

# **AUTOTRONICS COURSE – AN INNOVATIVE APPROACH IN MODERN AUTOMOTIVE TECHNOLOGY EDUCATION IN AFRICA FOR SUSTAINABLE DEVELOPMENT**

BY

<sup>1</sup>ENGR. HARUNA ABUBAKAR(harounsadeeq@yahoo.com)

<sup>2</sup>USMAN OZOVEHE YAHAYA (almizansoftwareresolution1@yahoo.com)

<sup>3</sup>ENGR. ABDUL-AKABA TIJANI (otarutijani@gmail.com)

<sup>1,2</sup>Mechanical and Aerospace Ground Engineering Department (MAGED), Air Force Institute of Technology, Air Force Base Kaduna - Kaduna, Nigeria.

<sup>3</sup>Mechanical Engineering Department, Kaduna Polytechnic, Kaduna, Nigeria.

## **ABSTRACT**

The paper describes an Autotronics course addressing the current and anticipated skill shortages of car mechanics and employers in car garages. Autotronics could be describe as an artificial word that combines automotive sector and electronics content. It has without doubt been at the heart of every meaningful automobile industrial breakthrough recorded in the last two centuries and is continually transforming maintenance operations with endless discovery of new techniques. In Africa, there is need to provide effective industrious and institution affiliations where autotronics skill acquisition can be used to reduce unemployment among our teaming youths and enhances the maintenance skills of our incompetent mechanics. In advanced countries of the world, autotronics plays important role in their socio-economic development of their citizens. The course uses an innovative, blended learning approach, which combines multimedia with sophisticated classroom training in order to meets the standards and challenges of modern automotive technologies worldwide. The course contains a comprehensive suite of

modules, which allow self-guided learning to be completed at the learner's own pace, be up to date, highly interactive and practical. Content of the course modules and topics of the practical training, dedicated to automotive electronics and OBD (On Board Diagnosis) are considered.

Key words: Autotronics, automotive sector, vocational training, technology

## INTRODUCTION

The purpose of this paper is to encourage Government, institutions, private companies, car garage owners and unemployed youths in our society of Africa continent to embrace and support Autotronics as a course to be studied or a certain engineering skill to be acquired. Once this is done, it will reduce unemployment in our society and will ultimately improve our socio-economic development of our dear continent Africa.

The training needed for car garage and car mechanic qualifications has changed significantly in the past few years. A wide variety of technological developments in the automobile industries are responsible for this. Though, the need to give emphasis on youth skills development, especially for the less privilege, educated, poor and school drop-out has been neglected for some time now throughout the African region. Thus, skill acquisition among our youth needs to be encouraged. The educational level attainment in African countries is not showing much impact on the work force, knowing the fact that these are indicators of determining the productivity and income level, as well as the economic strength of any nation.

In this paper we looked at autotronics as a tool for industrialization and promoting modern automotive technology for sustainable development of African continent. There is need to address knowledge gap on autotronics skills in most of the African countries, in order to rescue the continent. This unique skill has without doubt been

at the heart of every meaningful Automobile industrial breakthrough recorded in the last two centuries and is continually revolutionizing the maintenance operations with endless discovery of new techniques.

Furthermore, very few if any among the African tertiary institutions of higher learning that offered a Degree or HND in automotive engineering with speciality in autotronics in both universities and polytechnics. None to mention that possesses adequate and up to date equipment and laboratory facilities capable of carrying out effective research and experiment needed in this modern automotive technology. Though, several papers were presented by so many researchers in different fields of engineering, suggesting ways by which our socio-economic development of our society could improve. The fundamental benediction of studying autotronics as a course in our tertiary institutions and as a skill in our skill acquisition centres is the empowerment of vulnerable group, talented unemployed youths and engineering graduates in the society.

