Republic of the Philippines
SULTAN KUDARAT STATE UNIVERSITY
College of Industrial Technology
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NAME:_____ AT312 Midterm Exam DATE:_____

YEAR AND SECTION:_____

GENERAL DIRECTION:

- READ AND ANSWER CAREFULLY
- YOU MUST CLEARLY ENCIRCLE THE LETTER (A, B, C, OR D) CORRESPONDING TO YOUR CHOSEN ANSWER DIRECTLY ON THIS EXAM PAPER.
- IF YOU CHANGE YOUR MIND, COMPLETELY CROSS OUT THE ORIGINAL CIRCLE AND THEN CLEARLY ENCIRCLE YOUR NEW CHOICE. DO NOT LEAVE TWO CHOICES CIRCLED.

Test I: multiple choice:

1. What is the minimum number of distinct propulsion methods a vehicle must use to be classified as a hybrid vehicle?
   a) One
   b) Two
   c) Three
   d) Four
2. A Hybrid Electric Vehicle (HEV) uses which two main components for propulsion?
   a) Steam engine and electric motor
   b) Gas turbine and gasoline engine
   c) Electric motor and gas turbine
   d) Internal Combustion Engine and Electric Motor
3. How is a Hybrid Electric Vehicle (HEV) able to achieve an improvement in fuel economy compared to a conventional vehicle?
   a) It requires special, high-octane racing fuel.
   b) It uses a much larger, more powerful engine.
   c) By selectively using or combining its two power sources at their most efficient operating points.
   d) By relying only on the internal combustion engine at all times.
4. The ability of an HEV's electric motor to propel the vehicle without the engine running most directly demonstrates which operating principle?
   a) Power assist mode
   b) Regenerative braking
   c) Idle Stop Mode
   d) Pure electric mode (or motoring mode)
5. A motorist drives a vehicle that shuts off the engine while stopped at a light and restarts it instantly upon acceleration. This scenario demonstrates the application of which common hybrid system feature?
   a) Regenerative Braking
   b) Power Assist Mode
   c) Idle Stop Mode
   d) Series-Parallel Drive
6. During a rapid pass, the electric motor unit activates to contribute additional torque alongside the running gasoline engine. This action is applying the concept of:
   a) Generator mode
   b) Power Assist Mode
   c) Electric-Off Drive
   d) Battery Charging
7. When analyzing the function of a Motor/Generator Unit (M/G) in a hybrid system, which of the following best describes its dual role?
   a) It exclusively propels the vehicle, never generating power.
   b) It only generates electricity when the vehicle is cruising at high speed.
   c) It can either use electricity from the battery to propel the vehicle or convert kinetic energy into electricity to charge the battery.
   d) It is solely used to regulate the air conditioning system.
8. Which key difference differentiates a Mild Hybrid from a Full Hybrid in terms of propulsion capability?
   a) The Mild Hybrid does not use an electric motor.

b) The Full Hybrid cannot use its engine for propulsion.
c) The Full Hybrid can propel the vehicle using the electric motor alone, while the Mild Hybrid cannot.
d) The Mild Hybrid uses regenerative braking, but the Full Hybrid does not.

9. The inclusion of an Internal Combustion Engine (ICE) remains necessary in a Hybrid Electric Vehicle (primarily because it can):
a) Provide high torque at zero RPM.
b) Provide sustained power for high-speed travel or long distances and generate electricity to replenish the high-voltage battery.
c) Only operate the auxiliary 12-volt battery.
d) Only use diesel fuel for propulsion.

10. A mechanic argues that the improved fuel economy of a Hybrid Electric Vehicle is entirely offset by the increased weight of the battery and motor components. How should this claim be evaluated, based on the vehicle's design principles?
a) Correct, as the weight gain always negates the fuel savings.
b) Incorrect, as the electric motor has no weight.
c) Partially incorrect. While weight increases, the system's efficiency gains from regenerative braking and engine optimization successfully outweigh the weight penalty, resulting in net fuel savings.
d) Irrelevant, as the biggest factor in fuel economy is tire pressure.

11. An engineering team is tasked with creating a hybrid drive system that maximizes the use of regenerative braking to capture the greatest amount of energy. To achieve this, the team should synthesize a control system that:
a) Keeps the internal combustion engine running constantly to assist braking.
b) Uses friction brakes as the primary source of stopping power.
c) Directs the motor/generator unit to maximize electricity generation whenever the vehicle is decelerating or coasting.
d) Minimizes the size of the high-voltage battery pack.

