

SCHEME OF STUDIES
DIPLOMA IN AUTOMOBILE ENGINEERING
(C-20)

CURRICULUM STRUCTURE

V Semester Scheme of Studies - Diploma in Automobile Engineering[C-20]

Pathway	Course Category / Teaching Department	Course Code	Pathway Title	Hours per Semester			Total contact hrs /Semester	Credits	CIE Marks		SEE-1 Marks (Theory)		SEE-2 Mark (Practical)		Total Marks	Min Marks for Passing (including CIE marks)	Assigned Grade	Grade Point	SGPA and CGPA
				L	T	P			Max	Min	Max	Min	Max	Min					
Programme Specialization Pathway																			
1	ES/AT Specialization pathways in emerging areas (Student may select any one specialization)	20AT51I	Farm Machinery & Equipment	104	52	312	468	24	240	96	60	24	100	40	400	160			Both SGPA & CGPA
		20AT52I	Construction and Earthmoving Equipment	104	52	312	468	24	240	96	60	24	100	40	400	160			
		20AT53I	Automation & Robotics	104	52	312	468	24	240	96	60	24	100	40	400	160			
		20AT54I	Electric & Hybrid Vehicle Technology	104	52	312	468	24	240	96	60	24	100	40	400	160			
Science and Research Pathway				L	T	P	Total	Credits	CIE Marks		SEE Marks								
									Max	Min	Max	Min							
2	BS/SC/AT Specialization pathway in Science and Research (Student need to take all four papers in this pathway)	20SC51T	Paper 1-Applied Mathematics	52	26	0	78	6	50	20	50	20	100	40					
		20SC52T	Paper 2 – Applied Science	52	0	52	104	6	50	20	50	20	100	40					
		20RM53T	Paper 3 – Research Methodology	52	0	52	104	6	50	20	50	20	100	40					
		20TW54P	Paper 4 – Technical Writing	39	13	52	104	6	60	24	40	16	100	40					
			Total	195	39	156	390	24	210	84	190	76	400	160					
Entrepreneurship Pathway																			
3	ES/AT	20ET51I	Entrepreneurship and Start up	104	52	312	468	24	240	96	160	64	400	160					

I:- Integrated L: - Lecture T:- Tutorial P:- Practical BS- Basic Science:: ES-Engineering Science:: SC: Science.

**Note: In 5th Semester student need to select any one of the pathways consisting of 24 credits
Students can continue their higher education irrespective of the pathway selected**

CURRICULUM STRUCTURE

VI Semester Scheme of Studies - Diploma in Automobile Engineering[C-20]

Pathway	Course Category / Teaching Department	Course Code	Pathway	Course		Total contact	Credits	CIE Marks		SEE Marks		Total Marks	Min Marks for Passing	Assigned Grade	Grade Point	SGPA and CGPA
								Max	Min	Max	Min					
Internship	ES/AT	20AT61S	Specialisation pathway	Internship/ project	40 Hours / week Total 16 Weeks	640	16	240	96	160	64	400	160			
		20AT61R	Science and Research Pathway	Research project	40 Hours / week Total 16 Weeks	640	16	240	96	160	64	400	160			
		20AT61E	Entrepreneurs hip and Start up pathway	Minimum Viable Product - MVP/ Incubation/ Startup proposal	40 Hours / week Total 16 Weeks	640	16	240	96	160	64	400	160			

Note: Student shall undergo Internship/Project/research project/MVP/Incubation/Startup proposal in the same area as opted in 5th semester pathway



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Program	Automobile Engineering	Semester	5
Course Code	20AT51I	Type of Course L:T:P	104:52:312
Specialization	Farm Machinery & Equipment	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

Welcome to the curriculum for the Specialisation Pathway – **Farm Machinery & 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.

Farm mechanization is playing a vital role in farm for raising crops. Farm tools, implements, and equipment play very important role in horticultural operations. Introduction of Equipment / Machinery in farming operations will not only increase production but also reduces labour requirement on farms. In order to do horticultural operations successfully, one must have a good working knowledge of the tools, implements and equipment before using them. The subject will enable the students to understand the basic principles, construction and working of farm machinery for different crops. This will also enable them to select appropriate machinery, use, repair and maintain the same. This knowledge will be highly useful in running an Agro Service Centre for Farm Machinery.

You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to select appropriate machinery, use, repair and maintain the farm tractor and its implements. This knowledge will be highly useful in running an Agro Service Centre for Farm Machinery.

Leading to the successful completion of this bootcamp, you shall be equipped to either do an **Internship** in an organisation working on **Farm Machinery & 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.

Course Cohort Owner

A Course Cohort Owner is a faculty from the core discipline, who is fully responsible for one specialised field of study and the cohort of students who have chosen to study that specialised field of study.

Instruction to 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 session 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/showroom/service Centre 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 can augment or use for supplementally teaching on line courses available although 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: A student should be able to

C01	Apply farm mechanization techniques to increase productivity and profitability in agriculture and to implement erosion control measures to reduce soil erosion in farm land.
C02	Determine the field capacity and field efficiency to evaluating the performance of a machine, Evaluating the performance of a tractor and implements.
C03	Service and troubleshoot tractor system and power tillers.
C04	Adjust and fix the implements to tractor and tiller.
C05	Demonstrate and implement future enhancements on farm technologies, operate differential farm portal to claim the benefits from government by farmers, use drone in farming.

Detailed course plan

Learning outcomes (Week 1):

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

1. Examine different types of soils and different agricultural practices and recommend the best way raising the crops.
2. Apply farm mechanization techniques to increase productivity and profitability in agriculture.
3. Identify and implement Erosion control measures in farms to reduce soil erosion.

Week	C	P	O	Day	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	About Specialization – Future-Companies and Service sectors in India and outside India, Career opportunities. Importance and scope of agriculture, horticulture, sericulture, animal husbandry and forestry as farming enterprises and relation to industry.	2		2	About Farm tractors and Machinery- History- Importance- with an Example of a company (like M&M, TAFE, Escorts Tractors, VST tillers and tractors etc....) brief how the need for agricultural equipment evolved. Farm mechanization in India - Makes of tractors, power tillers, earth moving machinery - Classification of tractors	2		1
1	1	1	2		Farm Mechanization: 1.Introduction, Objectives of farm mechanization, Scope of farm mechanization, Benefits of farm mechanization.	2	2		Introductory Agriculture, principles of Agronomy: 1.Methods of crop production.	3		

			<p>2. Limiting factors in farm mechanization. Bottlenecks in Indian farm mechanization system.</p> <p>3. Classification of farm machines, Principles of selection of machines used to preparing land for production of crops.</p>				2. Contribution of agriculture and horticulture crops to national economy.			
1	1	3	<p>Agronomy:</p> <p>1. Definition and scope of agronomy.</p> <p>2. Classification of crops, Effect of different weather parameters on crop growth and development.</p>	2	2		<p>1. Video demonstration on Inter-cultivation implements and practices</p> <p>2. Importance of soil in crop production, Soil physical property, Effects of tillage on soil physical properties and root growth.</p> <p>3. Soil color- factors, attributes and significance.</p>	2	1	
1	1	4	<p>1. Green manuring, manure and fertilizer management for different cropping systems.</p> <p>2. Methods of fertilizer application.</p> <p>4. Video demonstration on Green manuring and fertilizer application</p>	2	2		<p>SOIL CONSERVATION:</p> <p>1. Soil erosion - causes, types and agents of soil erosion.</p> <p>2. Erosion control measures: agronomic measures - contour cropping, strip cropping, mulching; mechanical measures - terraces, bunds;</p> <p>3. Landslides-factors causing it, land slips, Measures for control.</p>	2	1	

	1		5	Developmental Assessment			Assessment Review and corrective action			3	
	1		6	Industry Class + Industrial Assignment Industry Class on: Field visit to farm land to show the farm work/green manuring/ fertilizer application/ how the soil condition will affect the growth of the crops.	2	3					
Learning outcomes (Week 2): At the end of the week the student will be able to: <ol style="list-style-type: none"> 1. Determine the field capacity and field efficiency to evaluating the performance of a machine. 2. Determine the total cost of performing field operation and measure area in map using planimeter. 3. Test material used in tractors body. 											
2	2	1	1	Tutorial (Peer discussion on Industrial assignment)	-	4	-	Field capacities & economics: 1.Terms related to Field performance of Machines-- Theoretical Field Capacity, Theoretical Time per hectare, Effective Field Capacity, Effective Operating Time, Field Efficiency, Performance Efficiency, Field Machine Index, Comparative Index, Time Efficiency, Material Capacity, Factors affecting field efficiency.	3		