## **AUTOTRONICS**

The Autotronics is referred to as modern automotive technology in the field of automobile engineering. Significantly, it has many applications in motor vehicles technology. Autotronics as an aspect of automobile engineering presents basics, advantages, layout and components and functional operation of various computer controlled motor vehicle systems. In addition, it clarifies how to use recent diagnostic tools and equipment for fault finding and analysis. It deals with computer controlled motor vehicle systems like; engine management, ABS (Anti Brake Skid), TCS (Traction Control), SCS (Stability Control) and others. The self-diagnosis and fault codes are also included.

Some of the modern cars are as much electronic as they are mechanical, thus creating a new AUTOTRONIC area (AUTOMobile + elecTRONIC). A modern car has several control modules, which monitor and manage most of the major systems in the vehicle. The most common types are engine and drive line control, cruise

control, suspension control, anti-lock braking and airbag control, climate control, GPS-based navigation system, stability management system, instrumentation, infotainment, etc. Systems such as steering systems, collision warning, voice recognition, Internet access, night vision enhancement and collision avoidance systems [1, 2, 7, and 5].

## MODERN AUTOMOTIVE TECHNOLOGY

The modern automobile is a complex technical system employing subsystems with specific design functions. Some of these consist of thousands of component parts that have evolved from breakthroughs in existing technology or from new technologies such as electronic computers, high-strength plastics, and new alloys of steel and nonferrous metals. Some subsystems have come about as a result of factors such as air pollution, safety legislation, and foreign competition. The fig.1 below shows a typical vehicle, indicating the major functional components of an automobile.

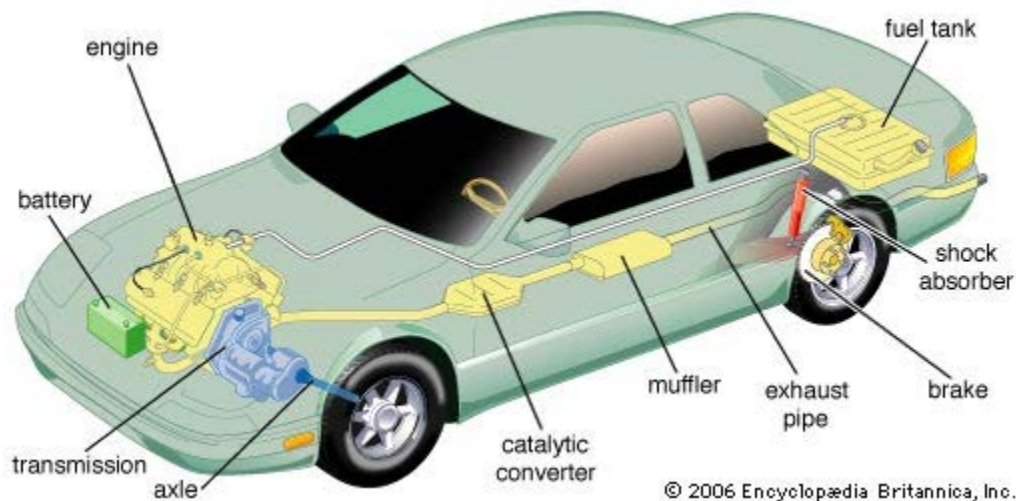


Fig.1 the Major Functional Components of an Automobile.

## **SKILLS ACQUISITION CENTRES IN AFRICA**

The evolvement of new fields of engineering operations and methods discovered through adequate research and technology advancement necessitated the establishment of skills training centres in most African countries to serve as a bridge between the academia and industry. The aim is to bring together the practicing engineering professionals from the industry and the academicians from higher institution of learning to exchange ideas and knowledge in ensuring that required skills are imparted adequately.

Though, the idea to establish industrial skills training centre in most African countries was conceived in 1978, following years of periodic appraisal of the effort of various formal and non-formal vocational institutions. The industrial training fund in a bid to introduce into the national economy an effective and vocational training system, commissioned a study of in-plant and apprentice training in Africa. The vocational training in the formal vocational training institutions was more or less improvised and geared more towards theory than practices. Almost all the vocational training institutions suffer from lack of funds, qualified and experienced instructors and equipment [10].

