Please revise the following text to suit your requirements.

This sample scheme of work covers both classroom and workshop based learning for Unit 306. It is based on 30 hours across 12 sessions plus additional hours for independent learning.

This is only an example of a possible scheme of work. You can use it as it is, adjust it or extract content to suit your delivery needs, or the needs of individual learners.

The schemes of learning are intended to be learner-focused, and embrace current pedagogical methodology such as flipped and blended learning.

A version of this scheme of learning with **full supporting materials** is also available to purchase on **SmartScreen.co.uk**.

Where possible we have included blended learning activities that make good use of technology so as to help centres fulfil the minimum amount of digital teaching recommended by government.

Centres should also provide opportunities within the unit content to introduce the following wider skills and government initiatives:

- English, mathematics and ICT
- employability skills and behaviours
- British values (including the Prevent strategy).

Centres should also incorporate the following themes, where appropriate. Although they are not specifically referred to in the scheme of learning, City & Guilds regards these as essential in the teaching of the qualification:

- spiritual, moral, social and cultural issues
- health and safety considerations, in particular the need to impress upon learners the fact that they must preserve the health and safety of others as well as themselves
- environmental education and related European issues.

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Lesson 1: Hydrogen fuel cell vehicles – Basic system layout **Suggested teaching time:** 3 hours

Learning outcome: Understand operating principles of alternative power systems.

Topic	Suggested teaching	Suggested resources
Topic 1.1 Hydrogen fuel cell vehicles.	Introduce the learning outcome. Facilitate a group discussion exploring the need for alternative fuel vehicles. To cover: • hydrogen, electric and hybrid vehicles • the environmental and economic reason why they have been developed • industry barriers to alternative power systems − reference the influence of political oil and automotive lobbies in car producing countries around the world • the value of the petrol engine car production industry to the economy • the emissions scandal. Introduce the basic system layout of a hydrogen fuel cell vehicle. Use graphics and video to visually explore the system, including: • high pressure hydrogen tank • fuel cell • motor • power control unit (PCU) • battery. **Opportunity for applied learning:** • Learners to research and discuss the core differences in design and use of fuel cell vehicles compared to conventionally fuelled vehicles.	www.nextgreencar.com/fuelcellcars/ www.ukh2mobility.co.uk/fcevs/# www.gov.uk/government/uploads/system/uploads/attachment_data/file/521147/supporting-fleet-uptake-of-hydrogen-fuel-cell-vehicles-guidance-note.pdf

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Lesson 2: Hazards of hydrogen fuel cell vehicles **Suggested teaching time:** 3 hours

Learning outcome: Understand operating principles of alternative power systems.

Topic	Suggested teaching	Suggested resources
Topic 1.1 Hydrogen fuel cell vehicles	Recap on hydrogen fuel cell system layout, covered in lesson 1. Introduce the potential hazards when working on hydrogen fuel cell vehicles including: • high pressure within fuel system • fuel leakage in system • flammability of hydrogen (in atmosphere) • transfer from storage. **Opportunity for applied learning** Learners to research the hazards of hydrogen fuel cells and compare them to those of conventional fuelled vehicles including: • refuelling • storage • accidental damage • maintenance • conversion of energy within the fuel cell.	https://dps.mn.gov/divisions/sfm/programs-services/Documents/Responder%20Safety/Alternative%20Fuels/FuelCellHydrogenFuelVehicleSafety.pdf www.toyota-global.com/innovation/environmental_technology/fuelcell_vehicle/

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Lesson 3: Advantages and disadvantages of hydrogen fuel cell vehicles **Suggested teaching time:** 2 hours

Learning outcome: Understand operating principles of alternative power systems.

Topic	Suggested teaching	Suggested resources
Topic 1.1 Hydrogen fuel cell vehicles.	Recap lesson 2 on the hazards of hydrogen fuel cell vehicles. Discuss the advantages and disadvantages of hydrogen fuel cell vehicles. • Advantages – zero emissions (environmental impact) • Disadvantages – cost of fuel, lack of refuelling points, vehicle cost (including cost and difficulty of fuel cell maintenance). **Opportunity for applied learning** Split the class into groups. Assign each group an advantage or disadvantage to research. Focus on the impact to potential customers. Have there been any changes in the last few years, and what does the future hold? Groups to present to the class to show their findings and conclusions.	www.nextgreencar.com/fuelcellcars/ www.ukh2mobility.co.uk/fcevs/# www.gov.uk/government/uploads/system/uploads/attachment_data/file/521147/supporting-fleet-uptake-of-hydrogen-fuel-cell-vehicles-guidance-note.pdf https://dps.mn.gov/divisions/sfm/programs-services/Documents/Responder%20Safety/Alternative%20Fuels/FuelCellHydrogenFuelVehicleSafety.pdf www.toyota-global.com/innovation/environmental_technology/fuelcell_vehicle/

