bitcoin: Unlocking Digital Crypto currencies*”, O'Reilly Media, Inc. 2014.
2. Melanie Swa, “*Block chain*”, O'Reilly Media 2014.

WEB REFERENCES:

- NPTEL & MOOC courses titled blockchain technology
- blockgeeks.com/guide/what-is-block-chain-technology
- <https://nptel.ac.in/courses/106105184/>

DRONE TECHNOLOGY & ROBOTICS

COURSE OBJECTIVES

The course should enable the students to:

1. Learn concepts of Drone and Drone Technology
2. Impart knowledge of AI and Drone technology for various domains applications
3. To make the students to understand the basic concepts of UAV drone systems.
4. To introduce the stability and control of an aircraft

COURSE OUTCOMES

1. Design, build and program simple autonomous robots.
2. Implement standard signal processing and control algorithms.
3. Ability to design UAV drone system
4. To understand working of different types of engines and its area of applications
5. To understand static and dynamic stability dynamic instability and control concepts

UNIT-I- Robotics, Sensors and Signal processing Robotics:

Robotics and AI, Embedded Systems, Agent-Task-Environment model, Embodied Systems, Synthetic approaches to science Sensors and signal processing Common sensors and their properties, 1D signal processing, Vision

UNIT-II- AI and the Internet of Things:

AI and the Internet of Things: Real World Use-Cases: Automated vacuum cleaners, like that of the iRobot Roomba, Smart thermostat solutions, like that of Nest Labs

UNIT-III- Introduction to Drones:

Introduction to Drones: Introduction to Unmanned Aircraft Systems, History of UAV drones, classification of drones, System Composition, applications

UNIT-IV- Design of UAV Drone Systems:

Design of UAV Drone Systems: Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects-India Specific, Design for Stealth.

UNIT-V- Avionics Hardware of Drones:

Avionics Hardware of Drones: Autopilot, AGL-pressure sensors servos-accelerometer –gyros-actuators-power supply-processor, integration, installation, configuration.

TEXT BOOKS

1. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc., 1998.

REFERENCE BOOKS

1. The Art of Robotics: An introduction to engineering, F Martin, Addison-Wesley, forthcoming

DATA ANALYTICS

I. RATIONALE

Data Analytics uses statistical and computational methods to analyze data, aiding informed decision-making. Excel dashboards effectively present vital data at a glance, enhancing user interactivity. A Data Analyst collects, cleans, and visualizes Datasets to solve problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Perform Data Analytics in various business domains for improved decision making

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 - Elaborate the fundamental concepts of Data Analytics.

CO2 - Apply appropriate statistical techniques to analyze and interpret complex Datasets.

CO3 - Analyze numerical data by creating pivot table.

CO4 - Represent data in terms of various types of charts.

CO5 - Visualize the data using a Python library.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Course Content	Hours
1	Unit - I Introduction to Data Analytics 1.1 Data Analytics: An Overview, Importance of Data Analytics 1.2 Types of Data Analytics: Descriptive Analysis, Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis, Visual Analytics 1.3 Life cycle of Data Analytics, Quality and Quantity of data, Measurement 1.4 Data Types, Measure of central tendency, Measures of dispersion 1.5 Sampling Funnel, Central Limit Theorem, Confidence Interval, Sampling Variation	
2	Unit - II Statistical Analysis 2.1 Graphical techniques, box plot, skewness and kurtosis, Descriptive Stats 2.2 Correlation and Regression, Data Cleaning 2.3 Imputation Techniques 2.4 Anova and Chi Square 2.5 Scatter Diagram 2.6 Estimation and Hypothesis Testing 2.7 Sampling Distributions, Counting 2.8 Probability, Probability Distributions	

3	<p>Unit - III Data Analytics with Excel</p> <p>3.1 Excel Dashboard: Tables and Data Grids, Dynamic Filters and Controls, Trend Analysis and Forecasting</p> <p>3.2 Pivot Tables: Creating a Pivot Table Specifying Pivot Table Data</p> <p>3.3 Changing a Pivot Tables, Calculation Filtering and Sorting a Pivot Table</p> <p>3.4 Creating a Pivot Chart, Grouping Items</p> <p>3.5 Updating a Pivot Table, formatting a Pivot Table using Slicers</p>	
4	<p>Unit - IV Data Visualization</p> <p>4.1 Creating a Simple Chart, Charting Non-Adjacent Cells</p> <p>4.2 Creating a Chart Using the Chart Wizard, Modifying Charts, Moving an Embedded Chart, Sizing an Embedded Chart</p> <p>4.3 Changing the Chart Type, Changing the Way Data is Displayed, Moving the Legend</p> <p>4.4 Formatting Charts, Adding Chart Items, Formatting All Text, Formatting and Aligning Numbers, Formatting the Plot Area, Formatting Data Markers</p> <p>4.5 Pie Charts, Creating a Pie Chart Moving the Pie Chart to its Own Sheet Adding Data Labels, Exploding</p> <p>1.6 a Slice of a Pie Chart</p>	
5	<p>Unit - V Data Visualization using Python</p> <p>5.1 Overview of Matplotlib and its role in data visualization, Installing and setting up Matplotlib in Python</p> <p>5.2 Basic plotting with Matplotlib, Line plot, Scatter plots, Bar charts, Histograms, adding titles, labels, and legends to plots</p> <p>5.3 Changing figure size and aspect ratio, Customizing axes (limits, ticks, and labels)</p> <p>5.4 Exporting and Saving Visualizations: Saving plots in different formats (PNG, PDF, SVG), Adjusting the resolution and quality of saved plots, creating interactive visualizations using Matplotlib widgets</p>	

SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jinjer Simon	Excel Data Analysis: Your visual blueprint for analyzing data, charts, and PivotTables	Wiley Publication Edition: 3rd ISBN: 978- 0-470-59160-4
2	A. J. Smalley	Data Analysis with Excel	SAGE Publications Edition: 1st, 2007 ISBN 10: 0070139903 / ISBN 13: 9780070139909
3	Fabio Nelli	Python Data Analytics: With Pandas, NumPy, and Matplotlib	Apress publication ISBN-13 :978-1484239124 ISBN-13978-1484247372
4	Jake VanderPlas	Python Data Science Handbook	Shroff/O'Reilly Publication ISBN-10-9355422555 ISBN-13-978-9355422552
5	Business Analytics with MindTap	Jeffrey D. Camm James J Cochran Michael J. Fry Jeffrey W. Ohlmann	Cengage Learning India Pvt. Ltd. Publication Edition:4th ISBN: 9789360533533

V. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://spreadsheetpoint.com/excel/dashboard-in-excel/	Advance Excel
2	https://www.javatpoint.com/how-to-create-a-dashboard-in-excel	Excel Dashboard
3	https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel	Data Visualization
4	https://www.freecodecamp.org/news/introduction-to-data-visualization-using-matplotlib/	Matplotlib in Python
5	https://archive.nptel.ac.in/courses/106/107/106107220/	Introduction to data analytics

VEHICLE DIAGNOSIS LAB

Course Code-

L:T:P

Course Outcomes:

On successful completion of the course student should be able to:

CO1	Practice the trouble diagnosis of the Engine.
CO2	Practice the usage of Exhaust gas Analyzer and Smoke meter.
CO3	Measure the percentage of pollutants from petrol and diesel engines by using exhaust gas analyzer.
CO 4	Practice the diagnosing of various Transmission parts of a vehicle

Course Content:

1. Study and Practice trouble diagnosis of various vehicle systems like:
 - a. Engine
 - b. Starting system
 - c. Fuel system
 - d. Steering system
 - e. Suspension system
 - f. Clutch
 - g. Gear box
 - h. Differential
 - i. Wheel and tyres
 - j. Braking system
 - k. Charging system
 - l. Lighting system
2. Conduct exhaust gas analysis for the given petrol engine
3. Conduct exhaust gas analysis for the given diesel engine

Course Content:-

Unit No	Unit name
1.	Trouble diagnosis of engine
2.	Trouble diagnosis of starting system
3.	Trouble diagnosis of fuel system
4.	Trouble diagnosis of steering system
5.	Trouble diagnosis of suspension system
6.	Trouble diagnosis of clutch
7.	Trouble diagnosis of Gear box
8.	Trouble diagnosis of differential

9.	Trouble diagnosis of wheels and tyres
10.	Trouble diagnosis of brakes
11.	Trouble diagnosis of Charging system
12.	Trouble diagnosis of Lighting system
13.	Exhaust gas analysis of Petrol engine
14.	Exhaust gas analysis of Diesel engine
15.	Test/Revision

Pre requisites:

This course requires the basic knowledge of automobile servicing and maintenance

Suggested E-learning References:

1. www.learnengineering.org
2. www.sae.org
3. www.nptel.ac.in
4. <https://www.google.com/>
5. <https://en.wikipedia.org/wiki/Piston>

FUELS, LUBRICANTS AND I.C.ENGINES TESTING LAB

Course Code-

L:T:P

Pre requisites: This course requires the basic knowledge of physics, chemistry, fuels, I.C. Engines and lubricants.

Course Outcomes:

At the end of course student should be able to

CO1	Measure the Flash and Fire points of different fuels.
CO2	Evaluate the Kinematic and Absolute viscosities of the fuel and lubricating oils.
CO3	Determine the percentage of carbon in the given sample of fuel or lubricant.
CO4	Conduct the penetration test for semi solid lubricant.
CO5	Determine the Calorific values of solid and liquid fuels and gaseous fuels.
CO6	Find the degree of corrosivity of the given fuel or lubricant
CO7	Apprise the performance of the given petrol or diesel engine and to prepare heat balance sheet

Course Content:

1. Determination of flash and fire points of various fuels and lubricants using Abel's apparatus by open cup method.
2. Determination of flash and fire points of various fuels and lubricants using Pesky Martin's, apparatus by closed cup method.
3. Determination of flash and fire points of various fuels and lubricants using Cleveland's apparatus by closed cup method.
4. Determination of Kinematic and Absolute viscosities of the fuels and lubricating Oils using Redwood viscometer/Say bolt viscometer.
5. Conduct corrosion test on the given fuel or lubricant and assess the degree of corrosivity.
6. Find out the percentage of carbon in the given sample of fuel or lubricating oil.
7. Determination of Calorific values of Solid and liquid fuels using Bomb calorimeter.
8. Determination of Calorific value of gaseous fuel by using Junker's calorimeter.
9. Find the frictional power of the given multi cylinder petrol engine and calculate the mechanical efficiency at various loads.
10. Conduct load test on the given petrol engine.
11. Perform Load test on the given diesel engine.
12. Draw up Heat balance sheet for the given petrol engine.
13. Prepare Heat balance sheet for the given diesel engine.

Suggested E-Learning references

www.learnengineering.org www.sae.org
www.nptel.ac.in