12. Which hybrid design uses the Internal Combustion Engine (ICE) only to generate electricity to charge the battery, and never directly powers the vehicle's drive wheels?
a) Parallel Hybrid
b) Mild Hybrid
c) Series Hybrid
d) Full Hybrid

13. A core advantage of the Parallel Hybrid design is that it often allows the use of a smaller Internal Combustion Engine (ICE). What is the main reason this smaller engine is adequate?
a) The smaller engine is more efficient at high speeds only.
b) The electric motor is always available to assist the ICE, providing extra power for acceleration and high-demand situations.
c) The smaller engine only runs at a constant, most efficient speed.
d) The transmission is removed, reducing the load on the ICE.

14. A vehicle is being serviced, and the technician notes that there is no mechanical transmission, clutch, or torque converter connected between the ICE and the wheels. This vehicle is most likely utilizing which hybrid configuration?
a) Series Hybrid
b) Parallel Hybrid
c) Mild Hybrid
d) Micro-Hybrid

15. When analyzing the mechanical complexity of different HEV types, what is the most significant structural distinction of a Series-Parallel Hybrid compared to a pure Series Hybrid?
a) The Series-Parallel design uses a lower-voltage battery system.
b) The Series-Parallel design is incapable of regenerative braking.
c) The Series-Parallel design incorporates a mechanism that allows the Internal Combustion Engine to mechanically drive the wheels in addition to generating electricity.
d) The Series-Parallel design uses an electric motor that cannot operate alone.

16. A critic claims that the Series Hybrid design is inherently inefficient because it requires the energy generated by the ICE to be converted twice (chemical to electrical, then electrical back to kinetic). How should this claim be evaluated in the context of the design's overall function?
a) The claim is fully correct; the double conversion process makes the Series Hybrid the least fuel-efficient design overall.
b) The claim is irrelevant, as all hybrid designs rely solely on electricity for propulsion.

c) The claim is a valid critique regarding energy loss during conversion, but the overall efficiency gain comes from running the ICE at its single, most efficient speed, mitigating much of this loss.
d) The claim is incorrect; the ICE in a Series Hybrid only runs for a few seconds at a time.

17. A manufacturer aims to create a new vehicle model that includes the efficiency benefits of idle stop and regenerative braking but must be designed to be the lowest cost hybrid system on the market. Which design level should the engineers synthesize to meet these criteria?
a) Full Hybrid (Strong Hybrid)
b) Series Hybrid
c) Series-Parallel Hybrid
d) Mild Hybrid (Belt Alternator Starter system)

18. What is the specialized component responsible for regulating the flow of high-voltage DC power between the battery and the electric motor/generator?
a) The 12 volt auxiliary battery
b) The conventional transmission
c) The motor controller
d) The spark plugs

19. What design feature is typically found in the auxiliary 12 volt battery of a hybrid electric vehicle?
a) Lithium-ion (Li-ion)
b) Nickel Metal Hydride (NiMH)
c) Absorbed Glass Mat (AGM)
d) Lead-acid flooded cell

20. The electric motor in a hybrid vehicle is often described as having a dual purpose. What is the essential second purpose beyond simply propelling the vehicle?
a) Heating the passenger cabin
b) Acting as a generator to recharge the high voltage battery pack.
c) Operating the vehicle's hydraulic steering system
d) Shutting off the fuel supply to the engine

21. Why is the auxiliary 12 volt battery in a hybrid vehicle typically smaller than the starting battery in a conventional car?
a) It is only used to power the radio
b) It is not used to start the Internal Combustion Engine (ICE) under normal operating conditions
c) It must be small to fit into the dashboard
d) It is constantly recharged by solar panels

22. A technician is working on a high voltage hybrid battery pack and uses special insulated gloves before touching any terminals. This action is applying safety protocol specifically because of the component's
a) High temperature output
b) High direct current (DC) voltage
c) Exposure to low pressure fuel vapor
d) Risk of fire from low amperage

23. An HEV's drive system switches from using battery power for propulsion to using the electric motor to generate electricity. This sudden change in the motor/generator's function is managed by applying precise instructions from which component?
a) The 12 volt auxiliary battery
b) The engine's electronic control unit (ECU)
c) The motor controller
d) The vehicle's braking pads

24. Which factor is the most significant difference when analyzing the role of the high-voltage battery compared to the auxiliary 12 volt battery in an HEV?
a) The 12-volt battery is non-rechargeable
b) The 12 volt battery powers only the entertainment system
c) The high voltage battery stores the energy necessary for vehicle propulsion, while the 12-volt battery runs the standard vehicle electronics and control units
d) The 12 volt battery is always Lithium Ion (Li-ion)

25. When analyzing the function of the Motor Controller, which capability is most critical for achieving the HEV's improved fuel economy?
a) Its ability to physically shift the gears in the transmission
b) Its exclusive use of alternating current (AC) power
c) Its ability to convert and precisely regulate the high voltage DC battery power into AC power for the motor/generator
d) Its role in heating the engine coolant

26. When analyzing the power structure, the Internal Combustion Engine (I.C.E.) is considered a primary energy source, while the high voltage battery is considered an energy storage device. What conclusion logically follows from this distinction?
    a) The battery can produce energy indefinitely without the I.C.E.
    b) The battery can provide power only when the I.C.E. is completely turned off.
    c) The battery's ability to sustain electric only operation is limited and must be replenished by the I.C.E. (via the generator) or regenerative braking.
    d) The battery is much more powerful than the I.C.E.