2	1 , 2	2	Calculation of field capacity and field efficiency. (Simple Problems)		4	Economics of machinery usage: 1.Fixed cost, variable cost. Depreciation – Methods to calculate depreciation. 2. Operating cost, Estimation of cost of operation.	1	2	
2	1 , 4	3	Simple problems to show how to calculate the depression cost of the tractor, operating cost of the tractor		4	Simple problems to show how to calculate the depression cost of the tractor, operating cost of the tractor			3
2	1 , 4	4	Using planimeter/platometer measure given area of the land in map and calculate area of the land. Use Mobile app to plot, locate and measure the area of the land.	1	3	Using planimeter/platometer measure given area of the land in map and calculate area of the land. Use Mobile app to plot, locate and measure the area of the land.			3
2		5	Developmental Assessment			Assessment Review and corrective action			3
2	7	6	Industry Class + Industrial Assignment Industry Class on: Cost estimation and selection of tractor for different field work or Topic Related to material testing	2	3				
Learning outcomes (Week 3):									
At the end of the week the student will be able to:									
1. Inspect tractor chassis for crack, bent or twist.									
2. Service/ Troubleshoot of transmission systems in tractor.									
3	3	1 , 3	1	Tutorial (Peer discussion on Industrial assignment)		4	Tractors-	1	2

							1. Requirements of tractor, Classification/ Type of tractors and their applications, Wheeled type tractor parts & systems .2. Walk around check and identification of wheel type tractor components & show the various systems in tractors.		
3	1, 3, 4	2	Tractor Chassis: 1. Tractor chassis, Functions of tractor chassis frame, Types of tractor chassis frame, 2.Chassisless Tractor, Tractor having Chassis Frame, Tractor chassis section 3. Familiarization / Video demonstration on Tractor chassis.	2	2	Practice on visual Inspection of chassis frame for crack, bent and twists.		3	
3	1, 4	3	Tractor Transmission system: 1.Power Transmission system in Tractors- Functions. 2.Clutch in tractor –Requirement. 3. Gear box in tractor –Requirement- Types. 4. Familiarization of Tractor clutch assembly and its components and demonstration on clutch operation.	3	1	Compare/Observe Tractor transmission box with 4-wheeler gear box. (practice)		3	

	3	1 , 3	4	Service/Trouble shooting of clutch and gearbox		4	Servicing/ Overhaul Engine of Tractor			3
	3		5	CIE 1 - Written and Practice Test			Assessment Review and corrective action			3
	3		6	Visit to farm land or tractor showroom Check & observe different types of tractors in the market and also different manufacturers manual, compare the differences in different make and models.		5				
Learning outcomes (Week 4): At the end of the week the student will be able to: 1. <i>Adjustment of track width and ground clearance in tractor.</i> 2. <i>Perform general maintenance.</i> 3. <i>Service/ Troubleshoot braking system.</i>										
	3	4	1	Tutorial (Peer discussion on Showroom Visit), Report submission on visit.		4	Practice on <i>Adjustment of ground clearance in tractor (Video demonstration / Practice).</i>			3
	3	3	2	Practice on <i>Adjustment of track width and measure track width, wheel base (Video demonstration / Practice).</i>		4	<i>practice on tractor general maintenance</i>			3
4	3	1 , 3	3	Tractor Braking system: 1.Study of Braking system in tractors - types, Construction and working of Brake System – necessity of 2 brakes in tractor. 2. <i>Practice on checking & adjustment of tractor braking system.</i>	1	3	Troubleshooting the Tractor Brake, brake pedal.			3

	3	3	4	Tractor Differential: 1. Final drives - types of reductions - single reduction 2. Familiarization with tractor differential-single reduction	1	3	1. Double reduction final drives, Differential lock 2. Practice on Double reduction final drive & checking back lash in the differential.	1		2
	3		5	Developmental Assessment			Assessment Review and corrective action			3
	3		6	Industry Class + Industrial Assignment Industry Class on advancements in tractor transmission system	2	3				
Learning outcomes (Week 5): At the end of the week the student will be able to: 1. Fix the implements to PTO shaft and to troubleshoot PTO drive. 2. Service/ Troubleshoot the steering system.										
5	3	1	1	Tutorial (Peer discussion on Industrial assignment)		4	Power take-off shaft: 1. Power take off shaft – Necessity, Drive to PTO types –Transmission type, independent type & Continuous type PTO drive 2. Familiarization with tractor PTO shaft operation with Two or more PTO drive applications (Video demonstration/live practice)	1		2
	3	1, 3, 4	2	Practice on fixing of implements to the PTO shaft.		4	Troubleshooting the Tractor PTO drive			3

	3	1 , 3	3	Tractor Steering system: 1. Study of Steering system in tractors Necessity, Types of steering systems in tractors- wheeled type tractor. 2. <i>Familiarization /Practice on wheeled type tractor steering system</i>	1	3	<i>Troubleshooting the Tractor Steering system</i>			3
	3	4	4	<i>Adjustment of split front axle.</i>		4	Tractor Suspension system & Wheels: 1. Tractor Suspension system: Objective, Various Types of suspension in tractors 2. Wheels and Tyres of Tractor, Specification of Wheels & Tyres, Cage wheel & its applications.	3		
	3		5	CIE 2 - Written and Practice Test			Assessment Review and corrective action			3
	3		6	Industry Class + Industrial Assignment Industry Class on Power take-off shaft.	2	3				
Learning outcomes (Week 6): At the end of the week the student will be able to: 1. Troubleshoot tractor electrical system. 2. Hitching the implements to the tractor.										
6	3	1 , 2 , 4	1	Tutorial (Peer discussion on Industrial assignment)		4	<i>Familiarization on wheeled type tractor suspension system.</i>	1		2
	3	1 , 2	2	Tractor Electrical system:	1	3	<i>Troubleshooting the Tractor electrical system</i>			3

	4	<p>1. Tractor electrical system- functions, components of tractor electrical system</p> <p>2. Familiarization with tractor electrical system</p> <p>3. practice on checking the faults in electrical system.</p>						
3	1, 2, 4	<p>Hitch system in tractor:</p> <p>1.Hitch system in tractor- function, Types-Depth control, Draft control, position control.</p> <p>2.Hitch and control board of tractor hitch: Drawbar hitch, three-point linkage. Implement control.</p> <p><i>Video demonstration on hitching of implements to tractor</i></p>	2	2	Familiarization/ Practice on <i>Hitching of implements to the tractor.</i>			3
3	1, 2, 4	<p>Tractor hydraulic systems</p> <p>1.Tractor hydraulic systems- Necessity-fundamental components of hydraulic system & its functions.</p> <p>2. Familiarization/Practice on Construction & working of Tractor hydraulic system</p>	1	3	<p>1.Hydraulic systems applications in tractor, Lift mechanism – Depth wheel, Depth control- draft control- quick coupler</p> <p>2. <i>Familiarization on Construction & working of Tractor depth control & draft control (Video demonstration/ practice)</i></p>	1		2
3	5	Developmental Assessment			Assessment Review and corrective action			3
3	6	Industry Class + Industrial Assignment Industry Class on Tractor Hydraulic System	2	3				

Learning outcomes (Week 7):

At the end of the week the student will be able to:									
1. Troubleshoot the tractor hydraulic system 2. Service the power tiller and to add implements to power tiller.									
7	3	1 , 2 , 4	1	Tutorial (Peer discussion on Industrial assignment)	4		<i>Troubleshooting the Tractor Hydraulic system</i>		3
	3	1 , 2 , 4	2	Power tiller: 1.Introduction, role of Power Tiller in Agriculture, Types of Agriculture Tiller, Power Tiller Company in India. 2.Power Tiller Uses, Components, Operation, Power transmission in Power tiller. 3. <i>Video demonstration on Role of power tiller in Agriculture & other fields.</i>	2	2	Power Tiller: 1. <i>Walk around check and identification of Power Tiller components & its systems.</i> 2. <i>Service or Troubleshooting of power tiller.</i>		3
	3	1 , 3	3	Power Tiller attachments: 1. Attachments on a power tiller- Cage Wheel, Plough, Extension wheels 2. <i>Familiarization/ Video demonstration on working of cage wheel, Plough, Extension wheels used in power tiller and to add the above attachments to the power tiller.</i>	1	3	1.Water Pump, Potato Digger, Tyne Cultivator, Seed Cum Fertilizer Drill 2. <i>Familiarization/ Video demonstration on the working of Water Pump, Potato Digger, Tyne Cultivator, Seed Cum Fertilizer Drill used in power tiller and to add the above attachments to the power tiller.</i>	1	2
	3	1 , 2	4	1. Sprayer Unit, Slasher, Shredder in agriculture, Ridger (Furrower).	1	3	1. Axial Flow Thresher, Reaper, Leveller, Cultivator 2. <i>Familiarization/ Video demonstration on Axial Flow Thresher, Reaper, Leveller, Cultivator used in</i>	1	2

