

Government of Pakistan
National Vocational and Technical Training Commission

Prime Minister's Hunarmand Pakistan Program

"Skills for All"



Course Contents/ Lesson Plan

Course Title: Automotive Mechatronics

Duration: 6 Months

Course Details / Description & Preliminaries

Course Title	Automotive Mechatronics
Objectives and Expectations	<p><u>Employable skills through an intensive course on Automotive Mechatronics</u></p> <p>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.</p> <p>The course therefore is designed to impart not only technical skills but also soft skills (i.e. interpersonal/communication skills; personal grooming of the trainees etc.) as well as entrepreneurial skills (i.e. marketing skills; free lancing etc.). The course also seeks to inculcate work ethics to foster better citizenship in general and improve the image of Pakistani work force in particular.</p> <p>Main Expectations:</p> <p>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.</p> <p>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</p>

Key Features of Training & Special Modules

weaknesses of each individual 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. In order to materialize the main expectations, a special module on **Job Search & Entrepreneurial Skills** has been included in the later part of this course (5th & 6th month) through which, the trainees will be made aware of the Job search techniques in the local as well as international job markets (Gulf countries). Awareness around the visa process and immigration laws of the most favored labor destination countries also forms a part of this module. Moreover, the trainees would also be encouraged to venture into self-employment and exposed to the main requirements in this regard. It is also expected that a sense of civic duties/roles and responsibilities will also be inculcated in the trainees to make them responsible citizens of the country.
- iii. A module on **Work Place Ethics** has also been included to highlight the importance of good and positive behavior at work place in the line with the best practices elsewhere in the world. An outline of such qualities has been given in the Appendix to this document. Its importance should be conveyed in a format that is attractive and interesting for the trainees such as through PPT slides +short video

Training Tools/ Methodology

documentaries. Needless to say that if the training provider puts his heart and soul into these otherwise non-technical components, the image of Pakistani workforce would undergo a positive transformation in the local as well as international job markets.

In order 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 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 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.

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 longer time without boredom and loss of interest because they can clearly 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.

(ii) Success Stories

Another effective way of motivating the trainees is by means of 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 by means of 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 comprehensible words. Moreover, it is helpful if it is assumed that the reader/listener knows nothing of what is being revealed. 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 as suggested in the weekly lesson plan given in this document.

Suggestive structure and sequence of a sample success story and its various shapes can be seen at annexure III.

(iii) 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 class room 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 to be presented to the trainees.

The trainer may adopt a power point presentation or video format for such case studies whichever is deemed suitable but it's important that only those cases are selected that are relevant and of a learning value.

The Trainees should be required and supervised to carefully analyze the cases.

For the purpose they must be encouraged to inquire and collect specific information / data, actively participate in the discussions and intended solutions of the problem / situation.

Case studies can be implemented in the following ways:-

- i. A good quality trade specific documentary(At least 2-3

	<p>documentaries must be arranged by the training institute)</p> <p>ii. Health & Safety case studies(2 cases regarding safety and domestic accidents must be arranged by the training institute)</p> <p>iii. Field visits(At least one visit to a trade specific major industry/ site must be arranged by the training institute)</p>
<p>Learning Outcome of the Course</p>	<p>By the end of the course the trainees will be able to have following competencies and skills.</p> <ul style="list-style-type: none"> • Maintain Personal Health, Hygiene & Safety • Maintain Engine Assembly • Maintain Fuel System • Maintain Engine Lubrication System • Maintain Brake System • Maintain Suspension System • Maintain Vehicle Transmission System • Maintain Electrical System • Perform Advanced Communication • Analyse the components of an automotive control systems and its implementation. • Design and implement different control for Automobile. • Evaluate energy storage and energy management technology options for a hybrid or electric vehicle and be able to judge between different technologies relative to a given vehicle application and overall system design.
<p>Course Execution Plan</p>	<p>Total duration of course: 6 months (26 Weeks) Class hours: 4 hours per day Theory: 20% Practical: 80% Weekly hours: 20 hours per week Total contact hours: 520hours</p>

