

Advanced RV Diagnostics, Measurement & Reliability

MRR-RV215 | 15 weeks | 5 proposed semester credits | 45 lecture + 30 lab + 150 independent hours

Original independent curriculum proposal for institutional review only. MRR is not claiming state approval, institutional accreditation, GRCC articulation or award of college credit, an RVTI affiliation, or RVTI exam authorization. Credit, accreditation, industry certification and instructor eligibility require separate written decisions by the appropriate organizations.

Safety:

Exercises rely on inert demonstration devices, de-energized schematics, current-limited low-voltage trainers, simulated records, or manufacturer literature. A course webpage is not a license to manipulate LP-gas piping, energized 120/240-volt systems, generators, refrigerants, roof-access systems, brakes, hitches, jacks, or safety-critical structural parts. Practical work requires qualified supervision, an appropriate facility and documented stop-work authority.

Prerequisite: MRR-RV205 or documented comparable knowledge of RV systems, technical algebra, measurement, and lab safety.

Student learning outcomes

- Construct a testable failure hypothesis and an evidence plan that distinguishes observation, inference and confirmed failure.
- Quantify basic measurement uncertainty and interpret electrical, hydraulic and thermal data within stated assumptions.
- Analyze cross-system symptoms using systems diagrams, fault trees and risk-based diagnostic sequencing.
- Evaluate repair alternatives for safety, reliability, serviceability, customer cost and evidentiary sufficiency.
- Produce auditable technical reports, supervised practical evidence and a defensible diagnostic case presentation.

Seminar practice and assessment

For every technical model, include quantitative assumptions, relevant source documents, units, uncertainty, a falsifying test, and scope limitations. Instructors evaluate lab performance in supervised facilities; online checkboxes do not record academic credit.

Proposed workload

Each week: 3 lecture hours, 2 supervised laboratory hours, 10 hours of independent reading, calculations, technical writing and peer critique. Over 15 weeks: 45 lecture, 30 lab, 150 independent; total 225 planned learning hours.

Academic integrity

All case records and numeric exercises are original fictional teaching scenarios, not service records. Student reports must label synthetic values, credit technical sources and avoid falsified test evidence.

WEEK 01 | Evidence-based diagnostic reasoning and measurement limits

Lecture / theoretical framework

A symptom is not a defect and a replaced component is not proof of the original failure. Build a fault-isolation plan from independent observations, calibrated or known-condition measurements, and a model of the system boundary. Document operating conditions and the possibility of correlated errors. Treat missing information as uncertainty, not license to guess.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A technician reports that three apparently independent tests prove a defective battery; all three were performed with the same unverified meter and under different load conditions.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A nominal 12.0 V reference is read at 11.7 V. Compute the signed error and the percentage error relative to the reference.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Using two current-limited DC trainers and different meters, record repeated measurements, units, conditions, instrument identifiers and observed disagreement. No connection to an RV is required.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Produce a two-page evidence map with three competing explanations, one falsifying test for each, and a discussion of measurement dependence.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Measurement uncertainty; diagnostic fault trees; manufacturer service literature.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 02 | DC distribution, voltage drop and conductor resistance

Lecture / theoretical framework

A network should be modeled under load rather than inferred from open-circuit readings. Contact resistance, connector corrosion and return-path losses create nonlinear symptoms at high current. Use Kirchhoff-style reasoning and measure potential difference across components in a supervised low-voltage setting.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

An RV slide controller resets when the motor is energized, although the resting battery voltage looks adequate.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A 12 A test load passes through a connection with 0.075 ohm resistance. Estimate the connection voltage drop and power dissipated.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

On a 12 V current-limited trainer, compare open-circuit and loaded voltage at two points. Log differences and thermal risk without heating unsafe parts.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Submit a network diagram, measurement table, error budget and ranked fault hypotheses.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Circuit laws; voltage-drop testing; conductor and connector manufacturer data.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 03 | Battery state, charging and energy accounting

