Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister’s Youth Skills Development Programme (PMYSDP)

"Skills for All"

Course Contents / Lesson Plan
Course Title: Automotive Mechatronics
Duration: 3 Months

Trainer Name	
Author Name	**Engr. Muhammad Akram Sarfraz** **Instructor, GCT Railway Road, Lahore**
Course Title	**Automotive Mechatronics**
Objectives and Expectations	**Employable skills and hands-on practice in automotive mechatronics** This is a special course designed to address unemployment in the youth. The course aims to achieve the above objective through hands on practical training delivery by a team of dedicated professionals having rich market/work experience. This course is therefore not just for developing a theoretical understanding/back ground of the trainees. Contrary to that, it is primarily aimed at equipping the trainees to perform commercially in a market space in independent capacity or as a member of a team. The course therefore is designed to impart technical skills in the youth of Pakistan to perform their role in the development of nation. **Main Expectations:** In short, the course under reference should be delivered by professional instructors in such a robust hands-on manner that the trainees are comfortably able to employ their skills for earning money (through wage/self-employment) at its conclusion. This course thus clearly goes beyond the domain of the traditional training practices in vogue and underscores an expectation that a market-centric approach will be adopted as the main driving force while delivering it. The instructors should therefore be experienced enough to be able to identify the training needs for the possible market roles available out there. Moreover, they should also know the strengths and weaknesses of each trainee to prepare them for such market roles during/after the training. **i.** Specially designed practical tasks to be performed by the trainees have been included in the Annexure-I to this document. The record of all tasks performed individually or in groups must be preserved by the management of the training Institute clearly labeling name, trade, session, etc. so that these are ready to be physically inspected/verified through monitoring visits from time to time. The weekly distribution of tasks has also been indicated in the weekly lesson plan given in this document. **ii.** . To maintain interest and motivation of the trainees throughout the course, modern techniques such as: • Motivational Lectures • Success Stories • Case Studies These techniques would be employed as an additional training tool wherever possible (these are explained in the subsequent section on Training Methodology). Lastly, evaluation of the competencies acquired by the trainees will be done

objectively at various stages of the training and a proper record of the same will be maintained. Suffice to say that for such evaluations, practical tasks would be designed by the training providers to gauge the problem-solving abilities of the trainees.

(i) Motivational Lectures

The proposed methodology for the training under reference employs motivation as a tool. Hence besides the purely technical content, a trainer is required to include elements of motivation in his/her lecture. To inspire the trainees to utilize the training opportunity to the full and strive towards professional excellence. Motivational lectures may also include general topics such as the importance of moral values and civic role & responsibilities as a Pakistani. A motivational lecture should be delivered with enough zeal to produce a deep impact on the trainees. It may comprise of the following:

- Clear Purpose to convey the message to trainees effectively.
- Personal Story to quote as an example to follow.
- Trainees Fit so that the situation is actionable by trainees and not represent a just idealism.
- Ending Points to persuade the trainees on changing themselves.

A good motivational lecture should help drive creativity, curiosity, and spark the desire needed for trainees to want to learn more.

The impact of a successful motivational strategy is amongst others commonly visible in increased class participation ratios. It increases the trainees' willingness to be engaged on the practical tasks for a longer time without boredom and loss of interest because they can see in their mind's eye where their hard work would take them in short (1-3 years); medium (3 -10 years) and long term (more than 10 years).

As this tool is expected that the training providers would make arrangements for regular well planned motivational lectures as part of a coordinated strategy interspersed throughout the training period as suggested in the weekly lesson plans in this document.

Course-related motivational lectures online link is available in **Annexure-II**.

(ii) Success Stories

Another effective way of motivating the trainees is using Success Stories. Its inclusion in the weekly lesson plan at regular intervals has been recommended till the end of the training.

