MRR UNIVERSITY / SEMESTER 4

RV Reliability Research, Quality Engineering & Industry Capstone

MRR-RV235 | 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-RV225 or documented comparable engineering and research preparation. Faculty approval of capstone scope and facilities is required.

Student learning outcomes

• Formulate a constrained applied research question and produce a reproducible protocol with safety and ethical approval.

• Analyze reliability and service data using descriptive and inferential methods with transparent uncertainty.

• Integrate electrical, mechanical, environmental and service-process evidence into a substantiated root-cause report.

• Evaluate proposed interventions through life-cycle cost, failure consequence, maintainability and human factors.

• Produce a scholarly technical dossier, supervised demonstrator, and oral defense suitable for external academic review.

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 | Capstone question, scope, stakeholder and ethics charter

Lecture / theoretical framework

A capstone requires an answerable question rather than a vaguely defined repair. Translate a stakeholder need into an outcome variable, explanatory factors, sampling frame and constraints. Pre-register the analysis plan where practical and ensure customer confidentiality. Approval of an academic proposal is not authorization to work on live hazardous equipment.

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 service shop wishes to reduce repeat callbacks for intermittent low-voltage faults without increasing hazardous testing.

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

From 240 jobs and 30 callbacks, compute the observed callback fraction.

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

Review an anonymized synthetic work-order dataset and select a feasible nonhazardous study design.

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 research charter with hypothesis, population, operational definitions, ethics, hazards and exclusion criteria.

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

Research methods; data protection; technical ethics.

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 | Literature review, standards hierarchy and evidence quality

Lecture / theoretical framework

Manufacturer instructions, applicable standards, empirical tests and forum reports have different evidentiary weight. Evaluate edition, jurisdiction, measurement context and conflicts of interest. A literature review should synthesize claims and identify gaps; a source list without critique does not establish a scientific basis.

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

Two sources disagree about acceptable wiring practices; one is a dated online forum and another is an OEM installation guide.

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

Five of eight candidate sources are primary technical documents. What fraction are primary?

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

Annotate ten permitted documents for provenance, claim type, revision and applicability.

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 source matrix with at least eight credible references and an argument map for conflicting claims.

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

GRCC library research guidance; applicable current technical standards; OEM documents.

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 | Research design, sampling and measurement assurance

Lecture / theoretical framework

Reliability data are subject to survivorship bias, incomplete reporting and variable exposure. Design a repeatable measurement protocol, choose meaningful denominators and control for confounders. Document instrument calibration and uncertainty even when only simulated data are available.

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 fleet reports a higher failure count but is also used three times as intensively as a comparison fleet.

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

Fleet A has 18 failures in 9,000 RV-hours; Fleet B has 10 in 2,500 RV-hours. Compare crude rates.

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

Conduct a small simulated sampling experiment and explore bias from missing high-failure units.

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

Present a sampling plan, data dictionary, quality controls and limitations analysis.

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

Experimental design; instrument uncertainty; statistical reasoning.

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 | Reliability modeling and survival-analysis assumptions

Lecture / theoretical framework

Mean time between failures, survival probability and hazard functions are not synonyms. An exponential model can support introductory calculations but often misses wear-out, infant mortality and changing use conditions. Treat censored observations as information rather than failures.

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 service report assumes constant failure rate for a component that is known to degrade with age.

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

Assuming exponential lifetime with hazard 0.002/hour, estimate survival through 100 hours.

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

Plot supplied right-censored synthetic lifetimes and compare a simple empirical curve with exponential assumption.

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 statistical critique of when constant-rate modeling is misleading.

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; survival analysis; censoring terminology.

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 | Root cause analysis: electrical and control evidence

Lecture / theoretical framework

Root-cause claims must connect physical mechanism, symptom timing and independent evidence. Five-whys worksheets can organize discussion but cannot replace causal testing. Distinguish initiating event, contributing conditions and root organizational cause; a new part working temporarily is not conclusive.

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 stored RV repeatedly drains its battery after service despite a replacement battery and converter.

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 0.25 A parasitic load operates continuously for 12 days. Estimate charge removed.

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 an inert simulated fault network to compare before-and-after load traces and challenge an initial mistaken diagnosis.

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 defensible root-cause dossier with evidence chain and proposed confirmation test.

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

Failure analysis; electrical energy balance; supplier 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 06 | Root cause analysis: moisture, climate and materials

Lecture / theoretical framework

Corrosion, adhesive failure and water ingress reflect environmental exposure and material compatibility. A failed seam can be a primary path or a downstream victim. Compare competing moisture transport mechanisms and reject theories unsupported by recorded exposure and construction details.

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

Two RVs show similar ceiling stains but one was parked under tree cover and one in open sun.