In a bid to introduce a modern and systematic vocational training system which is broad-based in nature, industrial training fund in 1981 took a policy decision to go into direct training of craftsmen and technicians by establishing industry-oriented vocational training institutions which is called Industrial Skills Training Centre (ISTC).

The Centre's objectives are therefore to:

1. Trains and develops high level skilled manpower in the occupational area that exists in the Centre.
2. Liaises with the industrials to upgrade the skills of their work force for improved productivity.

3. Undertakes studies to establish the skill requirements of industries and develop job specifications for purposes of skills training.
4. Empowers the youth through skills acquisition programme aimed a job creation and entrepreneurship development.
5. Designs and implements booster courses based on industry's perceived needs.
6. Certifies and issues trainees with ITF competency certificate at the successful completion of the programme.

All these are bold steps in improving the professionalism of our industrial workforce and indeed to train our redundant teaming youths of our dear continent, Africa. The aim is to reduce unemployment for sustainable socio-economic development of our society. But the aim could not be achieved without looking at the other aspects of development like the field of modern automotive technology, specifically, 'Autotronics'. As we all know modern sophisticated vehicles are being imported into the continent without actually having adequate well skilled manpower to handle the aftersales services on those vehicles, perhaps making the end users uncomfortable. One of the ways to alleviate that is to ensure adequate manpower in the field of autotronics. Therefore, the need to introduce 'AUTOTRONICS', as a course in our higher institutions of learning and indeed as an occupational area in our vocational training centres cannot be overemphasized.

### **THE NEED FOR AUTOTRONICS EDUCATION IN AFRICA**

As is the case in all areas of industry, lifelong learning is essential for the workforce, in order to stay viable in markets over the long term. Ongoing car mechanics re-skilling is being pushed ahead in particular due to the following developments:

1. The introduction of electronic and communications components from different manufacturers, based on different standards;

2. Increasing technical complexity at the workplace in car garages (introduction of new machines, diagnostic technologies);
3. Increasing competitive pressure on limited brand-authorized car garages in the country;
4. The existence of unskilled mechanics in most of our car garages and as a consequence of this, the demand for garages to acquire basic knowledge of Autotronics that can be used for maintenance and trouble-shooting for different brands.
5. While large car garages with exclusive contracts with major car brands are responding to the growing demands for employee qualification with more extensive training budgets and systematic continuing education courses, the small and medium size garages are at a structural disadvantage in terms of staff training and development, due to limited financial and staffing resources.

To address these challenges and to fill the gap between current state of car servicing and the skill manpower requirements, an Autotronics course needs to be introduced to meet up the skill manpower demand of small and medium sized car garages and so-called roadside car mechanics garages.

### **AUTOTRONICS COURSE STRUCTURE AND TRAINING**

The Autotronics course is based on the traditional classroom theoretical and practical training. The practical training should be provided in well-equipped Laboratory or Workshop. The course contains a comprehensive module in combination with sophisticated classroom training specifically designed to meet the needs of car garages and car mechanics. This module is adapted to local requirements; allow self-guided learning to be completed at the learner's own pace, be up to date and highly practical offering interactive multimedia elements.

The course breaks down into three course modules made up of the following thematic areas as shown below:

### **Autotronics Professional level I**

This level covers such activities as checking circuit resistance, continuity, testing basic electrical/electronic components; performing series and parallel circuit test; measuring current and voltage; calculating total resistance/impedance; practicing Ohm's and Kirchhoff's laws; analyzing waveforms and measure signals values like peak, frequency, period; testing circuit with electronic components like diode rectifier, Zener diode, voltage limiter, transistor switch in driving circuit; troubleshooting concerning opens, shorts and grounds in circuits, existence of unwanted resistances and analyzing AC signal waveforms for fault discovering.