A success story may be disseminated orally, through a presentation, or using a video/documentary of someone that has risen to fortune, acclaim, or brilliant achievement. A success story shows how a person achieved his goal through hard work, dedication, and devotion. An inspiring success story contains compelling and significant facts articulated clearly and easily comprehendible words. Moreover, it is helpful if it is assumed that the reader/listener knows nothing of what is being revealed. The optimum impact is created when the story is revealed in the form of:-

- Directly in person (At least 2-3 cases must be arranged by the training institute)
- Through an audio/ videotaped message (2-3 high-quality videos must be arranged by the training institute)

It is expected that the training provider would collect relevant high-quality success stories for inclusion in the training.

	Case Studies Where a situation allows, case studies can also be presented to the trainees to widen their understanding of the real-life specific problem/situation and to explore the solutions. In simple terms, the case study method of teaching uses a real-life case example/a typical case to demonstrate a phenomenon in action and explain theoretical as well as practical aspects of the knowledge related to the same. It is an effective way to help the trainees comprehend in depth both the theoretical and practical aspects of the complex phenomenon in depth with ease. Case teaching can also stimulate the trainees to participate in discussions and thereby boost their confidence. It also makes the classroom atmosphere interesting thus maintaining the trainee interest in training till the end of the course. Depending on suitability to the trade, the weekly lesson plan in this document may suggest case studies be presented to the trainees. The trainer may adopt a PowerPoint presentation or video format for such case studies whichever is deemed suitable but only those cases must be selected that are relevant and of a learning value. The Trainees should be required and supervised to carefully analyze the cases. For this purpose, they must be encouraged to inquire and collect specific information/data, actively participate in the discussions, and intended solutions to the problem/situation. Case studies can be implemented in the following ways: - i. A good quality trade-specific documentary (At least 2-3 documentaries must be arranged by the training institute) ii. Health &Safety case studies (2 cases regarding safety and industrial accidents must be arranged by the training institute) iii. Field visits(At least one visit to a trade-specific major industry/ site must be arranged by the training institute)
Entry-level of trainees	For an advanced course of automotive mechatronics proposed entry level is minimum Intermediate, So expectations from the trainees are: • Can Maintain Personal Health, Hygiene & Safety Having Basic Knowledge of • Engine Assembly • Fuel System • Engine Lubrication System • Brake System • Suspension System • Vehicle Transmission System • Electrical System • Communication System

Learning Outcomes of the course	By the end of this course, students will be able to: • Understanding of Automotive Mechatronics • An ability to work effectively, as an individual and in a team • Understanding of Electrical Fundamentals • Understanding of Ignition System Fundamentals • An ability to Diagnosis Electrical Systems • Automatic Transmission Fundamentals • Understanding of Electronic Diesel Fuel Injection Systems • Understanding of Heating, Ventilation and Air Conditioning (HVAC) Systems • Understanding and Diagnosis of Hybrid Electric Vehicles
Course Execution Plan	The total duration of the course: **3 months (12 Weeks)** Class hours: **4 hours per day** Theory: **20%** Practical: **80%** Weekly hours: **20 hours per week** Total contact hours: **260 hours**
Companies offering jobs in the respective trade	Public/Private industries including: • Automobile Manufacturers • Spare Parts Dealers • Service Dealers • Government Institutes • Local Automobile Workshops • All Private Institutes who are managing Automotive Mechatronics
Job Opportunities	Technicians at Automobile Manufacturers • Dealers of Spare Parts • Service Advisors • Technicians at 3S, 5S and & 7S Dealers • Technicians at Local Automobile Workshops
No of Students	25
Learning Place	Classroom / Lab / Workshop
Instructional Resources	**Development Platform:** https://youtu.be/P7F68ufzO54 https://youtu.be/zPAElcQH0YY https://youtu.be/pqF-aBtTBnY https://www.howacarworks.com/basics/how-engine-timing-works **Learning Material:**

	https://youtu.be/H7Iay0Ke_t4 https://youtu.be/devo3kdSPQY https://youtu.be/7ZXF5n7HGGY https://www.mechanicalbooster.com/2014/02/what-are-main-parts-of-automobileengine.html https://itstillruns.com/service-radiator-6922310.html