Companies Offering Jobs in the respective trade	Public/Private industries including: <ol style="list-style-type: none"> 1. Automobile Manufacturers 2. Spare Parts Dealers 3. Service Dealers 4. Government Institutes 5. Local Automobile Workshops 6. All Private Institutes who are managing Automotive Mechatronics
Job Opportunities	<ul style="list-style-type: none"> • Technicians at Automobile Manufacturers • Dealers of Spare Parts • Service Advisors • Technicians at 3S, 5S and & 7S Dealers • Technicians at Local Automobile Workshops • Manager / Assistant Manager Automotive Mechatronics
No of Students	<p style="text-align: center;">25</p>
Learning Place	<p style="text-align: center;">Classroom / Lab / Workshop</p>
Instructional Resources	<p>Development Platform:</p> <p>https://youtu.be/P7F68ufzO54</p> <p>https://youtu.be/zPAElcQH0YY</p> <p>https://youtu.be/pqF-aBtTBnY</p> <p>https://www.howacarworks.com/basics/how-engine-timing-works</p> <p>Learning Material:</p> <p>https://youtu.be/H7lay0Ke_t4</p> <p>https://youtu.be/devo3kdSPQY</p> <p>https://youtu.be/7ZXF5n7HGGY</p> <p>https://www.mechanicalbooster.com/2014/02/what-are-main-parts-of-automobile-engine.html</p> <p>https://itstillruns.com/service-radiator-6922310.html</p>

WEEKLY SCHEDULE OF TRAINING

Scheduled Week	Module Title	Learning Units	Remarks
Week 1	Introduction & ELECTRICAL I	<p>Motivational Lecture (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Electrical Fundamentals I • Electrical Circuits I 	<p>Task-1 Task-2</p> <p>(Details may be seen at Annexure-I)</p>
Week 2		<p>Success stories (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Fundamentals of Magnetism • Batteries • Electrical System Diagnosis I • Scan Tools 	<p>Task-3 Task-4 Task-5 Task-6</p> <p>(Details may be seen at Annexure-I)</p>
Week 3	ELECTRICAL II	<p>Motivational Lecture (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Electrical Fundamentals II • Electrical Circuits II 	<p>Task-7 Task-8</p> <p>(Details may be seen at Annexure-I)</p> <p style="background-color: #f4a460;">Home Assignment-1 (Details may be seen at Annexure-II)</p>
Week 4		<p>Success stories (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Electrical System Diagnosis II • Charging Systems and Control Circuits • Charging System Testing and Diagnosis 	<p>Task-9 Task-10 Task-11</p> <p>(Details may be seen at Annexure-I)</p> <p style="background-color: #a0c0ff;">Monthly Test 1</p>

Week 5		Motivational Lecture (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> • Starter Motors and Control Circuits • Starting System Testing and Diagnosis 	Task-12 Task-13 (Details may be seen at Annexure-I)
Week 6	ELECTRICAL III	Success stories (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> • Electrical Fundamentals III • Control Module Inputs, Switches, and 	Task-14 Task-15 (Details may be seen at Annexure-I)
Week 7		Motivational Lecture (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> • Sensors, Control Module Outputs and Output Devices • Control Modules 	Task-16 Task-17 (Details may be seen at Annexure-I) Home Assignment-2 (Details may be seen at Annexure-II)
Week 8		Success stories (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> • Multiplexing and Networking • Advanced Electrical Schematics 	Task-18 Task-19 (Details may be seen at Annexure-I) Monthly Test 2
Week 9	IGNITION SYSTEMS	Motivational Lecture (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> • Ignition System Fundamentals • Electronic Ignition Systems 	Task-20 Task-21 (Details may be seen at Annexure-I)

Week 10		Success stories (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> Ignition System Diagnosis and Service 	Task-22 (Details may be seen at Annexure-I)
Week 11	ELECTRICAL SYSTEMS DIAGNOSIS	Motivational Lecture (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> Gauges and Warning Systems Lighting Systems 	Task-23 Task-24 (Details may be seen at Annexure-I)
Week 12		Success stories (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> Wiper and Washer Systems Power Accessory Systems Heated Systems 	Task-25 Task-26 Task-27 (Details may be seen at Annexure-I)
	Build your CV	Download professional CV template from any good site (https://www.coolfreecv.com or relevant) <ul style="list-style-type: none"> Add Personal Information Add Educational details Add Experience/Portfolio Add contact details/profile links 	
Week 13	Overview of the previous weeks & Mid Term Examination		
Week 14		Motivational Lecture (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> Speed Control Systems Information and Entertainment Systems Safety and Security Systems 	Task-28 Task-29 Task-30 (Details may be seen at Annexure-I)
Week 15		Success stories (For further detail please see Page No: 3& 4) <ul style="list-style-type: none"> Vehicle Networks 	Task-31 Task-32 Task-33 (Details may be seen at Annexure-I)