		4	2. Familiarization/ Video demonstration on Sprayer Unit, Slasher, Shredder in agriculture, Ridger (Furrower) used in power tiller and to add the above attachments to the power tiller.				power tiller and to add the above attachments to the power tiller.			
	3		5	CIE 3 - Written and Practice Test			Assessment Review and corrective action			3
	3	1, 2, 4	6	Visit to Tractor Service Centre and look into the power tillers and attachments		5				
Learning outcomes (Week 8): At the end of the week the student will be able to: <ol style="list-style-type: none"> Adjust the agricultural implements based on the need of the job. Field testing of different agricultural implements. 										
	4	2, 4	1	Tutorial (Peer discussion on Industrial assignment/ Industrial visit) & Report Submission on service center visit		4	1. Trailer, Power Tiller Operated Generator, Auger Digger 2. Familiarization/ Video demonstration on working principle and application of Trailer, Power Tiller Operated Generator, Auger Digger used in power tiller	1		2
8	4	2, 4	2	Agricultural Implements: 1. Tillage: Primary and secondary tillage equipment, Plough-purpose-chisel plough, Mould board Plough-Construction- types 2. Practice on Plough mounting & basic adjustments-depth of cut, Cutting angle etc.	1	3	1. Disc plough-specification, Uses, Main parts of Disc plough, Direct mounted disc plough, Disc scrapper, Furrow wheel 2. Practice on Adjustment of cutting angle in disc plough to various soil conditions.	1		2
	4	2, 4	3	Secondary Tillage:	1	3	1. Levelling and puddling implements & its maintenance-Specification-use	1		2

			1. Secondary tillage implements- Purpose-types, Disc harrow-types-construction & operation-Uses 2. Practice on Operating hints, Maintenance of Disc harrow			2. Cultivators-types-uses-care & maintenance. 3. Field testing/Video demonstration on levelling, puddling, cultivator plough			
4	2 , 4	4	Cage wheel: 1. Necessity, Construction, application, specification of cage wheel 2. Practice on mounting the cage wheel to tractor.	1	3	Sowing and Planting: 1.Introduction, methods of sowing-Broadcasting-Dibbling -Drilling- Seed dropping behind the plough- 2. Transplanting- Hill dropping (manual, mechanical), precautions while sowing the seeds. 3. Field testing/ Video Demonstration of sowing and planting equipment.	1		2
4		5	Developmental Assessment			Assessment Review and corrective action			3
4	2 , 4	6	Industry Class + Industrial Assignment Industry Class on: Agricultural implements	2	3				

Learning outcomes (Week 9):

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

1. Field testing of different agricultural implements.

9	4	2 , 4	1	Tutorial (Peer discussion on Industrial assignment) & Report Submission on mines visit.		4	1. Seed drill-function-components of seed drill- Construction and working of seed drills, no-till drills and strip-till drills. 2.Field-testing and adjustment / Video demonstration of seed drill	1		2
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4	2 , 4	2	Planter: 1.Planter-Functions-Construction and working of planters, rice transplanters. 2. <i>Field-testing and adjustment / Video demonstration of rice transplanter</i>	1	3	Threshers: 1.Introduction, Functions of Power threshers, types of power threshers, Main components of threshers, Principle of threshing 2. Functions- Feeding Hopper, threshing unit, cleaning unit, power transmission unit, main frame and transport unit 3. <i>Field-testing / Video demonstration of Threshers.</i>	1		2
4	2 , 4	3	Fertilizer Equipment: 1.Importance of Fertilizer application, Fertilizer drill machine, fertilizer spreader-types- Constructions 2.Pesticide sprayer- Sprayer nozzle- types. Pumps for spraying etc 3. <i>Field-testing and adjustment / Video demonstration of fertilizer sprayer</i>	1	3	Harvesting: 1. Introduction- Types- Principle of cutting crop- 2. Harvesting machine- Reaper, Tea leaf harvesting machine, Maize/corn harvesting machine, Palm harvester. 3. <i>Field operation practice/video demonstration on reaper and & other harvesting machine</i>	1		2
4	2 , 4	4	Rotavator: 1. Features-Specifications –Types- Use 2. <i>Field operation practice/video demonstration on Rotavator.</i>	1	3	Trailer: 1.Features-Types-Uses 2. <i>Field operation practice/video demonstration on Trailer</i>	1		2
4		5	CIE 4 - Written and Practice Test			Assessment Review and corrective action			3
4	2 , 4	6	Industry Class + Industrial Assignment Industry Class on Fertilizer equipment and advance techniques used.	2	3				

Learning outcomes (Week 10): At the end of the week the student will be able to:										
1. Demonstrate and implement future enhancements on farm technologies 2. Operate different government portals related to farming & to help claim benefits given to farmers.										
10	5	2 , 4	1	Tutorial (Peer discussion on Industrial assignment)	4		Future of Farming Technology: 1. Introduction, agriculture industry facing challenges - An elevated increase in Demographics will boost Demand for food	3		
	5	2 , 4	2	1. current uses of Natural resources are Highly stressed 2. direct and indirect causes of degraded farmland 3. Climate change is Reducing productivity In agriculture	2	2	1. Food waste is a massive Market inefficiency and an Environmental threat 2. Outcome: poverty and hunger 3. Agriculture 4.0: disrupting the system is doable with new technologies	3		
	5	2 , 4	3	1. Agriculture 4.0: Produce differently using new techniques 2. Use new technologies to bring food production to consumers, increasing efficiencies in the food chain- Vertical and urban farming. 3. Genetic modification and Cultured meats	2	2	<ul style="list-style-type: none"> • Applying 3d printing Technology to food • <i>Video demonstration of 3d printing Technology in food industry.</i> 	1		2

	5	2 , 4	4	<p>Farm Portal (Website): Demonstration and practice on how to operate/use the portal, their benefits to farmers.</p> <ul style="list-style-type: none"> • Various schemes for farmers by state and Central government and how to claim that- Requirement, Documents to be produced etc. • KKISAN, DEPARTMENT OF AGRICULTURE & FARMERS WELFARE - Demonstration and practice on how to operate/use the portal, their benefits to farmers. 		4	<p>Farm Portal: Demonstration</p> <ul style="list-style-type: none"> • Benefits and Subsidies provided by government for various agricultural implements purchase, pump set etc. • How to operate/browse into the farm portal. 			3
	5		5	Developmental Assessment			Assessment Review and corrective action			3
	5	2 , 4	6	Industry Class + Industrial Assignment Industry Class on Government schemes like kisan Yojana etc.	2	3				
Learning outcomes (Week 11):										
1. Demonstrate and implement future enhancements on farm technologies										
11	5	2 , 4	1	Tutorial (Peer discussion on Industrial assignment)		4	Incorporate cross industry technologies and applications- drone technology		3	

							Incorporate cross industry technologies and applications- Blockchain and securing the agriculture value chain Nanotechnology and precision agriculture			
5	2 , 4	2	Food sharing and crowd farming the role of government- Traditional industry promoter/facilitator	1	3	<p>1. Some Modern Agriculture Technology-Semi-automatic robots, Drones used in agriculture</p> <p>2. <i>Video demonstration on Semi-automatic robots used in agriculture.</i></p> <p>3. <i>Video demonstration on Drones used in agriculture.</i></p>			3	
5	2 , 4	3	<p>Smart Farming:</p> <p>1. Introduction, Difference between Traditional & Smart farming,</p> <p>2. Impact of new technology in Agriculture.</p> <p>3. Video demonstration on smart farming</p>	1	3	<p>1. Role of SAAS-based cloud software in smart farming</p> <p>2. Benefits of smart farming using SaaS solutions</p> <p>3. <i>Video demonstration on SAAS based cloud software in smart farming</i></p>	1		2	
5	2 , 4	4	<p>1.IoT-based remote sensing equipment used agriculture, Advantages of IoT in Agriculture</p> <p>2. Computer imaging in smart agriculture</p>	1	3	1.Applications of Cloud-based Software in Agriculture			3	

			3. <i>Video demonstration on IoT based remote sensing & Computer imaging in agriculture.</i> 4. Role of Digital Farming Technology Preseason, in-season, Post-season intervention			2. Differences between IoT and SaaS solutions to consider before investing in one 3. <i>Video demonstration on Cloud based software in Agriculture</i>			
	5	5	CIE 5 - Written and Practice Test			Assessment Review and corrective action			3
	5	2, 4	Industry Class + Industrial Assignment Industry Class on IOT/ Computer imaging/ Cloud-based Software in smart agriculture		4				
Learning outcomes (Week 12):									
At the end of the week the student will be able to:									
1. Apply drone in farming applications.									
12	5	2, 4	1	Tutorial (Peer discussion on Industrial Visit)	4	1. <i>Case study on Smart farming</i> 2. <i>Case study on Smart farming Technology involving in India.</i>	1		2
	5	2, 4	2	Agro- chemical spraying using Drone: 1. Introduction to agricultural drone, Drone and their uses. 2. Identify & select different types of Drones Identify basic concepts of Drones 3. Critical parameters considered while spraying in field using drone	4	Safe application standards: Use of PPE kit, Basis maintenance issues. Field practice on care and maintenance.	1		2
	5	2, 4	3	Practice on flying a drone using drone simulator/ Drone		4	Practice on flying a drone using drone simulator/Drone		

5	2 , 4	4	Practice on flying a drone using drone simulator/ Drone		4	Practice on flying a drone using drone simulator/ Drone		3
5		5	Developmental Assessment			Assessment Review and corrective action		3
5	2 , 4	6	Field Visit where drone is used in spraying/ for any agricultural practices		5			
Learning outcomes (Week 13): At the end of the week the student will be able to: 1. Demonstrate the mini project which he has worked on.								
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. 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.					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 will have from a technical, social and business perspective. b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified. 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.		40 Hrs.