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Lesson 4: Electric powered vehicles and their safety **Suggested teaching time:** 2 hours

Learning outcome: Understand operating principles of alternative power systems

Topic	Suggested teaching	Suggested resources
Topic 1.2 Electrically powered vehicles.	Introduce the topic of electric powered vehicles. Give a brief introduction of what constitutes an electrically powered vehicle, including: • power sources • charging options • battery life • vehicle range • a brief overview of operating types. Explain safety procedures required when working with this type of vehicle including: • general safety procedures • powering down the system • isolating batteries. **Opportunity for applied learning** Learners to research the risks and hazards when working on electric vehicles covering the points above and to identify relevant training opportunities and required accreditation needed to work on electric vehicles.	Hilliers Fundamentals of motor vehicle technology – A Hillier Nelson Thornes, 2nd edition ISBN-13:978-1408515181 www.nextgreencar.com/electric-cars/ www.hse.gov.uk/mvr/topics/electric-hybrid.htm

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Lesson 5: Electric power storage **Suggested teaching time:** 3 hours

Learning outcome: Understand operating principles of alternative power systems.

Topic	Suggested teaching	Suggested resources

Topic 1.2
 	
Electrically powered vehicles.
	Recap on lesson 4.
	
	Explain the storage of electricity in batteries and the repowering of batteries using:
	• external charge points
	• internal charging.
	
	Opportunity for applied learning
	• Split learners into groups to research the advantages and disadvantages of electric vehicles, presenting the findings to the class.
	  ○ Advantages:
	  ▪ zero emissions
	  ▪ government subsidies
	  ▪ reduced noise (driver and passenger)
	  ▪ two pedal control
	  ▪ low running costs.
	  ○ Disadvantages:
	  ▪ lack of charging points
	  ▪ vehicle costs
	  ▪ pedestrian safety hazard due to reduced noise level
	  ▪ limited range.
	
	• Learners conduct a questionnaire to survey public opinion about electric vehicles. Record and present findings using appropriate spreadsheet software, and produce a short report on the findings.
		www.gov.uk/government/uploads/system/uploads/attachment_data/file/435980/public-attitudes-evehicles.pdf.pdf
		
		www.thechargingpoint.com/beginners-guide.html

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Lesson 6: Hybrid vehicles – Introduction **Suggested teaching time:** 3 hours

Learning outcome: Understand operating principles of alternative power systems.

Topic	Suggested teaching	Suggested resources

Topic 1.3
 	
Hybrid vehicle systems.
	Introduce the topic by exploring basic hybrid vehicles:
	• Fuel systems:
	  ○ diesel
	  ○ petrol
	  ○ ethanol
	  ○ electric motors and batteries.
	• Hybrid types including:
	  ○ full hybrid
	  ○ mid hybrid
	  ○ plug-in hybrids using series and parallel systems.
	• Power generators including:
	  ○ self-generation
	  ○ plug-in.
	
	Opportunity for applied learning
	• Learners to research two different hybrid vehicle system types outlining the key differences in each system type.
	• They present their findings in a report showing the key differences, and identifying the best applications of each hybrid system.
		www.toyota-global.com/innovation/environmental_technology/hybrid/
		
		www.hybridcars.com/
		
		Video links:
		How a hybrid engine works:
		YouTube
		www.youtube.com/watch?v=m2qvGJwTuBo

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Lesson 7: Hybrid vehicle analysis – Pros and cons **Suggested teaching time:** 2 hours

Learning outcome: Understand operating principles of alternative power systems.

Topic	Suggested teaching	Suggested resources

Topic 1.3
 	
Hybrid vehicle systems.
	Recap on lesson 6.
	
	Learners to compare advantages and disadvantages of hybrid system against conventional internal combustion engines:
	• Advantages:
	  ○ low emissions
	  ○ extended range.
	• Disadvantages:
	  ○ battery life
	  ○ cost of repairs
	  ○ charge point availability.
	
	Opportunity for applied learning
	• Learners to review their learning from lesson 6. Then, in small groups they should discuss, then present their findings outlining the main reasons for adopting hybrid vehicle technology.
	• Learners highlight the advantages and disadvantages of this technology.
	• They research hybrid sales trends, looking for case studies around hybrid fleet cars or use in the taxi industry (eg Uber).
		futurethinking.com/wp-content/uploads/2015/03/Automotive-Trends-2015.pdf
		
		www.smmt.co.uk/wp-content/uploads/sites/2/AutoAnalysis-report-the-future-of-UK-automotive-manufactuing-October-2015.pdf
		
		www.businessgreen.com/bg/news/2440905/uk-electric-car-market-enjoys-record-surge-in-demand

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Lesson 8: Vehicle lighting systems **Suggested teaching time:** 3 hours

Learning outcome: Understand principles of lighting and hazard management systems