		<ul style="list-style-type: none"> • Antilock Brake Systems • Passenger Restraint Systems 	<p>be seen at Annexure-I)</p> <p>Home Assignment-3 (Details may be seen at Annexure-II)</p>
	Create an account profile on Fiverr (at least two gigs) and Upwork	Create an account by following these steps: Step 1: Personal Info Step 2: Professional Info Step 3: Linked Accounts Step 4: Account Security	
Week 16	AUTOMATIC TRANSMISSIONS AND TRANSAXLES	<p>Motivational Lecture (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Automatic Transmission Fundamentals • Planetary Gear Sets • Torque Converters • Oil Pumps 	<p>Task-34 Task-35 Task-36 Task-37</p> <p>(Details may be seen at Annexure-I)</p> <p>Monthly Test 3</p>
Week 17		<p>Success stories (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Clutches and Bands • Hydraulic Valve Fundamentals • Shift Valves 	<p>Task-38 Task-39 Task-40</p> <p>(Details may be seen at Annexure-I)</p>
Week 18		<p>Motivational Lecture (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Electronically-Controlled Automatic Transmissions (Operation) • Electronically-Controlled Automatic Transmissions (Circuits) 	<p>Task-41 Task-42</p> <p>(Details may be seen at Annexure-I)</p>

<p>Week 19</p>		<p>Success stories (<i>For further detail please see Page No: 3& 4</i>)</p> <ul style="list-style-type: none"> • Electronically-Controlled Automatic Transmissions (Diagnosis) • Continuously Variable Transmissions (CVTs) • Automatic Transmission Testing and Adjustments 	<p>Task-43 Task-44 Task-45</p> <p>(Details may be seen at Annexure-I)</p> <p>Home Assignment-4 (Details may be seen at Annexure-II)</p>
<p>Week 20</p>		<p>Motivational Lecture (<i>For further detail please see Page No: 3& 4</i>)</p> <ul style="list-style-type: none"> • Automatic Transmission Service and Repair 	<p>Task-46</p> <p>(Details may be seen at Annexure-I)</p> <p>Monthly Test 4</p>
<p>Week 21</p>	<p>DIESEL FUEL SYSTEMS</p>	<p>Success stories (<i>For further detail please see Page No: 3& 4</i>)</p> <ul style="list-style-type: none"> • Electronic Diesel Fuel Injection Systems 	<p>Task-47</p> <p>(Details may be seen at Annexure-I)</p>
<p>Week 22</p>		<p>Motivational Lecture (<i>For further detail please see Page No: 3& 4</i>)</p> <ul style="list-style-type: none"> • Diesel Engine Emission Controls 	<p>Task-48</p> <p>(Details may be seen at Annexure-I)</p>

	<p>How to search and apply for jobs in at least two labor marketplace countries (KSA, UAE, etc.)</p>	<ul style="list-style-type: none"> • Browse the following website and create an account on each website <ul style="list-style-type: none"> ▪ Bayt.com – The Middle East Leading Job Site ▪ Monster Gulf – The International Job Portal ▪ Gulf Talent – Jobs in Dubai and the Middle East • Find the handy ‘search’ option at the top of your homepage to search for the jobs that best suit your skills. • Select the job type from the first ‘Job Type’ drop-down menu, next, select the location from the second drop-down menu. • Enter any keywords you want to use to find suitable job vacancies. • On the results page you can search for part-time jobs only, full-time jobs only, employers only, or agencies only. Tick the boxes as appropriate to your search. • Search for jobs by: <ul style="list-style-type: none"> ▪ Company ▪ Category ▪ Location ▪ All jobs ▪ Agency <p>Industry</p>	
<p>Week 23</p>	<p>HEATING, VENTILATION AND AIR CONDITIONING (HVAC) SYSTEMS</p>	<p>Success stories (<i>For further detail please see Page No: 3& 4</i>)</p> <ul style="list-style-type: none"> • HVAC Systems • HVAC Controls 	<p>Task-49 Task-50</p> <p>(Details may be seen at Annexure-I)</p>
<p>Week24</p>		<p>Motivational Lecture (<i>For further detail please see Page No: 3& 4</i>)</p> <ul style="list-style-type: none"> • HVAC Service 	<p>Task-51</p> <p>(Details may be seen at Annexure-I)</p>