Lecture / theoretical framework

State of charge, state of health and terminal voltage are different constructs. Chemistry, temperature, current, aging and rest history determine the relationship between them. A system may have nominal energy capacity but an unsuitable current capability. Distinguish Wh from W and Ah from A.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A camper has nominal storage capacity but a high-demand appliance trips its inverter soon after startup.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

For a 12.8 V, 150 Ah battery, 80% assumed usable capacity and 90% inverter efficiency, estimate delivered AC energy.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Use sample discharge logs to estimate energy throughput by numerical integration; analyze uncertainty from variable voltage.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Write an engineering memorandum separating capacity, peak current, protective cutoff and inverter surge hypotheses.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Battery technical data sheets; inverter surge ratings; chemistry-specific charging manuals.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 04 | Shore-power topology and protective-device interpretation

Lecture / theoretical framework

Electrical safety investigations begin with the principle that a tripped protective device is a symptom requiring explanation, not a nuisance to defeat. Distinguish source-side interruption, equipment faults, leakage paths and overcurrent in a model-based analysis. Branch circuits, neutral and equipment grounding have separate functions.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

Repeated trips occur after rainfall; an earlier invoice claims the converter must be replaced without supporting test records.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A 1,350 W representative load is supplied at 120 V. Estimate steady current, ignoring power-factor and surge effects.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Use a de-energized schematic and instructor-controlled demonstration board to locate protective devices; do not perform energized household or RV AC service.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Develop a hazard-first decision tree, outlining which observations are appropriate for a qualified electrician.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

NFPA 70/NEC latest applicable edition, manufacturer documentation, and facility safety policy.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 05 | Intermittent faults and probability of detection

Lecture / theoretical framework

Intermittent failures require repeatable test conditions and careful logging. Environmental factors, vibration and heat can correlate with failure without being causal. Sampling intervals can hide transients, and uncontrolled manipulation can destroy evidence. Choose a diagnostic test based on the distinction between information gain and induced risk.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A low-voltage accessory fails during towing but passes every inspection in a stationary bay.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A logger samples once per 5 s. A signal drop lasts 0.2 s at a random phase. Estimate the chance that one sampling instant catches a single drop.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Capture simulated intermittent events on a low-voltage trainer at two sample rates; compare detection rate and aliasing.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Propose a controlled test matrix that separates thermal, vibrational and connector-related variables.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Instrumentation sampling principles; OEM wiring diagrams; reliability literature.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 06 | Control systems, sensors and diagnostic signal quality

Lecture / theoretical framework

Control signals should be interpreted in context: a sensor can be accurate but the controller may operate on filtered or delayed data. Disambiguate a true process failure from a failed sensor or actuator. Define expected ranges and protective behaviors before interpreting a fault code.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A tank monitor displays full when the vessel is half empty; replacement of the display changes nothing.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A linear 0-5 V sensor maps to 0-100% tank level. What level does 3.25 V represent in the ideal model?

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Calibrate a simulated analog sensor with a protected 5 V signal source and compare predicted versus observed values.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Prepare an instrument-validation plan including span, offset, hysteresis and environmental influences.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Sensor supplier data; control-system signal conditioning; measurement assurance.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 07 | Freshwater hydraulic networks and pump behavior

Lecture / theoretical framework

Pressure is not flow, and a pump rating at zero head is not the useful flow rate of an installed system. Analyze restrictions, elevation, air entrainment and pressure-switch cycling separately. Model networks using an empirical head-loss curve, then compare predictions with safe simulated observations.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A pump cycles rapidly when a faucet is opened a small amount but appears normal during full flow.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A flow of 6 L/min fills a 9 L test vessel. Estimate fill time and state relevant volume-measurement uncertainty.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Use a tabletop water circuit with a small pump and gauges to compare flow through two safe restriction settings.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Create a diagnostic table distinguishing air, blockage, check-valve leakage and pressure-switch drift.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Fluid mechanics fundamentals; pump curves; plumbing component specifications.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 08 | Wastewater, venting and winterization failure analysis

Lecture / theoretical framework

A winterization claim must consider trapped volumes, flow topology, freeze expansion and materials compatibility. A visibly drained tank does not establish that all valves, traps and low points are protected. Develop a system inventory and define verifiable boundaries instead of relying on a generic checklist.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A seasonal RV suffered a cracked fixture after being certified winterized; the technician performed only an air purge.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