Topic	Suggested teaching	Suggested resources
Topic 2.1 Lighting systems used in vehicles.	Introduce subject of modern vehicle lighting systems. Give a brief history of how vehicle lighting has changed and discuss with learners why this has happened. Cover: • electronics • design. Explain briefly how the following lighting systems work (show a video and use a real vehicle to demonstrate): • light emitting diodes (LED) • high intensity discharge (HID) • adaptive lighting. **Opportunity for applied learning** • Learners to research the key differences between LED and HID lighting. They should document why they are used in conjunction with adaptive lighting systems describing the basic functionality and safety features of these lighting systems.	www.osram.co.uk/osram_uk/news-and-knowledge/automotive-special/trends-in-automotive-lighting/index.jsp www.magnetimarelli.com/excellence/technological-excellences/the-full-led-technology www.audi.com/com/brand/en/vorsprung_durch_technik/content/2015/03/light.html Video link: BMW intelligent headlight technolo: YouTube www.youtube.com/watch?v=ordX8_CYwK0

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Lesson 9: Hazard avoidance systems

Suggested teaching time: 3 hours

Learning outcome: Understand principles of lighting and hazard management systems

Topic	Suggested teaching	Suggested resources
Topic 2.2 Hazard avoidance concept and systems.	Introduce the topic with a brief overview of the systems and why they have been developed. Safety and electronics allow these systems to be used. Show videos about the following systems: • night vision • collision avoidance • lane assistance • parking assistance • adaptive cruise control. **Opportunity for applied learning** • Learners to compare the safety systems and state whether they are passive or active, giving reasons. • Learners describe the advantages of the safety sysytems to drivers and other road and pavement users. • Learners explain how the systems interact with one another and with other vehicle systems including lighting, transmission and engine management.	www.volvocars.com/uk/about/our-innovations/city-safety# www.audi-mediacenter.com/en/assistance-systems-237 www.volkswagen.co.uk/technology/proximity-sensing Video links: YouTube Night vision: www.youtube.com/watch?v=pxGk7h0G_Es Forward collision avoidance system: www.youtube.com/watch?v=MfOgwrhJG8A Collision avoidance system and lane departure warning: www.youtube.com/watch?v=WL9ZWMWl2eQ Parking assistance: www.youtube.com/watch?v=VOv1IR5rUDw Adaptive cruise control: www.youtube.com/watch?v=IMYi3G7dkU4

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Lesson 10: Dashboard technology **Suggested teaching time:** 2 hours

Learning outcome: Research telemetry and software used in vehicles.

Topic	Suggested teaching	Suggested resources
Topic 3.1 Dashboard technology.	Introduce the subject explaining the modern dashboard including: • touch screens • active driver displays. If possible, show learners a vehicle with this technology. Also use manufacturers' websites to source video demonstrations of these types of technology. **Opportunity for applied learning** • Learners to research and document current product offerings around these technologies. They should assess the benefit to drivers, ease of operation and safety factors.	www.audi.com/com/brand/en/vorsprung_durch_technik/content/2014/03/audi-virtual-cockpit.html Video links: Dashboard technology: www.jaguar.co.uk/jaguar-range/xe/features/in-car-technology.html

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Lesson 11: Telemetry systems

Suggested teaching time: 2 hours

Learning outcome: Research telemetry and software used in vehicles.

Topic	Suggested teaching	Suggested resources

Topic 3.2
 	
Telemetry systems.
	Recap on the previous lesson, linking touch screens and active displays to vehicle telemetry systems.
	
	Briefly describe the differences between a tracking system and a global positioning system (GPS).
	
	Opportunity for applied learning
	
	• Learners to produce a report explaining how a tracking system and GPS operate. This may need to be completed as independent learning. Applications for each system should be explained, including:
	  ○ route planning and navigation
	  ○ fleet management
	  ○ vehicle security
	  ○ insurance and accident reconstruction
	  ○ driver/vehicle performance feedback.
		http://smartlab.herts.ac.uk/project/remote-vehicle-telemetry-capture-monitoring/
		
		www.global-fleetsolutions.com/telemetry/

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Lesson 12: Vehicle Wi-Fi systems **Suggested teaching time:** 2 hours

Learning outcome: Research telemetry and software used in vehicles.

Topic	Suggested teaching	Suggested resources

Topic 3.3
 	
Wi-Fi technology for vehicles.
	Recap on the previous lesson.
	
	Introduce the topic of vehicle Wi-Fi systems, including:
	• vehicle integration (fault finding, downloads and communications)
	• area coverage, including range and limitations.
	
	Opportunity for applied learning
	• Learners to research the current application of vehicle Wi-Fi systems. They should report on:
	  ○ features
	  ○ driver benefits
	  ○ connectivity limitations.
		http://support.volvocars.com/uk/Pages/category.aspx?category=8caea1fd91a2b107c0a80151730105f0
		
		www.bmw.com/com/en/insights/technology/connecteddrive/2013/connectivity_technologies/index.html

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