<p>Week25</p>	<p>HYBRID ELECTRIC VEHICLES (HEV)</p>	<p>Success stories (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • HEV Safety Protocols • Hybrid Electric Vehicles 	<p>Task-52 Task-53</p> <p>(Details may be seen at Annexure-I)</p>
<p>Week 26</p>	<p>VEHICLE SYSTEM MANAGEMENT, INTEGRATION AND VEHICLE NETWORKS</p>	<p>Motivational Lecture (For further detail please see Page No: 3& 4)</p> <ul style="list-style-type: none"> • Vehicle System Management, Integration and Vehicle Networks 	<p>Task-54</p> <p>(Details may be seen at Annexure-I)</p>
<p>Entrepreneurship and Final Assessment in project</p>		<ul style="list-style-type: none"> • Job Market Searching • Self-employment • Introduction • Fundamentals of Business Development • Entrepreneurship • Startup Funding • Business Incubation and Acceleration • Business Value Statement • Business Model Canvas • Sales and Marketing Strategies • How to Reach Customers and Engage CxOs • Stakeholders Power Grid • RACI Model, SWOT Analysis, PEST Analysis • SMART Objectives • OKRs • Cost Management (OPEX, CAPEX, ROCE etc.) 	
<p>Projects & Final Assessment</p>			

Annexure-I

Note: The following tasks are required to be performed multiple times by each trainee/group until sufficient proficiency level is acquired. The trainer is required to determine the number of times, each task needs to be repeated by a trainee as per his/her low/medium/high level of skill and proficiency during any stage of the course.

TASKS FOR ADVANCE AUTOMOTIVE MECHATRONICS

Task No.	Task Description	Week
1.	Explain basic electrical principles	Week-1
2.	Perform electrical circuit measurements	
3.	Explain the principles of magnetism	Week-2
4.	Diagnose and service batteries	
5.	Diagnose and repair simple electrical circuits	
6.	Use generic, manufacturer-specific or laptop-based scan tools and software	
7.	Use electrical terms, formulas and meters	Week-3
8.	Determine electrical values in a circuit	
9.	Diagnose electrical systems	Week-4
10.	Describe the operation of a charging system	
11.	Diagnose charging systems	
12.	Describe the operation of a starter motor	Week-5
13.	Diagnose starting systems	
14.	Use electrical diagnostic aids and test procedures	Week-6
15.	Describe and test input devices	
16.	Describe and test output devices	Week-7
17.	Describe the operation of automotive control modules	
18.	Describe the operation of vehicle networks	Week-8
19.	Interpret wiring diagrams and related information to evaluate advanced circuit operation	
20.	Describe the operation of an ignition system	Week-9
21.	Describe the operation of electronic ignition systems	
22.	Diagnose ignition systems	Week-10
23.	Diagnose and repair instrument panel circuits and warning systems	Week-11
24.	Diagnose and repair vehicle lighting systems	
25.	Diagnose and repair wiper and washer systems	Week-12
26.	Diagnose and repair power accessories	

27.	Diagnose and repair heated systems	
28.	Diagnose and repair vehicle speed control systems.	Week-14
29.	Diagnose information and entertainment systems	
30.	Diagnose factory installed vehicle safety and security systems	
31.	Diagnose and repair vehicle networks	Week-15
32.	Diagnose problems related to anti-lock brake systems	
33.	Diagnose and repair occupant restraint systems	
34.	Describe operating principles of an automatic transmission	Week-16
35.	Diagnose planetary gear sets	
36.	Diagnose torque converters	
37.	Diagnose and repair oil pumps	
38.	Diagnose and repair clutches, bands and servos.	
39.	Diagnose and repair hydraulic valves	Week-17
40.	Diagnose and repair shift valves	
41.	Explain the operation of electronically-controlled automatic transmissions	
42.	Diagnose problems related to the circuits in an electronically-controlled automatic transmission	Week-18
43.	Diagnose problems related to electronically-controlled automatic transmission operation	
44.	Explain the operation of CVTs	Week-19
45.	Test an automatic transmission	
46.	Repair automatic transmissions	
47.	Diagnose and repair electronically-controlled diesel fuel injection systems	Week-20
48.	Describe diesel engine emission controls	Week-21
49.	Explain the operation of HVAC systems	Week-22
50.	Diagnose HVAC controls	Week-23
51.	Diagnose and repair HVAC systems	
52.	Describe the safety hazards associated with hybrid electric vehicles (HEV).	Week-24
53.	Describe the operation of a hybrid electric vehicle	
54.	Diagnose problems associated with integrated vehicle systems.	Week-25
		Week-26