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

Model Questions CIE-1

Programme	Automobile Engineering	Semester	V		
Course	Farm Machinery and equipment	Max Marks	30		
Course Code	20AT51I	Duration	4 hours		
Name of the course coordinator					
Note: Answer one full question from each section.					
Qn. No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) – 10 marks					
1.a)	Justify the statement “weather and climate affect the agriculture productivity”.	L4	1	1,2	4
b)	A plot of 1000X800 m is to be drilled by a corn planter. The planter is having 6 rows with spacing of 120 cm. The speed of travel of planting is 5 kmph. Assume that the time lost in each turn is 10s and time lost in filling the seed hopper is 10 min per hectare. Take an overlap of 15 cm in each run. Find the field efficiency of the machine.	L3	2	1,4	6
2.a)	Erosion of soil can be controlled by various methods; how can erosion be controlled by contour cropping.	L3	1	1,2	5
b)	Farmer is planning for the compaction of soil for cultivation, how do you calculate the cost of operation of implement, Explain.	L4	2	1,4	5
Section-2 (Practical) - 20 marks					
3)	A tractor has been towed to a garage with defect ‘NOT STARTING’. Check for the causes for this defect and give the remedial solution.	L3	3	1,3	20

4)	When clutch is pressed and released, the driver observes the poor release of the clutch. What might be the problem, identify and give the remedial solution	L3	3	1,3	20
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Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme :	Automobile Engineering	Max Marks :	100	
Semester :	V	Duration :	3 Hrs	
Course :	Farm Machinery and equipment			
Course Code :	20AT51I			
Instruction to the Candidate: Answer one full question from each section.				
Q.No	Question	CL	CO	Marks
Section-1				
1.a)	“Agricultural machinery helps to mechanize the work of agriculture”, Justify the statement, Distinguish benefits and limitations of farm mechanization.	L4	1	10
b)	Erosion of soil can be controlled by various methods; how can erosion be controlled by contour cropping.	L3		10
2.a)	How the nitrogen in the soil can be increased and how does nitrogen help in productivity of the crop.	L3		10
b)	Justify the statement “weather and climate affect the agriculture productivity”.	L4		10
Section-2				
3.a)	Farmer is planning for the land preparation for rice plantation, how do you calculate the cost of operation of implement, Explain.	L4	2	10
b)	A plot of 1000X800 m is to be drilled by a corn planter. The planter is having 6 rows with spacing of 120 cm. The speed of travel of planting is 5 kmph. Assume that the time lost in each turn is 10s and time lost in filling the seed hopper is 10 min per hectare. Take an overlap of 15 cm in each run. Find the field efficiency of the machine.	L3		10

4.a)	For a farm machinery is there a need for depreciation calculation? Explain about different methods for estimation of depreciation of farm machinery	L4		10
b)	Determine Theoretical Field Capacity for a machine that travels at 5.0 kmph and has an operating width of 20m. Say loss time is 0.75 hrs in a 10 hr day, what is the effective Field capacity?	L3		10
Section- 3				
5.a)	The tractor front wheels are smaller in comparison to the rear wheels, what is need for this type of design? What are the technical advantages of this arrangement?	L4	3	10
b)	The tractor has some problem, the mechanic checks and states the fault is in the clutch. Illustrate the minimum 3 signs of bad clutch in farm tractor and how to overcome it.	L3		10
6.a)	If the performance of your tractor starts decreasing over time, most likely the fuel system is probably what's malfunctioning. How does this effect the performance of the tractor and what is its remedial solution	L4		10
b)	A tractor has been towed to a garage with defect 'NOT STARTING". What can be the likely causes for this defect and how will you trace the same.	L3		10
Section-4				
7.a)	With a neat sketch Construction and working of seed drills	L3	4	10
b)	What are the adjustments needed from disc plough for better working condition under field condition.	L4		10
8.a)	Distinguish between mould board plough and disc plough with neat sketches	L4		10
b)	What are the procedures to be followed for the maintenance of the disc plough	L3		10
Section-5				
9.a)	How using SaaS solutions can benefit of smart farming. Justify the statement "Remote management of the farm" in smart farming.	L4	5	10
b)	In farmer portal, NMSA- What are the objectives of soil health card scheme	L3		10
10.a)	What is the smart farming solution, its essential features and its contribution to crop health management?	L3		10

b)	"Drone in agriculture" Justify the statement - drone help in productivity of the farming.	L4		10
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Sample Question & Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
Problem statement	Estimate the time required to cultivate land by using disc plough, based on type of soil, type of tractor and implement.	
1	Collection of data	20
2	Analyze the given Problem	20
3	Preparation of specification table	20
4	Result/ Calculation	20
5	Viva voce	20
Total		100

Equipment:

Sl. No.	Particulars	Quantity
1.	Planimeter/Platometer	5
2.	Tractor	1
3.	Power Tiller	1
4.	Cage Wheel	1
5.	Disc plough	1
6.	Sowing and planting Equipment	1
7.	Threshers	1
8.	Pesticide sprayer	1
9.	Harvesting machine	1

10.	Drone	1
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References

Sl. No	Description
1	Farm Mechanization for Production by <u>Dhirendra Khare, S.B. Nahatkar, A.K. Shrivastava, A.K. Jha</u> (Scientific Publishers, 2018)
2	Introductory Farm Machinery and Equipments Engineering by Amaresh Sarkar
3	Agronomy of Field Crops by SR Reddy by <u>Craig C & Kristine M Moncada Sheaffer</u>
4	Introduction To Agronomy Food, Crops, And Environment by Craig C & Kristine M Moncada Sheaffer
5	Fluid power Engineering by RK Hegde & Niranjana Murthy
6	Farm machines and Equipment by C.P. Nakra
7	Fluid power transmission and control system by P.G. Mundas
8	Farm Tractor Maintenance and Repairs” by S C Jain
9	Farm Tractors (Olyslager Auto Library)” by Olyslager Organization
10	Tractors and Agricultural Machinery by Srinivasan, VV Narayanan, Sanjeev kumar singh, Geetha Lakshmi (Publisher: New India Publishing Agency)
11	FARM TRACTOR, POWER TILLER MAINTENANCE & REPAIR by S.C. JAIN, C.R. RAI
12	Agricultural Drones by Krishna K. R.
13	Quadcopters and Drones: A Beginner's Guide to Successfully Flying and Choosing the Right Drone Publisher : Createspace Independent Pub (25 June 2015) by Mark Smith.



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Automobile Engineering	Semester	V
Course Code	20AT52I	Type of Course	104:52:312
Course Name	Construction and Earthmoving Equipment	Credits	24
CIE Marks	240	SEE Marks	160

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.

Course Cohort Owner

A Course Cohort Owner is a faculty from the core discipline, who is fully responsible for one specialised field of study and the cohort of students who have chosen to study that specialised field of study.