27. A service manual states that special battery chargers that limit the charging voltage must be used for the auxiliary 12 volt battery (AGM design). How should a technician evaluate the necessity of this precaution?
    a) The precaution is unnecessary, as all 12 volt batteries can be charged the same way.
    b) The precaution is valid, but only because the 12 volt battery is smaller.
    c) The precaution is critical, as the AGM design can be damaged or have its lifespan significantly shortened by overcharging with a conventional charger that does not regulate voltage properly.
    d) The precaution is only required if the vehicle is being serviced outdoors.

28. An engineering team is tasked with creating a new safety protocol for servicing the high voltage hybrid system. The most essential step they must synthesize into the protocol before any repair work begins is:
    a) Checking the air pressure in the tires.
    b) Implementing a procedure to physically disable or "de-energize" the high voltage system at its main service disconnect.
    c) Thoroughly washing the outside of the vehicle.
    d) Replacing the windshield wipers.

29. What is the specialized process used by a hybrid vehicle to convert the kinetic energy of deceleration into electrical energy for storage in the battery?
    a) Power Assist Mode
    b) Electric Off Drive
    c) Idle Stop Mode
    d) Regenerative Braking

30. A key operating principle of a full hybrid system involves using the electric motor to propel the vehicle alone at low speeds. The primary goal of this pure electric mode is to:
    a) Allow the vehicle to travel at its maximum possible speed.
    b) Charge the high voltage battery rapidly.
    c) Eliminate fuel consumption and tailpipe emissions during low speed and stop and go driving.
    d) Increase the engine's wear and tear for maintenance.

31. A vehicle is coasting downhill, and the driver lightly presses the brake pedal. The hybrid system uses its electric motor to create resistance to slow the car while simultaneously recharging the battery. This scenario demonstrates the application of which operational mode?
    a) Regenerative Braking
    b) Motor Controller Failure
    c) Power Assist Mode
    d) Full Engine Power Mode

32. How does the Power Assist Mode (using the electric motor to boost acceleration) contribute to the overall fuel economy of a hybrid vehicle?
    a) It increases the vehicle's total weight, improving traction.
    b) It allows the Internal Combustion Engine to be smaller and operate at its most efficient range, relying on the electric motor for peak demands.
    c) It shuts off all electrical accessories when accelerating.
    d) It only provides power when the battery is completely discharged.

33. Which specific operational feature of a hybrid vehicle is generally considered the most effective for maximizing fuel economy gains in a city driving environment?
    a) Maintaining a high cruising speed on the highway.
    b) The ability of the engine to run at high RPMs.
    c) The frequent use of regenerative braking and Idle Stop Mode due to constant stopping and starting.
    d) Running the air conditioning system constantly.

34. An engineering team is tasked with creating a control strategy for a new hybrid model to be used on improving highway fuel economy during long drives. The team should synthesize a strategy that primarily focuses on:
    a) Maximizing regenerative braking at high speeds.

b) Operating the engine's load and speed to run at its highest thermal efficiency point during steady state cruising
c) Eliminating the use of the electric motor power on the highway
d) Completely depleting the battery pack as soon as the drive begins

35. Which benefit is consistently listed as a primary advantage of a Hybrid Electric Vehicle (HEV) design?
a. Elimination of all maintenance requirements
b. Significantly reduced vehicle weight
c. Improved fuel economy compared to a conventional vehicle
d. Much lower initial purchase price

36. A significant disadvantage of many complex hybrid designs is the increased cost of the vehicle. What is the main component responsible for this price increase?
a. The standard gasoline engine
b. The conventional transmission fluid
c. The smaller, more aerodynamic tires
d. The high voltage battery pack and associated power electronics

37. A repair shop is servicing a highly complex Series Parallel Hybrid. The technician must obtain specialized training and tools for this model. This situation demonstrates the disadvantage of which factor?
a. Improved fuel economy
b. Increased technical complexity and specialized service requirements
c. Reduced engine size
d. Lighter curb weight