ELECTRICAL I

Electrical Fundamentals I

- Describe the physical qualities of insulators, conductors and semi-conductors.
- Describe the physical qualities and units of measure used for electromotive force, current, resistance and power.

Electrical Circuits I

- Use electrical symbols and basic schematics.
- Identify the three basic circuit types and their basic electrical properties.
- Identify and explain an open, short or grounded circuit.
- Using Ohm's Law, calculate for any of its variables when two are known.
- Apply Ohm's Law to a circuit to calculate voltage, current and resistance.
- Calculate power and explain the implications of power requirements in circuit design.
- Perform voltage drop measurements using a voltmeter.
- Perform parasitic drain and current draw tests using an ammeter.
- Measure electrical resistance using an ohmmeter.
- Service electrical circuit protection devices.

Fundamentals of Magnetism

- Describe magnetism and electromagnetism, and their properties.
- Describe the construction and operation of electromagnetic coils.
- Describe how magnetism or electromagnetism can change electrical energy into mechanical energy.
- Describe how magnetism or electromagnetism can change mechanical energy into electrical energy.

Batteries

- Describe the purpose, construction, operation and ratings of batteries.
- Test and service batteries.
- Diagnose problems related to batteries.
- Perform battery charging and boosting operations.

Electrical System Diagnosis I

- Use test equipment to test simple circuits and interpret results.
- Perform simple wire and connector repairs.
- Understand the hazards associated with electrostatic discharge (ESD) when working on vehicle electronic systems

Scan Tools

- Use scan tools to retrieve diagnostic trouble codes and data, clear codes, reset warning systems and perform function tests.
- Interpret scan data related to first period automotive systems.

ELECTRICAL II

Electrical Fundamentals II

- Calculate current, voltage and resistance in a circuit.
- Use electrical test equipment to locate opens, shorts or grounds in an electrical circuit.

Electrical Circuits II

- Interpret electrical circuit diagrams.
- Perform measurements of current, voltage and resistance.

Electrical System Diagnosis II

- Connect scan tools to vehicles and interpret scan data on applicable second period automotive systems.
- Use diagnostic strategies to locate open, shorts and grounds in an automotive circuit.

Charging Systems and Control Circuits

- Describe the operating principles of a generator.
- Describe the purpose, construction and operation of a vehicle charging system and its related components.
- Describe the purpose and operation of electronic voltage regulators.
- Describe the purpose, construction and operation of instrument panel charge indicator/warning devices.

Charging System Testing and Diagnosis

- Perform common diagnostic routines on charging systems and associated wiring.
- Interpret results and diagnose problems from data obtained from charging system diagnostic tests.

Starter Motors and Control Circuits

- Describe the operating principles of dc motors.
- Describe the purpose, construction and operation of starter motors and related components.
- Using wiring diagrams, describe the operation of starter motor electrical circuits.

Starting System Testing and Diagnosis

- Perform starter system diagnostic routines, interpret results and diagnose problems from the data obtained.
- Use sounds heard during performance of the starter motor load test to aid in starter motor diagnosis.
- Test starting system components and associated wiring.

ELECTRICAL III

Electrical Fundamentals III

- Interpret electrical circuit diagrams.
- Use electrical test equipment to identify and locate high resistance, shorts and opens.

Control Module Inputs, Switches, and Sensors

- Describe how and where discrete switches are used as control modules.
- Identify types of sensor classification (inductive, resistive, etc.),
- Describe the operation and application of commonly used sensors.
- Describe the term “feedback loop” and how sensors are used in a feedback system.
- Test sensors and switches according to sensor/switch type.

Control Module Outputs and Output Devices

- Describe the operation and application of common output devices, including solenoids, relays, lamps and motors.
- Describe how output devices interacting with control modules can be used to control a variety of vehicle systems.
- Test output devices according to output type.