Teaching aims in this module concern learner ability to read and analyze wiring diagrams; creation of learner self-confidence in multimeter and oscilloscope usage, interpret readings and determine needed repair; ability to relate fault in a circuit and reason that cause it. The summary of the course outline is as shown:

- Introduction to Automotive Systems
- Electrical Fundamental
- Basics of Measurement Techniques
- Basics of Automotive Electronics
- Basic Hydraulic and Pneumatic Components
- Electrical Power Supply in Cars
- Practical Training for the Level 1 covers General Electrical System Diagnosis and Services

### **Autotronics Professional level II**

The second level activities include testing various sensors and their circuits (temperature sensor, throttle position sensor, MAP sensor, Knock sensor, MAF



sensor); reading and interpreting automotive manual data; testing actuators with Pulse Width modulation (relay, EGR valve); measuring computer outputs; using diagnosis flowchart to localize trouble in sensor/actuator/circuitry; relate trouble symptom with the reason of its appearance.

Teaching aims in this module concern learner ability to read and interpret automotive manual data, ability to choose and apply different testing methods of vehicle sensors and actuators; ability to test and diagnose temperature sensors and their circuits; relate measured data with expected reaction of control modules, ability to test and diagnose different automotive sensors and their circuits; ability to relate troubles with engine behavior, ability to test motors and relate trouble symptoms with reason of its appearance; ability to relate troubles with vehicle behavior, understanding pulse width modulation for controlling actuators. The summary of the course outline is as shown:

- Basics of Sensors and Actuators
- Automotive Computers
- Gasoline Engine Management Systems
- Diesel Engine Management Systems
- Practical Training for the Level 2 covers Sensors' and Actuators' Diagnosis and Services

### **Autotronics Professional level III**

The last level accentuates upon OBD (On-board Diagnostic) data retrieval and DTC (Diagnostic Trouble codes) diagnosis by using live experiments with scan OBDII Tool.

Teaching aims in this module concern trainee's preparation to perform a scan tester diagnosis on a car, their ability to use the scan tool software and hardware to read data from an EOBD compliant car and analyze this data, the learner readiness to

create and use symptom charts to set up a strategic approach to troubleshooting problems. The summary of the course outline is as shown:

- Emission Control
- On-Board Diagnostic (OBD)
- Road Safety Systems
- Automatic Transmissions
- Electronic Suspension and Steering System
- Communication systems
- Comfort and Safety Systems
- Practical Training for the Level 3 covers Live Experiments with scan OBDII Tool

All course modules combine basic knowledge with their specific fields of application in the car industry. The objective of the course is to impart core competencies applicable across brands in the topics mentioned, supporting users in their day-to-day work on the cars of different manufacturers.

### **THE IMPORTANT OF AUTOTRONICS COURSE**

By the end of the course, participant will be able to:

- Outline the advantages of autotronics applications in motor vehicle technology.
- Outline the basics of electronic control (sensing, data processing, actuating, closed loop).
- Describe the structure and the functional operation of vehicle computer, sensors and actuators.
- Explain how engine computer controlled systems work.
- Explain how automotive chassis related computer controlled systems work.

- List and describe the principle of operation of modern vehicles diagnostic tools & equipment.
- List and describe the used modern motor vehicles diagnostic techniques.
- Troubleshoot problems of all type professionally.
- And ultimately be able to carry out maintenance on vehicles according to the respective manufactures' specifications.

## **RECOMMENDATIONS**

In view of the fact that this initiative hinges on the fact that trainees will become self-employed and employers which will reduce pressure on labour market, the following recommendations are made practical.

- Skill acquisition centres should be established for Autotronics.
- Practical skills necessary for self-employment in Autotronics are to be identified.
- The skill area of Autotronics should be segmented for both small and medium car garages.
- Adequate training and instructional materials should be provided in the training centres.
- Commercial banks should extend their credit services to the development of car garages.
- Investment guarantee agencies for establishment of car garages to cater for the limited-resource entrepreneur with the business potential should be established.

## **CONCLUSION**

The paper considers an innovative approach dedicated to modern automotive technology education for Government, Institutions, car mechanics and employers in car garages. It combines the advantages of an intensive classroom training

(individual learner's pace, use of multimedia, etc.) and the possibility of applying theoretical knowledge acquired directly on the real car.

It is our belief that action taken in this direction will empower youth for economic and social development and indeed will promote the modern automotive technology for sustainable development in Africa.

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