Assume a 0.8 L isolated water-filled cavity may experience about 9% expansion on freezing. Estimate the additional volume required.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Trace a transparent mock plumbing circuit and identify dead legs, trapped cavities and cross-connections.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Draft a winterization acceptance protocol with explicit limitations and customer disclosure.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Manufacturer winterization guidance; material property data; system drawings.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 09 | Propane systems: hazards, boundaries and decision thresholds

Lecture / theoretical framework

Combustion systems combine gas pressure, ventilation, ignition and control logic. A competent technician differentiates hazard recognition from work authorization: an uncertain gas condition is grounds for isolation and qualified referral. Technical education can teach logic and component identification without allowing unqualified manipulation of live gas systems.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

An owner reports an odor after moving an RV; a previous inspector says a component is safe based solely on a visual check.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A hypothetical risk matrix rates severity 5/5 and detectability 4/5. Explain why a lower assumed frequency does not justify opening a gas line as a teaching exercise.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Use a fully inert labeled schematic board to map valves, regulators, detectors, vents and emergency responses.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Write a stop-work and referral protocol that avoids implying any live-gas qualification.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

RVTI topic categories; gas appliance OEM literature; site safety manual.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 10 | HVAC measurements and heat-transfer reasoning

Lecture / theoretical framework

Temperature difference alone does not establish delivered cooling or heating without knowledge of airflow, humidity and duty cycle. Distinguish sensible heat from latent heat and separate a control fault from a thermodynamic fault. Diagnose from a boundary-energy balance rather than a single outlet thermometer reading.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

The operator reports poor cooling; supply air is cooler than return, but the occupied zone does not reach its setpoint.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

At 0.18 kg/s air mass flow and 6 K temperature decrease, with $c_p=1.005 \text{ kJ}/(\text{kg K})$, estimate sensible cooling rate.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Compare safe recorded temperature and airflow datasets under two simulated obstruction conditions.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Produce a heat-balance memo listing assumptions, sources of load and tests reserved for HVAC-qualified personnel.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Introductory thermodynamics; HVAC OEM diagnostic specifications; airflow measurement texts.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 11 | Refrigeration architectures and appliance duty cycles

Lecture / theoretical framework

Absorption and vapor-compression refrigerators use different energy conversions and respond differently to leveling, ventilation and ambient conditions. A duty-cycle observation must be interpreted in light of weather, cabinet loading and control state. Analyze performance records without bypassing electrical, propane or refrigeration protections.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A three-way refrigerator performs acceptably overnight but fails to maintain food temperature in direct afternoon sunlight.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A 120 W compressor runs 45% of a 24 h period. Estimate electrical energy consumption before conversion losses.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Analyze manufacturer-supplied or instructor-simulated temperature-time logs and compute time above an assigned threshold.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Compare appliance architectures, ventilation assumptions and defensible referral thresholds in a critical report.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Appliance manuals; food-temperature guidance; thermal performance literature.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 12 | Roofing, moisture transport and failure attribution

Lecture / theoretical framework

Moisture damage can originate from rain ingress, condensation or plumbing leakage. Water can migrate away from its entry point, so a stained panel is not proof of roof seam failure. Construct a moisture transport hypothesis using gradients, material layers, exposure history and non-destructive evidence.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A ceiling stain appears two days after rain; a window seam was re-sealed earlier in the season.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

Measured moisture-content proxy readings are 18, 22, 31, and 19 arbitrary units at four locations. Determine the median and range.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Examine supplied photo sets and inert material coupons; practice annotation of exposure routes without roof access.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Build a decision tree that differentiates active infiltration, residual moisture and sensor-material artifacts.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Building-envelope diagnostics; sealant OEM material data; instrument limitations.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 13 | Slide-outs, awnings and electromechanical failure modes

Lecture / theoretical framework

Actuated systems couple motor torque, friction, geometry, electrical supply and mechanical constraint. An overload indication can arise from binding rather than a defective motor. Evaluate alignment and wear without conducting unsafe field operations or unsupported structural weld repairs.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A slide travels out but stalls while returning; a prior quote recommended replacing its controller.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

At a simplified efficiency of 75%, a 200 W electrical input results in what useful mechanical power?