MODULES

Scheduled Weeks	Module Title	Days	Hours	Learning Units	Home Assignment
Week 1	**Introduction & Electrical**	**Day 1**	**Hour 1**	Course Introduction and Expectations	
			Hour 2	Intro to Automotive Mechatronics	
			Hour 3	Job Market Overview	
			Hour 4	Work Ethics in Institute	
		Day 2	**Hour 1**	History of Automotive Mechatronics	• **Task 1** *Details may be seen at Annexure-I*
			Hour 2	Current State of Automotive Mechatronics	
			Hour 3	Applications of Automotive Mechatronics	
			Hour 4	Electrical Fundamentals	
		Day 3	**Hour 1 to 4**	Electrical Fundamentals	
		Day 4	**Hour 1 to 4**	Batteries	
		Day 5	**Hour 1to 4**	Scan Tools	
Week 2		**Day 1**	**Hour 1 to 4**	Electrical System Diagnosis	• **Task 2** *Details may be seen at Annexure-I*
		Day 2	**Hour 1**	Charging Systems and Control Circuits	
			Hour 2	Operating Principles of a Generator	

			Hour 3 to 4	Construction of a Vehicle Charging System	
		Day 3	**Hour 1 to 4**	Charging System Testing and Diagnosis	
		Day 4	**Hour 1 to 4**	Starter Motors and Control Circuits	
		Day 5	**Hour 1 to 4**	Starting System Testing and Diagnosis	
Week 3		**Day 1**	**Hour 1 to 4**	Interpret electrical circuit diagrams.	
		Day 2	**Hour 1 to 4**	Electrical testing equipment	• **Task 3** *Details may be seen at Annexure-I*
		Day 3	**Hour 1 to 4**	Control Module Inputs and Switches	
		Day 4	**Hour 1 to 4**	Control Module Inputs and Sensors	
		Day 5	**Hour 1 to 4**	Control Module Outputs and Output Devices	
Week 4		**Day 1**	**Hour 1 to 4**	Control Modules	
		Day 2	**Hour 1 to 4**	Multiplexing and Networking	• **Task 4** *Details may be seen at Annexure-I*
		Day 3	**Hour 1 to 4**	Advanced Electrical Schematics	
		Day 4	**Hour 1 to 4**	Advanced Electrical Schematics	
		Day 5	**Hour 1 to 4**	Advanced Electrical Schematics	
Week 5	**Ignition Systems**	**Day 1**	**Hour 1 to 2**	Ignition System Fundamentals	• **Task 5** *Details may be seen at Annexure-I*
			Hour 3 to 4	Ionization and Induction for Ignition Systems	

		Day 2	**Hour 1**	Electronic Ignition Systems	
			Hour 2 to 4	Ignition Module	
		Day 3	**Hour 1 to 2**	Computer Interaction to control an ignition System	
			Hour 3 to 4	Inputs and Output devices for Electronic Ignition	
		Day 4	**Hour 1to 2**	Distributorless Ignition Systems	
			Hour 3	Ignition System Diagnosis and Service	
			Hour 4	Ignition System Problems	
		Day 5	**Hour 1**	Diagnosing of Ignition Problems	
			Hour 2	Analysis of Primary Waveforms	
			Hour 3	Analysis of Secondary Waveforms	
			Hour 4	Removing and Installing a Distributor.	
Week 6	**Electrical Systems Diagnosis**	**Day 1**	**Hour 1 to 4**	Gauges and Warning Systems	• **Task 6** *Details may be seen at Annexure-I*
		Day 2	**Hour 1 to 4**	Lighting Systems	
		Day 3	**Hour 1 to 4**	Wiper and Washer Systems	
		Day 4	**Hour 1 to 4**	Power Accessory Systems	
		Day 5	**Hour 1 to 4**	Heated Systems	