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: • Selection of machines based on type of soil • Haul distance • Weather condition 	4			Soil Stabilization Methods and Equipment for:	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"> • Compaction • Additives • Dewatering • Freezing. Maintenance Management		3
	5		Developmental Assessment			4	Assessment Review and corrective action	-	3
	6	Industrial Class + Industrial Assignment	Industry Class on	2		3			
			Planning and Management of construction Construction equipment						

				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=YrYdZ6j8Qxl 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
<p>Learning outcomes (Week 5): At the end of the week the student will be able to:</p> <ol style="list-style-type: none"> 1. Review the Engine and other features related to engine. 2. Trouble shoot and service the steering system of earth moving vehicles. <p>Demonstrate the Controls of the shovel</p>											
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

			2. Steering of tracked vehicles - Skid steering - clutch /brake steering system- construction and working 3. Planetary steering system - construction and working. 4. Differential steering system - construction and working of each type. 5. Articulated steering- construction & working.							
		3	Power shovels: 1. Introduction to power shovels and its basic parts- Specifications. 2. Types and sizes of power shovels. 3. <u>Selecting the Types and Size of Power shovels.</u> 4. Optimum Depth of Cut.	2		2	<u>Factors affecting the output of power shovel-</u> <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	Shovel Controls: <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	Operation of Power shovel- <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"> Tyres and wheels- Practice on wheel changing Checking Lubrication and hydraulic system Checking Oil levels – engine sump, transmission and differential case 		4	Pre-operational checks and maintenance of power shovel – <ol style="list-style-type: none"> Hydraulic oil level reservoir. Engine coolant level Air filter and air intake Fan belt 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	CO	PO	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 – <i>EGR system (Servicing and troubleshooting)</i>	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. <i>Operating mechanism of bucket in excavator.</i> 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	<i>Servicing of bucket, frame, swing.</i>			3
			3	Practice on <i>Under Carriage Track adjustment</i>			4	<i>Practice on changing the track/ Remove and refit Track chain assembly.</i> https://www.youtube.com/watch?v=1vclSITq10			3
			4	<i>Adjusting working attachment for correct functioning during field operation.</i>			4	<i>Maintenance and Regular check-up of excavators</i> https://www.youtube.com/watch?v=-9qdCiSgJ-8			3

			5	Developmental Assessment			4	Assessment Review and corrective action		3	
			6	Construction site Visit			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			
Learning outcomes (Week 13):									
At the end of the week the student will be able to:									
1. Demonstrate the mini project which he has worked on.									
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. 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.					Project 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 will have from a technical, social and business perspective. b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified. 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.			40 Hr s

4. CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

Model Questions CIE-1

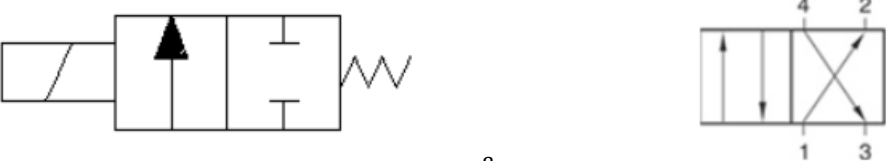
Programme	Automobile Engineering	Semester	V		
Course	Construction and Earthmoving Equipment	Max Marks	30		
Course Code	20AT52I	Duration	4 hours		
Name of the course coordinator					
Note: Answer one full question from each section.					
Qn. No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) – 10 marks					
1.a)	With proper justification, explain how soil help us decide the type of earthmoving equipment need for that purpose?	L4	1	1,2	5
b)	Why are 5/2 valves commonly used for pneumatic control of double acting cylinder whereas hydraulic systems use 4/2 valves, what is the extra port for.	L3	2	1,4	5
2.a)	With a neat Circuit diagram of Meter-in and meter-out, explain how both are different from each other.	L3	2	1,2	5
b)	The site manager needs the excavator for a month, it's a monsoon season he is not sure the number of hours it will be working at site and is in a dilemma whether to rent or lease the excavator, what do you suggest. Write the answer with proper justification.	L4	1	1,4	5
Section-2 (Practical) - 20 marks					
3)	In the given hydraulic system has excessive operating temperature, also the expert had suggested there might be a possibility of pressure filter block. How do you resolve the problem	L4	2	1,3	20

4)	In the given hydraulic system, the cylinder has air in the system, how do you overcome this situation.	L4	2	1,3	20
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Note : Theory questions shall be aligned to practical questions

**Assessment framework for SEE 1 (Theory)
Sample Question Paper**

Programme :	Automobile Engineering				Semester: V
Course :	Construction and Earthmoving Equipment				Max Marks: 100 Marks
Course Code :	20ME52I				Duration: 3 Hrs
Instruction to the Candidate: Answer one full question from each section.					
Q.No	Question	CL (L3/L4)	CO	Marks	
Section-1					
1.a)	With proper justification, explain how soil help us decide the type of earthmoving equipment need for that purpose?	L4	1	10	
b)	It is said that maintenance management of construction equipment's is very essential in construction firm. Justify the statement with proper points.	L3		10	
2.a)	Compare Depreciation calculation method straight-line method and double declining balance method. Which method is best suitable for calculating depreciation cost of construction equipment, Justify your answer.	L3		10	
b)	The site manager needs the excavator for a month, it's a monsoon season he is not sure the number of hours it will be working at site and is in a dilemma whether to rent or lease the excavator, what do you suggest. Write the answer with proper justification.	L4		10	
Section-2					
3.a)	Why are 5/2 valves commonly used for pneumatic control of double acting cylinder whereas hydraulic systems use 4/2 valves, what is the extra port for. Draw the sketch of 5/2valve and 4/2 valve double acting cylinder.	L3	2	10	
b)	What is the characteristic of the diagrams given below	L4		10	

				
4.a)	Conclude that why hydraulic systems are preferred for heavy work than the pneumatic systems.	L3		10
b)	Which is the circuit in which the hydraulic motor is located after the speed control valve is, Explain the circuit with neat sketch	L4		10
Section- 3				
5.a)	This is the equipment used in construction site to clear the site, level land etc. Which is this equipment and how does it help in the process stated above. If you have to buy or rent the bulldozer, how does its size be measured and why?	L4	3	10
b)	The contractor has to build a road, but there are few buildings which has to be demolished and also some trees which uprooted and planted few meters apart. Which earthmover is better for the job, justify your answer. With a neat sketch explain its components.	L3		10
6.a)	“The crawler mounted bulldozer is sometimes advantageous over wheel mounted bulldozers” how do you justify the statement.	L4		10
b)	While choosing the excavator teeth which are the factors to be looked to be considered. What is the type of excavator teeth and how they are different from each other.	L3		10
Section-4				
7.a)	“Dumper still tip over when travelling on a gentle gradient even if it's not overloaded or being driven too fast” How can it happen, explain with proper justification? State 2 requirements of using a stop block or earth bank at a trench discharging point	L4	4	10
b)	The operator has been asked to tip material into a new trench, Name 5 requirements that must be followed before tipping and why	L3		10
8.a)	What decides the minimum distance that machines must keep from overhead lines and why must the distance be kept.	L3		10
b)	In commercial trucks, the hydraulic fluid has turned milky and is the indicator of water contamination. How can we mitigate the presence of water in hydraulic system.	L4		10

Section-5				
9.a)	The blind spots in trucks are also called as No Zones, which are the 4 blind spots in commercial trucks. What are the tips to be followed to avoid truck accidents.	L3	4	10
b)	Which belt conveyor prevents sliding down of material at an inclination of 55° with horizontal. Explain with neat sketch	L4	4	10
10.a)	For a given depth of cut, the output of a power shovel can be increased by decreasing the angle of swing. Is the statement true or false, justify your answer.	L3	3	10
b)	The power shovels are suitable in close range works of excavation. How?	L4	3	10

Sample Question & Scheme of Evaluation for SEE 2

Sl No	Description	Marks
Problem statement	The operator of a mini excavator observes the hydraulic leak. Take the necessary steps to resolve this problem. (Hint: check seals and gaskets)	
1	Problem analysis	10
2	Problem identification	10
3	Equipment/ tools used to repair or replacement	10
4	Dismantling & assembling along with replacing or servicing of given case	30
4	Result (solved the problem or not/ whether it is working condition)	20
5	Viva voce	20
Total		100

Equipment:

Sl. No.	Particulars	Quantity
1	Bench mounted Test Rig for Venturi meter	1
2	Hydraulic Single acting/ Double acting cylinder Kit	1
3	Pneumatics Trainer Kit with all standard accessories.	1
4	Any opensource simulation software	1
5	EGR System	1
6	CRDI System	1
7	Excavators	1
8	Bull-Dozer	1
9	Mining truck	1

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.



Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Program	Automobile Engineering	Semester	V
Course Code	20AT53I	Type of Course L:T:P	104:52:312
Specialization	Automation & Robotics	Credits	24
CIE Marks	240	SEE Marks	160

Introduction :

Welcome to the curriculum for the Specialisation Pathway – **Automation and Robotics**. 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.

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 fulfils 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 fulfils repetitive functions or tasks. This course attempts to provide basic theoretical and practical aspects of automation technologies to develop operational competency, also gives a knowledge on robotics. Hence this course is the foundation for diploma engineers who want to further specialise 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 bootcamp, you shall be equipped to either do an **Internship** in an organisation 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 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.

Course Cohort Owner

A Course Cohort Owner is a faculty from the core discipline, who is fully responsible for one specialised field of study and the cohort of students who have chosen to study that specialised field of study.