Control Modules

- Describe the functions of a processor in an electronic control module.
- Describe how control modules interact with inputs, outputs and other control modules to control a component, circuit or system
- Describe the operation and applications of diodes, transistors, capacitors and inductors

Multiplexing and Networking

- Describe the purpose of the data stream.
- Describe the function and types of multiplexing.
- Describe how multiplex wiring is used in a vehicle network.

Advanced Electrical Schematics

- Use manufacturers' wiring diagrams and related information to verify advanced circuit operation.
- Analyze symptoms to identify circuit faults.
- Use wiring diagram information to select test procedures to isolate circuit faults.

IGNITION SYSTEMS

Ignition System Fundamentals

- Describe the purpose, construction and operation of an ignition system and its related components.
- State how ionization and induction apply to ignition systems.
- Describe the operation of a basic distributor type ignition system.

Electronic Ignition Systems

- Describe the function of an ignition module and its related components.
- Describe the essential wiring connections to an ignition module.
- Describe how a computer interacts with sensors and outputs to control an ignition system.
- Identify the sensor inputs and output devices essential to computer controlled ignition system operation.
- Describe the operation of distributorless ignition systems.

Ignition System Diagnosis and Service

- Test and diagnose problems related to ignition systems and related components using scan tools, lab scopes and test equipment.
- Diagnose ignition system problems from analysis of primary or secondary waveforms.
- Describe the procedures for removing and installing a distributor.

ELECTRICAL SYSTEMS DIAGNOSIS

Gauges and Warning Systems

- Describe the operation of instrument panel gauges.
- Describe the operation of visual and audible warning devices.
- Diagnose and repair problems related to warning devices.

Lighting Systems

- Describe the purpose and operation of vehicle lighting systems and related components.
- Diagnose and repair faults related to vehicle lighting systems.
- Align headlamps.

Wiper and Washer Systems

- Describe the purpose and operation of available wiper and washer systems.
- Diagnose and repair faults related to wiper and washer systems.

Power Accessory Systems

- Describe the operation of power seat adjusters, power lock systems and power windows.
- Describe the operation of power assisted trunks and side doors.
- Diagnose and repair problems associated with power accessories

Heated Systems

- Describe the operation and service procedures for heated glass systems.
- Describe the operation and service procedures for heated seats and steering wheels.
- Diagnose and repair faults related to heated components

Speed Control Systems

- Describe the operation of vehicle speed control systems.
- Diagnose and repair problems related to vehicle speed control systems.

Information and Entertainment Systems

- Describe the operation of information systems.
- Describe the operation of entertainment systems.
- Diagnose problems related to information systems.
- Diagnose problems related to entertainment systems.

Safety and Security Systems

- Describe the operation of anti-theft and alarm systems.
- Describe the operation of remote systems.
- Diagnose problems related to factory installed safety and security systems

Vehicle Networks

- Diagnose and repair single fault problems related to multiplex systems.

Antilock Brake Systems

- Identify basic ABS components.
- Describe the operation of an ABS system.
- Demonstrate a diagnostic procedure for an ABS system.

Passenger Restraint Systems

- Describe the operation of active restraint systems.
- Identify the components of an active restraint system.
- Describe the operation of passive restraint systems.
- Identify components of a passive restraint system.
- Diagnose and repair passive restraint systems.

AUTOMATIC TRANSMISSIONS AND TRANSAXLES

Automatic Transmission Fundamentals

- Describe the operating principles of an automatic transmission

Planetary Gear Sets

- Describe the purpose and function of a planetary gear set.
- Describe the construction, parts and operating principles of a simple planetary gear set.
- Identify the drive, driven and held members of a planetary gear set in all forward and reverse ranges.
- Describe the construction, parts and operating principles of a compound planetary gear set.

- Diagnose simple and compound planetary gear set failures

Torque Converters

- Describe the purpose, parts and operation of a lock up torque converter.
- Describe the operation of torque converter control circuits and valves.
- Diagnose problems related to faulty torque converters, control circuits, valves and, their effects on transmission operation.

Oil Pumps

- Describe the function, parts and operation of a fixed displacement automatic transmission oil pump.
- Describe the function, parts and operation of a variable displacement automatic transmission oil pump.
- Diagnose problems related to faulty automatic transmission oil pumps.
- Disassemble and reassemble an automatic transmission oil pump.