Week 7		**Day 1**	**Hour 1 to 4**	Speed Control Systems	• **Task 7** *Details may be seen at Annexure-I*
		Day 2	**Hour 1 to 4**	Information and Entertainment Systems	
		Day 3	**Hour 1 to 4**	Safety and Security Systems	
		Day 4	**Hour 1 to 4**	Vehicle Networks	
		Day 5	**Hour 1 to 4**	Antilock Brake Systems	
Week 8	**Automatic Transmissions and Transaxles**	**Day 1**	**Hour 1 to 2**	Automatic Transmission Fundamentals	• **Task 8** *Details may be seen at Annexure-I*
			Hour 3 to 4	Planetary Gear Sets	
		Day 2	**Hour 1 to 4**	Torque Converters	
		Day 3	**Hour 1 to 4**	Oil Pumps	
		Day 4	**Hour 1 to 4**	Clutches and Bands	
		Day 5	**Hour 1 to 4**	Hydraulic Valve Fundamentals	
Week 9		**Day 1**	**Hour 1 to 4**	Shift Valves	• **Task 9** *Details may be seen at Annexure-I*
		Day 2	**Hour 1 to 4**	Electronically-Controlled Automatic Transmissions (Operation)	
		Day 3	**Hour 1 to 4**	Electronically-Controlled Automatic Transmissions (Circuits)	
		Day 4	**Hour 1 to 4**	Electronically-Controlled Automatic Transmissions (Diagnosis)	

		Day 5	**Hour 1 to 4**	Automatic Transmission Testing and Adjustments	
Week 10	**Diesel Fuel Systems**	**Day 1 to 2**	**Hour 1 to 4**	Electronic Diesel Fuel Injection Systems	• **Task 10** *Details may be seen at Annexure-I*
		Day 3 to 4	**Hour 1 to 4**	Diesel Engine Emission Controls	
		Day 5	**Hour 1 to 4**	Diagnostic and Repair of Electronically-Controlled Diesel Fuel Injection Systems	
Week 11	**Heating, Ventilation and Air Conditioning (HVAC) Systems**	**Day 1**	**Hour 1 to 4**	HVAC Systems	• **Task 11** *Details may be seen at Annexure-I*
		Day 2	**Hour 1 to 4**	HVAC Controls	
		Day 3	**Hour 1to 4**	HVAC Service	
		Day 4 to 5	**Hour 1 to 4**	Vehicle System Management, Integration and Vehicle Networks	
Week 12	**Hybrid Electric Vehicles (HEV)**	**Day 1**	**Hour 1 to 4**	HEV Safety Protocols	• **Task 12** **&** • **Task 13** *Details may be seen at Annexure-I*
		Day 2 to 3	**Hour 1 to 4**	Hybrid Electric Vehicles	
		Day 4 to 5	**Hour 1 to 4**	Final Assessment	

Tasks for Certificate in Automotive Mechatronics

Task No.	Task	Description	Week
1.	**Batteries Service**	Diagnose and service batteries	**Week 1**
2.	**Circuit Repairing**	Diagnose and repair simple electrical circuits	**Week 2**
3.	**Wiring Diagrams Interpretation**	Interpret wiring diagrams and related information to evaluate the circuit	**Week 3**
4.	**Automotive Control Modules**	Describe the operation of automotive control modules	**Week 4**
5.	**Electronic Ignition Systems**	Describe the operation of electronic ignition systems	**Week 5**
6.	**Lighting Systems**	Diagnose and repair vehicle lighting systems	**Week 6**
7.	**Speed Control Systems**	Diagnose and repair vehicle speed control systems.	**Week 7**
8.	**Hydraulic Valves**	Diagnose and repair hydraulic valves	**Week 8**
9.	**Automatic Transmission**	Diagnose problems related to the circuits in an electronically-controlled automatic Transmission.	**Week 9**
10.	**Emission Controls**	Describe diesel engine emission controls	**Week10**
11.	**HVAC Controls**	Diagnose HVAC controls	**Week11**
12.	**Safety Hazards for HEV**	Describe the safety hazards associated with hybrid electric vehicles (HEV).	**Week12**
13.	**HEV Operation**	Describe the operation of a hybrid electric vehicle	**Week12**