Instruction to 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 session 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 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 can augment or use for supplementally teaching on line courses available although 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: A student should be able to

C01	Select the right sensor and/or actuator for automating a given application and demonstrate process variables using sensors and/or transducers.
C02	Perform specified control functions using a Programmable Logic Controller (PLC) and list various applications of embedded systems
C03	Design and test an automation system for a required operational specification and troubleshoot to resolve any given issue
C04	Identify the possibilities of automation in a production system
C05	Develop, simulate, interface and Execute Robot Program for a specified process

Detailed course plan

(Week 1):

Week	CO	PO	Days	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>Note: Connect each sensor directly to the LED/Lamp with appropriate power supply</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>Note: Connect each sensor directly to the LED/Lamp with appropriate power supply</p>		3
		5	Developmental Assessment				Assessment Review and corrective action		3
		6	<p>Industrial Class + Industrial Assignment</p> <p>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	-	1. Input devices: • Strain Gauges • Pressure Sensors • Liquid level detectors 2. Input devices: • Fluid flow measurement • Smart Sensors 3. Output Devices: • Relay • Directional control Valve	2	1
	1	1	2	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: 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		<i>Simulate a ladder diagram for car parking.</i>		4	<i>Design ladder diagram for operating and controlling the Lift.</i>			3
2, 4	2, 7	3		<i>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.</i>		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		Present a Robotic Coordinate system using a robot <ul style="list-style-type: none"> Joint co-ordinate system Rectangular co-ordinate system User or object coordinate system Tool coordinate system. Steps to define user co-ordinate system. <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	Present an overview of the Robotic Cell <ul style="list-style-type: none"> Identify the Robotic Cell Components & Application tools 			4	Perform Mechanical Installation check of robot <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	Perform Electrical Installation check of robot <ul style="list-style-type: none"> Checking of the electric connections- Earthing cable, power cable, Pneumatic pipes etc 	2		2	Powering on the Robot and making the cell Healthy for programming <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 Programming + 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 Programming + 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 <ul style="list-style-type: none"> • 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		Weekly Assessment CIE 5 - Written and Practice Test				Assessment Review and corrective action			3
	5	2, 4	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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CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

CIE 1- Model Question Paper

Programme	Automobile Engineering	Semester	V		
Course	AUTOMATION & ROBOTICS	Max Marks	30		
Course Code	20AT53I	Duration	4 hours		
Name of the course Coordinator					
Note: Answer one full question from each section.					
Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) – 10 marks					
1.a)	Construct Standard symbols used for input & output devices in PLC (Any 3)	L3	1	1	5
b)	How the ladder diagram is different from normal circuit diagram	L4	2	2	5
2.a)	Build Ladder Diagram for any 4 logic gates. Compare any three gates with circuit diagram & truth table.	L4	1	1	5
b)	Develop a PLC ladder diagram to construct a signal, if one input is ON, red light will switch ON and if two inputs are ON, Green light will switch on	L3	3	3	5
Section-2 (Practical) - 20 marks					
3)	Select a suitable Sensor / Switch for a given Process Variable and activate <ul style="list-style-type: none"> • Selection of Sensor/Transducer – 05Marks • Activation and Result – 15 Marks 	L4	1	1	20
4)	Develop and simulate a simple ladder diagram for a given Case <ul style="list-style-type: none"> • Writing Ladder Program – 10 Marks • Simulate and Troubleshoot - 10 Marks 	L4	2	2	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme :	Automobile Engineering	Max Marks :	100
Semester :	V	Duration :	3 Hrs
Course :	AUTOMATION & ROBOTICS		
Course Code :	20AT53I		

Instruction to the Candidate: Answer one full question from each section.

Q.No	Question	CL	CO	Marks															
Section-1																			
1.a)	Draw a ladder diagram for a given truth table <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>A</td> <td>B</td> <td>Y</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> </table>	A	B	Y	0	0	1	0	1	0	1	0	0	1	1	0	L3	1	10
A	B	Y																	
0	0	1																	
0	1	0																	
1	0	0																	
1	1	0																	
b)	Justify the statement "Automation increases the manufacturing flexibility" with relevant example.	L4		10															
2.a)	The conveyer is transporting only metals. Suggest the appropriate sensor for detecting these objects and explain how that particular sensor works with sketch	L4		10															
b)	Justify the importance of Emergency stop in automation	L3		10															
Section-2																			
3.a)	Write a PLC Ladder Program Providing lubricant for the gear box before the lathe spindle starts to run which aims to ensure that the oil pump motor starts first and the main motor starts subsequently.	L4	2	10															
b)	Compare PLC with Relay logic Circuit	L3		10															
4.a)	Write a PLC Ladder Program such that Once the photoelectric sensor detects 10 products, the robotic arm will begin to pack up. When the action is completed, the robotic arm and the counter will be reset	L4		10															
b)	Construct the relay circuit to switch ON 220V motor using 24V DC signal (Use IEC symbols)	L3		10															
Section- 3																			

5.a)	Design a ladder diagram in the parking area, such that the Number of parking space available has to be shown and once the car enters the parking & car has to be detected while entering the parking space and the number of available parking space has to be minus one.	L4	3	10
b)	Develop a PLC ladder diagram to construct a signal, if one input is ON, red light will switch ON and if two inputs are ON, Green light will switch on	L3		10
6.a)	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.	L4		10
b)	Develop a PLC ladder diagram to construct a signal, if any 2 inputs are ON, an alarm sirens sound, If 3 inputs are ON, the relevant department is to be notified.	L3		10
Section-4				
7.a)	Compare thermocouple and RTD. Which type of sensor are used in automobile industry, justify your answer.	L3	4	10
b)	The automobile company has a huge demand for "A" model car, also they have orders for model "B" as well, both run in same assembly line. But there is a problem that the few sensors used in model "A" is getting delayed. How can you manage to solve this problem by using FMS.	L4		10
8.a)	The conveyor is transporting only metal. Suggest the appropriate sensor for detecting these objects. Explain its working with sketch.	L3		10
b)	The AMRS system increases productivity and save floor space, Justify the statement.	L4		10
Section-5				
9.a)	Compare the various attributes of robot with those of human being. Explain the robot structure with sketch	L4	5	10
b)	A robot does replace humans where the complicated works are involved. In Robots What do you understand by degrees of freedom, how many DOF's are required to position an end effector at any point in 3D space	L3		10
10.a)	Is robotics an automation. Sketch and explain servo control system for point-to-point positioning.	L4		10
b)	Classify the robots according to the coordinates of motion. with a sketch and example, explain the features of each type.	L3		10

Scheme of Evaluation for SEE 2:

Sl. No	Description	Marks
Problem Statement	A concrete manufacturing company are involved in supplying quality concrete products to the building industry. Their supply was getting delayed due to conventional process of handling the products. The process involved lifting 3 concrete slabs at a time and place on the infeed conveyor. After processing they are placed into 2 stacks of products on to the outfeed conveyor. Device a robot program to provide solution for the above process.	
1	Analyse of the problem	20
2	Writing robot program to solve the above problem	20
3	Simulate the program	20
4	Check for results	20
5	Viva voce	20
Total		100

Equipment:

Sl. No.	Particulars	Quantity
1	PLC Trainer Kit with the following Modules <ul style="list-style-type: none"> • Door Controller • Car Parking Application • Water Level Controller • Conveyor Controller Application • Lift control Application With different Length Patch Cords	5
2	Switches <ul style="list-style-type: none"> • Mechanical Switches 	5

	<ul style="list-style-type: none">• Proximity Switches• Photo electric Sensors and Switches	
3	Sensors <ul style="list-style-type: none">• Temperature Sensors• Position/Displacement Sensors• Strain Gauges• Pressure Sensors• Liquid level detectors• Fluid flow measurement• Smart Sensors• Proximity Sensors	5
4	Induction Motor with DOL Starter (3 Phase Ac 50 Hz)	1
5	Synchronise Motor with DOL Starter (3 Phase Ac 50 Hz)	1
6	Stepper Motor (Standard size)	1
7	Relays (Standard size)	10
8	Counter and Timers (Standard size)	10
9	Robot	1
10	Any open source simulation software	

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



Government of Karnataka

DEPARTMENT OF COLLEGIATE and TECHNICAL EDUCATION

Program	Automobile Engineering	Semester	5
Course Code	20AT54I	Type of Course	L:T:P (104: 52: 312)
Specialization	Electric and Hybrid Vehicle Technology	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

Welcome to the curriculum for the Specialisation Pathway – **Electric and Hybrid Vehicle Technology**. 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.

Vehicle is a fundamental requirement of modern life, but the CI engines is 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 bootcamp, you shall be equipped to either do an **Internship** in an organisation 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, Shopfloor technician, 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.

Course Cohort Owner

A Course Cohort Owner is a faculty from the core discipline, who is fully responsible for one specialised field of study and the cohort of students who have chosen to study that specialised field of study.

Instruction to 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 session 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/Service center/showroom 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 can augment or use for supplementally teaching on line courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademic, SWAYAM, etc.
10. Report should be maintained for industrial/field visit, such report shall be considered as industrial assignment.

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.