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Use a low-force benchtop linear actuator model to measure force variation with alignment changes under a clear instructor-set limit.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Write a fault tree covering direction-dependent mechanical loading, switches, wiring and control logic.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Actuator supplier manuals; motion-control fundamentals; manufacturer safety guidance.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 14 | Integrated diagnostics and failure-mode prioritization

Lecture / theoretical framework

Complex RV failures are frequently multi-causal. Build a shared fault tree across energy supply, controls, loads and environmental factors. The goal is not a single clever guess but an auditable reduction of uncertainty. Separate owner observations from instrument evidence and explicitly label unresolved branches.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

One camper displays low battery, an inactive water pump and intermittent slide control after a storage interval.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A two-branch fault tree lists $P(A)=0.25$ and $P(B)=0.15$, independent for illustration. Estimate $P(A \text{ or } B)$.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Reconcile five simulated data records from different systems and construct a cross-system failure hypothesis.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Submit a 1,500-word diagnostic dossier with evidence hierarchy, risk controls and repair options.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Reliability engineering; OEM documentation; diagnostic case methodology.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

WEEK 15 | Final integrated examination and technical defense

Lecture / theoretical framework

A defensible diagnosis must include clear scope, problem formulation, reproducible evidence, alternative hypotheses, model assumptions, risk controls and a disposition that does not exceed the evidence. The final examination evaluates technical literacy together with professional restraint.

The analytical objective is to justify the chosen system boundary and explain which variables were omitted. Develop an independent cross-check for the proposed interpretation, and distinguish an observed event from a confirmed causal mechanism. A single reading rarely justifies a hardware replacement; build an evidence hierarchy and show a test that could invalidate the initial diagnosis.

Synthetic case study

A synthetic mixed-system RV case includes time-series battery logs, recurring pump alarms and a water intrusion photograph.

Present competing hypotheses, severity-first hazards, and a source-backed diagnostic plan that does not exceed permitted supervision. Explain a plausible alternative that would result in a different repair decision.

Quantitative problem

A component has 20 failures across 10,000 observed operating hours. Compute the simple observed failure frequency.

Explain the derivation, units, order-of-magnitude reasonableness, assumptions and at least one sensitivity variation. Worked solutions are reserved for the faculty answer key.

Supervised laboratory

Under faculty supervision, defend a complete diagnostic dossier before a two-person panel; no live hazardous work.

Required record: objective; protected/inert equipment configuration; data table and units; limitations; instructor sign-off; hazard and stop-work statement.

Ten-hour independent research assignment

Submit final calculations, test evidence, source register, prioritized findings and a ten-minute oral defense.

Recommended distribution: four hours of source reading and technical verification, three hours of numerical/model work, and three hours of technical writing and revision.

Source evaluation

Scientific reasoning; reliability analysis; professional technical writing.

For research, use relevant manufacturer manuals and technical standards with current edition and jurisdiction verified. Disclose if the evidence is simulated or a generic estimate.

Seminar questions

1. What observation could disprove the current leading hypothesis?
2. Which risk would make continuation inappropriate even if a model predicts successful repair?
3. What primary-source specification must be obtained before a technician can act?

Technical source and approval register

The following references define external review boundaries; MRR does not claim authorship, RVTI endorsement or college approval.

GRCC Course Format & Credit Hour Policy (effective August 2025) —

https://www.grcc.edu/sites/default/files/docs/policy/7-13_Course_Format_and_Credit_Hour_2025-06_ada.pdf

GRCC Curriculum Development — <https://www.grcc.edu/faculty-staff/curriculum-support/curriculum-development>

RVTI Certification Levels — <https://www.rvti.org/career-path/training-levels>

RVTI Training Partners — <https://www.rvti.org/get-trained/find-training/training-partners>

Michigan Postsecondary Schools — <https://www.michigan.gov/leo/bureaus-agencies/wd/pss>