Annexure-II:

Motivational Lectures
Automotive Mechatronics

https://youtu.be/y20ANfRMJ8A?si=QxXwXuvx-QmmLZuJ
How automotive starting and charging systems work

https://youtu.be/dkZQDBddAaM?si=owgkSMFW6pSLppeG
How to test the charging system of your car

https://youtu.be/qui-JGnFeWI?si=ye4KAfq2wyv02zZo

12 signs of bad or failing fuel pump

https://youtu.be/8XeKXQUMqKs?si=eb0x91tj1J9fBKXW

How to choose a Car Scanner - Differences in Automotive Diagnostic Tools

https://youtu.be/rfiOOXakHwM?si=wkYxTnNxW-GR01d2

How to Read Electronics Circuit diagram electronics Schematics

https://youtu.be/TqQE0xkCJ8c?si=PQeSpw0vpQ6rqGVg

How Ignition System Works | Explained with Animation, Wiring Diagram, and Parts Overview

https://youtu.be/CGEd3SMsoLE?si=VtIgfGVODmFCHSe_

Learn How to Diagnose and Fix Car Electrical Problems Series | Part 1 Basic Electrical Principals
https://youtu.be/o8idQHB7f08?si=1qsiaLUCSMjsaaJO

Hybrid Vehicles How They Work

https://youtu.be/xG1w3l41lmQ?si=ZU63WjbGL0VrQke0

Electronic Fuel Injection System Working

Annexure-IV:

Workplace/Institute Ethics Guide

Work ethic is a standard of conduct and values for job performance. The modern definition of what constitutes good work ethics often varies. Different businesses have different expectations. Work ethic is a belief that hard work and diligence have a moral benefit and an inherent ability, virtue, or value to strengthen character and individual abilities. It is a set of values-centered on the importance of work and manifested by determination or desire to work hard.

The following ten work ethics are defined as essential for student success:

1. **Attendance:**
   Be at work every day possible, plan your absences don't abuse leave time. Be punctual every day.
2. **Character:**
   Honesty is the single most important factor having a direct bearing on the final success of an individual, corporation, or product. Complete assigned tasks correctly and promptly. Look to improve your skills.
3. **Team Work:**
   The ability to get along with others including those you don't necessarily like. The ability to carry your weight and help others who are struggling. Recognize when to speak up with an idea and when to compromise by blend ideas together.
4. **Appearance:**
   Dress for success set your best foot forward, personal hygiene, good manner, remember that the first impression of who you are can last a lifetime
5. **Attitude:**
   Listen to suggestions and be positive, accept responsibility. If you make a mistake, admit it. Values workplace safety rules and precautions for personal and co-worker safety. Avoids unnecessary risks. Willing to learn new processes, systems, and procedures in light of changing responsibilities.
6. **Productivity:**
   Do the work correctly, quality and timelines are prized. Get along with fellows, cooperation is the key to productivity. Help out whenever asked, do extra without being asked. Take pride in your work, do things the best you know-how. Eagerly focuses energy on accomplishing tasks, also referred to as demonstrating ownership. Takes pride in work.
7. **Organizational Skills:**

Make an effort to improve, learn ways to better yourself. Time management; utilize time and resources to get the most out of both. Take an appropriate approach to social interactions at work. Maintains focus on work responsibilities.

8. **Communication:**

   Written communication, being able to correctly write reports and memos. Verbal communications, being able to communicate one on one or to a group.

9. **Cooperation:**

   Follow institute rules and regulations, learn and follow expectations. Get along with fellows, cooperation is the key to productivity. Able to welcome and adapt to changing work situations and the application of new or different skills.

10. **Respect:**

    Work hard, work to the best of your ability. Carry out orders, do what's asked the first time. Show respect, accept, and acknowledge an individual's talents and knowledge. Respects diversity in the workplace, including showing due respect for different perspectives, opinions, and suggestions.