Detailed course plan

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	<p>Introduction to the course.</p> <p>About Specialization – Future-Companies and Service sectors in India and outside India, Career opportunities.</p> <p>History of electric vehicle. Components of electric vehicle.</p>	2		2	<p>Indian and global scenario:</p> <p>Technology Scenario.</p> <p>Market Scenario – Market overview, market trends.</p> <p>Benefits and Challenges of EV's.</p> <p>The future scope of electric vehicles.</p>	2		1
	1	1	2	<p>Policies and Regulations:</p> <p>Polices in India – Incentives, PLI (Production Linked Incentive) scheme, battery swapping policy, special E-mobility zone.</p> <p><i>Using Web browser, Practice to search and applying for PLI scheme.</i></p>	2		2	<p>Regulations for EV in India:</p> <p>Need for regulation and standards, ARAI Regulations and standards, Category and Type of Approval Required for EVs.</p>	3		
	1	1,2	3	<p>RTO Regulations for EVs:</p> <p>Electrical car registration and road tax, Driving licence policies for EV, Number plate policy for EV, RTO permission for Advertising on EVs.</p>	2		2	<p>Comparison- EV with IC engine vehicles technology, EV Configuration. EV classification and EV Terminology. Video demonstration.</p>	2		1

	1	1,2	4	Basic Vehicle Performances: Introduction, Tractive Effort, Vehicle Resistance-Rolling Resistance Force, Aerodynamic Drag, Gradient resistance. <i>Calculation of the Acceleration, Range, Gradeability and Maximum speed of BEV's</i>	2		2	<i>Calculation of the Acceleration, Range, Gradeability and Maximum speed of BEV's</i>			3
	1		5	Developmental Weekly Assessment				Assessment Review and corrective action			3
	1		6	Industry Class on environmental impact analysis and economical analysis of EV +Industry assessments	2		3				
2	1	2,4	1	PEER Discussion on Industry Assignment		4		<i>Calculation of the Acceleration, Range, Gradeability and Maximum speed of BEV's</i>			3
	1,2	2,4	2	Vehicle power plant: Compare Typical performance characteristics of gasoline engines and Typical performance characteristics of electric motor for traction (<i>By showing the graph, traction motor characteristics</i>) Battery Technology: Types of batteries - Lead Acid, Lithium Ion, Lithium Potassium, NiMH (Nickel metal hydride battery), Aluminium air.	2		2	Battery terminologies - SoC, DoD, SoH. <i>Battery charging and discharging calculation.</i> <i>Cell selection and sizing.</i> <i>Battery layout design.</i> <i>Battery pack configuration.</i>			3
	2	2,4	3	Battery selection criteria. Battery pack construction. Lithium battery manufacturing process.	2		2	<i>Cell selection and sizing, handling cells, understanding cell charging and discharging curves.</i>			3

				<i>Practice to build battery pack with series and parallel configuration.</i>				<i>Voltage, temperature and current Measurement.</i>			
	2	2,4	4	Battery Management System: Need of BMS. Functions of BMS. BMS building blocks. Mode of power. Design consideration of BMS. Battery cell balancing. Balancing methods – Active cell and Passive cell balancing.	2		2	<i>Conduct an experiment to measure Voltage, current and temperature with BMS. Balance cells with external circuits – Practical/Video demonstration.</i>			3
	2		5	Developmental Weekly Assessment				Assessment Review and corrective action			3
	2		6	Industry Class EV battery management system +Industry assessments	2		3				
3	2	2,4	1	PEER Discussion on Industry Assignment		4		Battery degradation. Lifespan for EV battery. Extend lifespan for EV battery. Safety of EV battery.			3
	2	2,4	2	<i>Connecting battery to a charger for battery charging, Inspecting & testing a battery after charging.</i>			4	<i>Check battery assembly sensors for proper functioning</i>			3
	2	2,4	3	Battery Disposal, Storing Batteries, Battery recycling. <i>Diagnose, repair, and test high voltage battery systems.</i>	1		3	<i>Diagnose, repair, and testing of EV battery controls.</i>			3
	2	2,4	4	Fuel Cells:	3		1	Hydrogen production methods – Electrolysis, POX reforming.	2		1

				Fuel cell technologies: Operating principle -Proton exchange membrane. Solid oxide fuel cell.				<i>Demonstration of (video) various hydrogen production methods.</i>			
	2		5	CIE 1- Written and practice test				Assessment Review and corrective action			3
	2		6	Industry Class battery maintenance +Industry assessments	2		3				
4	1	1,2,4	1	PEER Discussion on Industry Assignment		4		Hydrogen storage - Cryogenic liquid storage. Hydrogen Transportation. <i>Demonstration of (video) hydrogen storage and transport.</i> Hydrogen as Alternate fuel for motor vehicles.	2		1
	1	1,2,4	2	Fuel Cell Electric Vehicle <ul style="list-style-type: none"> Fuel Cell Electric Vehicle- Working of hydrogen engine 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 <ul style="list-style-type: none"> Hydrogen Fuel Cell Bus Filling up of fuel cell electric vehicle			4	Electric Vehicle Architecture: Types of EVs – Battery EV, Hybrid EV, Photovoltaic EV, Fuel cell, Solar operated EV.	2		1

	1	1,2,4	3	Electric vehicle architecture powertrains - BEV, HEV, PHEV, FCEV, Solar.	2	2	Electric Vehicle Chassis and Body Design: Body/chassis requirements. Body/chassis layout. EV body material selection.	1	2
	1	1,2,4	4	Effect of weight on efficiency and range. Comparison of different materials (features and safety). Body stability.	2	2	Suspension for EVs – Types – Working principle - Electric, Electromagnetic, Air suspension.		3
	1		5	Developmental Weekly Assessment			Assessment Review and corrective action		3
	1		6	Service station Visit		5			
5	3	1,2,4	1	PEER Discussion on Industry Assignment		4	Brakes for EVs – Types - Regenerative braking, Plugging type braking. Dynamic braking - Working principle- Advantages – Disadvantages.	2	1
	3	1,2,4	2	Diagnose, repair, and test regenerative braking.		4	Comparison between conventional and regenerative braking. <i>Field visit/Video demonstration on regenerative braking.</i>	1	2
	3	1,2,4	3	Steering System: Construction and working of Electrical Power steering.	2	2	Perform Electronic Power Steering Identification of EPS components and related sensors.		3
	3	1,2,4	4	Fault diagnosis of electrical power steering.	1	3	Troubleshooting and remedies for electrical power steering.		3
	3		5	CIE 2- Written and practice test			Assessment Review and corrective action		3
	3		6	Showroom Visit (EV and Hybrid vehicle)		5			
6	3	4	1	PEER Discussion on Industry Assignment		4	Electric Propulsion System: Block diagram.	2	1

							DC motor drives – Principle of operation and performance – Separate shunt motor, series motor and cumulative compound wound field DC motors.			
	3	4	2	Induction motor drives - Principle and working.	2	2	Testing and servicing of DC motor drives.			3
	3	4	3	Permanent magnet BLDC drives – Principle of operation – Advantages and disadvantages. Video demonstration on working of BLDC.	2	2	Control of BLDC motor drives – Block diagram: Torque control. Speed control.	2	1	
	3	4	4	Switched Reluctance Motor drives (SRMs) – Principle of operation with block diagram.	2	1	1	Basic magnetic structure of SRM-6/4 SRM, 8/6 SRM	2	1
	3	2,4	5	Developmental Weekly Assessment				Assessment Review and corrective action		3
	3		6	Industry Class on BLDC drives +Industry assessments	2		3			
7	3	1	1	PEER Discussion on Industry Assignment		4		Fault diagnosis of SRM - Field visit.	1	2
	3	1	2	Component sizing. Physical locations. Mechanical connection of motor. Electrical connection of motor.	2		2	Selection and sizing of motor. RPM and Torque calculation of motor.	2	1
	3	1	3	Configuration of EVs: Illustration of general EV configuration.	2		2	1. Conventional driveline with multi-gear transmission and clutch. 2. Single gear transmission.	2	1
	3	1	4	1. Integrated fixed gearing differential. 2. Separate motor and fixed gearing drive shaft.	2	2		1. Direct drive. 2. Separating wheel motor drive.	1	2

							Traction motor characteristics with graph.			
	3		5	CIE 3- Written and practice test			Assessment Review and corrective action			3
	3		6	Industry Class on multi-gear transmission and clutch. +Industry assessments	2	3				
8	3	1	1	PEER Discussion on Industry Assignment		4	Hybrid Electric Vehicles: Introduction. Concept of hybrid electric drive train. Types of HEVs, Torque-Coupling, speed coupling, torque and speed coupling parallel HEV.	2		1
	3	1	2	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.	2	2	3. Series-parallel (mechanical and electrical coupling). 4. Complex (mechanical and electrical coupling).	2		1
	3	1	3	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	2	2	Comparison between series-parallel and complex drive drain. (Video demonstration.)			3