Clutches and Bands

- Describe the purpose, parts and operation of clutch assemblies, pistons and seals.
- Describe the purpose, parts and operation of transmission bands and servo assemblies.
- Service transmission bands and clutches
- Describe the symptoms of faulty clutches, bands or servos.
- Diagnose faulty clutches, bands and servos

Hydraulic Valve Fundamentals

- Describe the operation of simple types of hydraulic valves.
- Describe the purpose and operation of a manual valve.
- Diagnose manual valve problems.
- Describe the purpose and operation of pressure regulating valves.
- Describe how throttle opening and gear selection affect main line pressure.

Shift Valves

- Describe the purpose, construction and operation of a shift valve.
- Describe how various driving conditions affect the operation of a shift valve.
- Diagnose shift valves problems and explain how the problems affect automatic transmission operation.

Electronically-Controlled Automatic Transmissions (Operation)

- Describe the operation of an electronically-controlled automatic transmission.
- Describe the electronic controls used in an electronically-controlled automatic transmission

Electronically-Controlled Automatic Transmissions (Circuits)

- Identify basic oil circuits and use a hydraulic circuit diagram to trace the flow of oil in an electronically-controlled automatic transmission
- Describe how one hydraulic circuit influences other hydraulic circuits.

Electronically-Controlled Automatic Transmissions (Diagnosis)

- Diagnose electronically-controlled automatic transmission problems.

Continuously Variable Transmissions (CVTs)

- Describe the operation and principles of a continuously variable transmission.
- Describe a road test procedure for verifying operation of a CVT.

Automatic Transmission Testing and Adjustments

- Test and verify automatic transmission operation using scan tools, lab scopes and common test equipment.
- Perform hydraulic pressure tests on an automatic transmission to diagnose failures.
- Adjust bands and linkages on an automatic transmission.
- Describe a road test procedure to verify automatic transmission operation.

Automatic Transmission Service and Repair

- Describe transmission fluid flush procedures.
- Disassemble an automatic transmission.
- Reassemble and adjust an automatic transmission

DIESEL FUEL SYSTEMS

Electronic Diesel Fuel Injection Systems

- Describe the chemical and combustion characteristics of diesel fuel.
- Describe the operation and design features of common electronically-controlled diesel fuel injection systems and related components.
- Perform on-vehicle testing of an electronically-controlled diesel fuel injector.
- Test intake air heater systems.
- Test an electronically-controlled glow plug.
- Describe maintenance procedures for electronically-controlled diesel fuel injection systems.
- Describe diagnostic and repair procedures for electronically-controlled diesel fuel injection systems.

Diesel Engine Emission Controls

- Describe the operation of exhaust gas recirculation (EGR) systems
- Describe the operation of diesel exhaust fluid (DEF) systems.
- Describe the operation of particulate filters.
- Describe the operation of catalytic converters.

HEATING, VENTILATION AND AIR CONDITIONING (HVAC) SYSTEMS

HVAC Systems

- Identify the environmental concerns with HVAC systems.
- Describe the principles and properties of heat.
- Describe the properties of refrigerants and refrigerant oils.
- Demonstrate the safety precautions when handling refrigerants and refrigerant oils.
- Describe the function of compressors, condensers, evaporators and accumulator/dryers.
- Describe the function of refrigerant metering devices used in HVAC systems

HVAC Controls

- Identify and explain the operation of components used for temperature control and air distribution.
- Describe how HVAC controls may be integrated with other vehicle systems.
- Diagnose electronic HVAC controls by accessing on-board diagnostic capabilities

HVAC Repair

- Identify the type of refrigerant used in an HVAC system.
- Recover, recycle and recharge HVAC systems according to legislated guidelines.
- Repair or replace defective HVAC components.
- Diagnose problems and outline repair procedures related to HVAC systems using common leak, pressure and temperature testing equipment.

HYBRID ELECTRIC VEHICLES (HEV)

HEV Safety Protocols

- Describe the safety hazards associated with servicing and testing hybrid electric vehicles

Hybrid Electric Vehicles

- Identify the variety of HEV designs on the market.
- Describe the operation of a HEV.
- Describe the interaction between the motor/generator and the engine during:

- high voltage charging
- traction torque
- kinetic energy recapture (regenerative braking or engine braking)
- internal combustion engine starting.