38. When analyzing the trade off between design complexity and performance, which statement best describes a disadvantage of the highly complex Series Parallel Hybrid system?
a. It is simpler to maintain than a mild hybrid
b. It has only one way to power the wheels
c. It often involves more sophisticated mechanical and electronic components, potentially increasing the likelihood and cost of repairs over time
d. It is unable to utilize regenerative braking

39. Which statement provides the best evaluation of the overall value proposition of a Hybrid Electric Vehicle (HEV)?
a. The HEV is always a poor choice due to its higher initial cost and battery replacement expense
b. The HEV's economic value depends on driving habits and local fuel costs, as the higher initial purchase price must be offset by long term fuel savings
c. The HEV is a superior choice only because its engine is smaller
d. The HEV provides no benefit over a conventional vehicle unless it is plugged in every night

40. An engineering team is tasked with creating a new hybrid drive system that mitigates the disadvantage of complexity while retaining the core benefits. Which design choice should they synthesize?
a. A pure Series Hybrid with a large battery and no engine connection to the wheels
b. A highly complex Series Parallel system with multiple clutches
c. A simpler Parallel Hybrid system that primarily uses a motor/generator unit to assist the existing drivetrain
d. A design that uses two separate, full sized gasoline engines

41. What is the specialized battery design typically used for the auxiliary 12 volt battery in a hybrid electric vehicle?
a) Lithium ion (Li ion)
b) Nickel Metal Hydride (NiMH)
c) Absorbed Glass Mat (AGM)
d) Flooded Lead Acid

42. The auxiliary 12 volt battery in a hybrid is often smaller than a conventional car battery. This difference exists because the 12 volt battery's primary role is not to:
a) Power the vehicle's interior lights and radio
b) Supply power to the vehicle's electronic control units (ECUs)
c) Provide the high current required to crank and start the Internal Combustion Engine (ICE)
d) Be tested and serviced using conventional methods

43. Why is the use of special insulated gloves (HV gloves) mandatory when servicing high voltage hybrid components?
a) The gloves prevent the technician from being sprayed with fuel

b) The gloves keep the high-voltage battery at a safe temperature.
c) The gloves provide a critical layer of insulation against the lethal direct current (DC) voltage.
d) The gloves protect the high-voltage system from external dirt.

44. A technician needs to charge a depleted 12-volt AGM auxiliary battery. To follow proper procedure, the technician must apply which type of charging equipment?
a) A conventional high-amperage charger that delivers uncontrolled voltage.
b) A specialized battery charger that strictly limits the charging voltage.
c) A high-voltage DC charger used for the main battery pack.
d) A battery charger that uses a randomized pulse charge.

45. Before any hands-on repair work is done near the hybrid's drive components, a technician performs a procedure to physically pull out a main service disconnect plug. This action is applying which crucial safety step?
a) Charging the 12-volt battery.
b) De-energizing the high-voltage system.
c) Testing the engine's compression.
d) Checking the tire pressure.

46. When analyzing the distinction between the two batteries in a hybrid, what must a technician do differently when servicing the high-voltage system versus the 12-volt auxiliary battery?
a) The high-voltage system can be handled bare-handed, while the 12-volt system requires gloves.
b) The high-voltage system requires a mandatory lockout/tagout procedure to disable power, while the 12-volt system requires standard battery service.
c) The high-voltage system must be charged with standard equipment.
d) The 12-volt battery cannot be disconnected.

47. A hybrid vehicle must be towed, and the service information dictates that the vehicle must not be towed with the drive wheels on the ground. Which key component is this procedure designed to protect?
a) The windshield wipers.
b) The electric motor/generator unit, which could create dangerous high-voltage if rotated while moving.
c) The vehicle's air filter.
d) The 12-volt auxiliary battery.

48. Which factor is most important to analyze when determining if a specific tool is safe to use on a high-voltage hybrid component?
a) The brand of the tool.
b) The tool's weight.
c) The tool's insulation rating and whether it is explicitly labeled for high-voltage use.
d) The color of the tool's handle.

49. A service manager claims that a technician only needs to wear one high-voltage (HV) glove when working on the system since the technician is grounded through their feet. How should a safety officer evaluate this claim?
a) The claim is correct, as wearing two gloves slows down the repair process.
b) The claim is partially correct, as only one hand touches the high-voltage line.
c) The claim is incorrect and dangerously negligent, as both gloves are required to protect against a potential path for current through the body.
d) The claim is only true if the technician is working on a dry floor.

...ngineer is tasked with creating a highly visible safety warning label for the high-voltage ...ery pack. To ensure the label is effective, the engineer must synthesize a warning that ...includes:
a) The cost of the battery and the location of the spare tire.
b) The battery's weight and chemical composition.
c) A clear, large symbol indicating a shock hazard and the specific high DC voltage present.
d) The part number and manufacturer's contact information.

END ☺☺☺

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