	3	1	4	Vehicle Control Unit: Introduction - Development process- Software - Hardware.	2	2	Data management. Sensor integration. CAN communication. Interfaces.	1	2
	3		5	Developmental Weekly Assessment			Assessment Review and corrective action		3
	3		6	Industry Class VCU +Industry assessments	2	3			
9	4	2	1	PEER Discussion on Industry Assignment		4	EV Charging Technologies: Classification of different charging technology for EV charging station.	3	
	4	.2	2	Introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) operations.	2	2	Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations. Video demonstration/Field visit.		3
	4	2	3	Bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle.	2	2	Wireless power transfer (WPT) technique for EV charging. Video demonstration/Field visit		3
	4	2	4	Diagnose, repair, and test vehicle charging interface/infrastructure.		4	Operate standard chargers and determine charging time under various conditions.		3
	4		5	CIE 4- Written and practice test			Assessment Review and corrective action		3
	4		6	Industry Class V2B and V2H +Industry assessments	2	3			
10	4	2,4	1	PEER Discussion on Industry Assignment		4	Requirement of charging inputs for different types of chargers.		3
	4	2,4	2	Diagnosis and remedy for charger not responding, charger not delivering expected current.		4	Components of charging station, block diagram of charging station. Terms associated with EV charging station.		3
	4	4	3	Testing and adjustment of EV sub-systems:		4	Identify Proximity sensor, Parking sensor, crash sensor, Rain and Light Sensor.		3

				Identify different location of various ECUs in vehicle.						
	4	4	4	Practice on Recognition of EV symbols.		4		Practice of safety precautions and procedures to be observed while working with EV Kit and related tools.		3
	4	4	5	Developmental Weekly Assessment				Assessment Review and corrective action		3
	4	4	6	Visit to charging station			5			
11	4	2	1	PEER Discussion on Industry Assignment		4		Practice on measuring voltage drop.		3
	4	2	2	Disassemble and assemble various components of EV using appropriate fasteners and hand tools.			4	Trace the wiring circuit of lighting system.		3
	4	2	3	Troubleshoot and repair accelerator pedal.			4	Diagnosis and remedy for charger not responding, charger not delivering expected current.		3
	4	2	4	Troubleshoot and repair brake.			4	Drive an EV following safety rules for driving. EV Safety: Preventive measures for electrical accidents & steps to be taken in such accidents.		3
	4		5	CIE 5- Written and practice test				Assessment Review and corrective action		3
	4		6	Industry Class safety rules to be followed in EV + Industry assessments	2		3			
12	5	2,4	1	PEER Discussion on Industry Assignment		4		Air Conditioning System Servicing: Identification of air conditioning system components.		3

	5	2,4	2	Working of Air-conditioning ECU			4	Preventive maintenance of FATC/HVAC machine.			3
	5	2,4	3	Adjustment of AC inside the cabin. Blower speed control and ventilation systems.			4	Identification and testing of ambient temperature sensor, air temperature sensor- Working.			3
	5	2,4	4	Testing and servicing of Air-conditioning system.			4	Testing and servicing of Air-conditioning system.			3
	5		5	Developmental Weekly Assessment				Assessment Review and corrective action			3
	5		6	Industry Class on HVAC +Industry assessments	2		3				
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. 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.		4		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 will have from a technical, social and business perspective. b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified. 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.			

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam - 4 hours

Sample Questions For CIE-1

Programme	Automobile Engineering	Semester	V		
Course	Electric and Hybrid Vehicle Technology	Max Marks	30		
Course Code	20AT54I	Duration	4 hours		
Name of the course coordinator					
Note: Answer one full question from each section.					
Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) - 10 marks					
1.a)	Compare, Draw and explain the ideal traction power plant characteristics in EV and IC vehicles.	L3	1	1	10
b)	Justify how rolling resistance effect the tire road contact in EV system.	L4	1	1	10
2.a)	There are few factors which effect the performance of batteries used in EV's. Explain with proper justification.	L3	2	2,4	10
b)	Is fuel cell and flywheel being energy source element in electric and hybrid EV's, Justify.	L4	2	2,4	10
Section-2 (Practical) - 20 marks					
3)	Construct a model to build battery pack with series configuration.	L3	2	2,4	20
4)	Conduct the experiment to test voltage, temperature and configuration current for EV	L3	2	2,4	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme : AUTOMOBILE ENGINEERING	Semester : V
Course : Electric and Hybrid Vehicle Technology	Max Marks : 100
Course Code : 20AT54I	Duration : 3 Hrs

Instruction to the Candidate: Answer one full question from each section.

Q.No	Question	CL	CO	Marks
Section-1				
1.a)	Compare, Draw and explain the ideal traction power plant characteristics in EV and IC vehicles.	L3	1	10
b)	In fuel cell in hydrogen production method using electrolysis, does electrolysis produce pure hydrogen. Justify your answer using proper explanation (draw the sketch if required).	L4		10
2.a)	There are different drive train configurations in EV, with neat sketch explain any 2 types.	L3		10
b)	Justify how rolling resistance effect the tire road contact in EV system.	L4		10
Section-2				
3.a)	There are few factors which effect the performance of batteries used in EV's. Explain with proper justification.	L3	2	10
b)	Is fuel cell and flywheel being energy source element in electric and hybrid EV's, Justify.	L4		10
4.a)	Is there a need for considering the electrical and mechanical constrains while sizing an electric machine for EV. Justify your answer	L4		10
b)	"The batteries take up a lot of space in the EV car" Is this statement true or false. Justify your answer. How Batteries packs are placed in EV, Explain with neat sketch.	L3		10
Section- 3				
5.a)	Enlist the architecture of hybrid electric drive train and explain with neat sketch the configuration of Series hybrid electric drive train.	L3	3	10
b)	I.C.E is not decoupled with the wheels; so, it cannot be charged at standstill in parallel hybrid electric vehicle. Is the above statement true, Justify your answer. Explain the different power flow control modes of a typical parallel hybrid system with the help of block diagrams.	L4		10

6.a)	Compare Hybrid vehicle with conventional vehicle. Dissect the environmental importance of EV and their social impacts.	L3		10
b)	The Vehicle System Controller is the level of decision to assess the torque requirements of the engine, generator, ICE, and mechanical brake according to the torque demand of the driver” How does this Vehicle System Controller work in HEV	L4		10
Section-4				
7.a)	Energy management system improves the fuel economy and optimize the performance of HEV, is this statement true? Elaborate energy management system and issues of energy management strategies of EHV	L4	4	10
b)	If the charger not delivering expected current how to Diagnosis and give remedial solution.	L3		10
8.a)	Write a flowchart the procedure to determine charging time under various conditions.	L3		10
b)	If the mechanic has to diagnose a hybrid vehicle's ground fault, which tool is used to test the high voltage in hybrid system. What actions are needed to disable the high voltage HV circuit?	L4		10
Section-5				
9.a)	Write a detailed procedure for testing of ambient temperature sensor. How does it work.	L3	5	10
b)	In the car, the AC has kept ON but the driver notices that no air coming from the vent, what might be the problem and how to solve it.	L4		10
10.a)	Write a detailed procedure followed in testing and servicing of Air-conditioning system.	L3		10
b)	When you're driving and the air suddenly goes from comfortably cool to horribly hot, what might be the problem and how to solve this.	L4		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
Problem Statement	The driver has noticed a problem in the power steering of the vehicle, he is finding it difficult to turn wheel/ stiff wheel. What might be the problem, give the remedial solution by troubleshooting or servicing it.	
1	Analyzing the problem	10
2	Fault finding	20
3	Assembly and disassembly	20
4	Result/ solution to the problem	30
5	Viva voce	20
Total		100

References:

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.

Tools and Equipment:

1. Electric Vehicle – 2-wheeler.

Motor Power 1200 – 1800 W

Motor Type – BLDC

Drive Type - Hub Motor

Battery Type - Li-ion

Battery Capacity 72 V/26 Ah

2. Electric Vehicle – 4-wheeler.

Engine Type – 3 Phase Induction Motor

Max Power – 25.5 bhp @3750 rpm

Max Torque – 53 Nm@ 0-3500 rpm

3. Hybrid Electric Vehicle – 4-wheeler.

4. Battery testing kit for voltage 6 V to 60 V.

5. Lithium Battery Pack.

Nominal Voltage – 12.8 V

Nominal Current – 32 A

6. Lithium-Ion Battery Charger.

Input Voltage: 180-250 V AC

Output Voltage: DC 54.6V

Application: Suitable for 48V E-Bike Batteries

Output Current: 3-4 A

7. Hydrogen Fuel Cell.
8. Electrical Power Steering Kit.
9. Brushless DC Motor.
10. Electric Vehicle Control Unit.
11. Car Air Conditioning Kit