VEHICLE SYSTEM MANAGEMENT, INTEGRATION AND VEHICLE NETWORKS

Vehicle System Management, Integration and Vehicle Networks

- Describe the impact on integrated systems caused by particular faults in a system.
- **Diagnose complex (2 or more faults) problems in vehicles with integrated systems.**

Home Assignment

Designing Effective Homework

To achieve a positive impact on student learning, homework assignments must be well-designed and carefully constructed. Some specific research findings include:

- ▶ Homework is most effective when it covers material already taught.
- ▶ Homework is most effective when it is used to reinforce skills learned in previous weeks or months.
- ▶ Homework is less effective if it is used to teach complex skills.

Characteristics of Good Assignments

When teachers plan homework, they should consider the characteristics listed below:

- ▶ Provide clear instructions for students;
- ▶ Can be completed successfully;
- ▶ Are not too long;
- ▶ Can be completed within a flexible time frame;
- ▶ Use information and materials that are readily available;
- ▶ Reinforce and allow practice of previously taught skills;
- ▶ Must not be unfinished class work;
- ▶ Are interesting to students and lead to further exploration and study;
- ▶ Stimulate creativity and imagination in the application of skills;
- ▶ Stimulate home and class discussion

Homework Don'ts

Do not assign homework that:

- ▶ Is unfamiliar, boring or impossible to do
- ▶ Requires complex skills or requires unreasonable time frames
- ▶ Is a “time filler” to keep students busy or a punishment for not doing class work
- ▶ Do not wait until the last minute to organize and assign the *homework (You may give useless or impossible tasks and/or giving inadequate directions)*
- ▶ Do not assume that all homes have equal resources, that all parents have equal skills and talents to support their children as learners
- ▶ Do not collect any homework you do not intend to check, review or grade.
- ▶ Do not assign homework that is so difficult and unfamiliar to students that their parents are tempted to:
 - Do the work for them;
 - Accuse their children of being inattentive in class; or
 - Accuse their children of failing.

Automotive Mechatronics

What is freelancing and how you can make money online - BBCURDU

<https://www.youtube.com/watch?v=9jCJN3Ff0kA>

What Is the Role of Good Manners in the Workplace? By Qasim Ali Shah | In Urdu

<https://www.youtube.com/watch?v=Qi6Xn7yKIIQ>

Hisham Sarwar Motivational Story | Pakistani Freelancer

https://www.youtube.com/watch?v=CHm_BH7xAXk

21 Yr Old Pakistani Fiverr Millionaire | 25-35 Lakhs a Month Income | Interview

<https://www.youtube.com/watch?v=9WrmYYhr7S0>

Failure to Millionaire - How to Make Money Online | Fiverr Superhero Aaliyaan Success Story

<https://www.youtube.com/watch?v=d1hocXWSpus>

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 importance of work and manifested by determination or desire to work hard.

The following ten work ethics are defined as essential for employee's 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 own weight and help others who are struggling. Recognize when to speak up with an ideas 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 life time

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. Takes 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 workplace 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.

Suggestive Format and Sequence Order of Success Story

S. No	Key Information	Detail/Description
1.	Self & Family background	<ul style="list-style-type: none"> • Self-introduction • Family background and socio economic status, • Education level and activities involved in • Financial hardships etc
2.	How he came on board NAVTTC Training/ or got trained through any other source	<ul style="list-style-type: none"> • Information about course, apply and selection • Course duration, trade selection • Attendance, active participation, monthly tests, interest in lab work
3.	Post training activities	<ul style="list-style-type: none"> • How job / business (self-employment) was set up • How capital was managed (loan (if any) etc). • Detail of work to share i.e. where is job or business being done; how many people employed (in case of self-employment/ business) • Monthly income or earnings and support to family • Earning a happy life than before
4.	Message to others (under training)	<ul style="list-style-type: none"> • Take the training opportunity seriously • Impose self-discipline and ensure regularity • Make Hard work pays in the end so be always ready for the same.

Note: Success story is a source of motivation for the trainees and can be presented in a number of ways/forms in a NAVTTC skill development course as under: -

1. To call a passed out successful person of institute. He/she will narrate his/her success story to the trainees in his/her own words and meet trainees as well.
2. To see and listen to a recorded video/clip (5 to 7 minutes) showing a successful person Audio video recording that has to cover the above mentioned points.
3. The teacher displays the picture of a successful trainee (name, trade, institute, organization, job, earning per month etc) and narrates his/her story in teacher's own motivational words.