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 simplified moisture index rises from 14 to 23 arbitrary units; compute percent change relative to initial.

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

Evaluate synthetic time-lapse moisture maps and inert material coupons.

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 differential-causation report including sampling locations, climate data and exclusions.

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

Materials degradation; building envelope principles; OEM sealant 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 07 | Lifecycle costing and economically defensible maintenance

Lecture / theoretical framework

A technically feasible repair may be economically unjustified; replacement may waste resources if a component is repairable. Compare total cost of ownership, failure probability, downtime, waste and uncertainty. Do not confuse customer preference with an engineering constraint; communicate the trade-off transparently.

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 part replacement costs $580 now, while a $210 repair has a modeled 35% chance of requiring $650 further work within a year.

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

Calculate simplified expected first-year repair expenditure, excluding downtime and discounting.

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

Create a discounted-cost spreadsheet using three failure scenarios and a sensitivity analysis.

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 customer-facing recommendation and a confidential technical appendix revealing uncertainty.

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

Engineering economics; repair/replacement decision science; service ethics.

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 | Quality systems, control charts and corrective action

Lecture / theoretical framework

Quality control should measure variation in a repeatable process and distinguish common-cause from special-cause evidence. A single outlier does not automatically identify a negligent worker. Root-cause corrective action includes preventive controls, verification measures and an owner.

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 shop observes repeated rework on winterizations despite updated checklists.

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 defect counts 2,4,3,6,5, compute mean defects per sampled period.

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 a synthetic quality dataset and develop a process map with failure opportunities.

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 corrective-action report with measurable indicators and monitoring windows.

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

Statistical process control; ISO-style quality principles; customer complaint analysis.

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 | Supply chain, discontinued parts and compatibility governance

Lecture / theoretical framework

Obsolete or unavailable components create configuration and warranty risks. Identify when an apparently similar part is non-interchangeable. A rigorous compatibility file includes revision, dimensions, operating limits, material and use consequences. Novel fabrication is constrained by safety-critical exclusions.

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 replacement appliance control board shares a connector but has an unknown firmware revision.

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

If three independent attributes each have 90% documented compatibility confidence, estimate joint confidence under a simplified independence assumption.

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

Build a traceable part-substitution dossier for inert nonstructural sample components.

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 an acceptance checklist and no-substitution criteria for safety-critical components.

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

OEM parts catalogs; configuration control; engineering verification.

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 | Risk regulation, compliance and professional liability

Lecture / theoretical framework

The validity of a design depends on applicable jurisdiction, code edition, installation category and organizational authority. Regulatory references should be precise rather than decorative; students must document what a source actually says. Do not advertise school, occupational or RVTI credential status without written authorization.

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 proposal labels a third-party course "RVTI certified" although no partnership or approved exam is involved.

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

If a training catalog proposes four courses with 5 credits each, compute the proposed total, then state the legal/academic limitation.

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

Audit a mock brochure for misleading credentials, unsupported safety claims and missing limitations.

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 compliance gap analysis and truthful public-language revision.

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

Michigan LEO proprietary school guidance; GRCC credit policies; RVTI credential rules.

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 | Service operations, human factors and diagnostic throughput

Lecture / theoretical framework

A service system can fail because of communication, scheduling, ambiguous handoffs or incentives even when individual technicians are competent. Examine human factors, workload variability and feedback loops. A robust job process distinguishes suspected problem, authorized inspection, estimate approval, quality assurance and final delivery.

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 shop has 40 open requests, 15 awaiting photos and 10 awaiting parts.

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

What percentage of open requests are awaiting parts?

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

Simulate job-flow scenarios and quantify cycle time with a small synthetic queue.

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

Design a service workflow that reduces unsafe pressure to skip verification steps.

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

Human factors; service operations; Lean process analysis.

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 | Capstone protocol execution and intervention test

Lecture / theoretical framework

Testing must follow the accepted protocol and stop conditions; changing methods after viewing outcomes can inflate apparent success. Capture failed tests and deviations as carefully as successful results. Undergo a structured midpoint review before proceeding to final documentation.

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 prototype fault-logging approach missed short transients during first-round testing.

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 device detects 27 of 30 scripted events. Compute recall with its denominator.

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

Conduct a supervised, low-energy verification or a reproducible simulated experiment, logging all deviations.

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 revision-controlled protocol, raw synthetic or safely collected data and a deviation log.

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

Test and evaluation; statistical performance metrics; safety protocol.

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 | Technical report, data provenance and reproducibility

Lecture / theoretical framework

A professional research product must allow another investigator to reproduce the analysis from disclosed inputs and methods. Separate code, raw data, processed data, figures and interpretation. Report negative findings and limitations. A polished conclusion unsupported by the dataset is an academic integrity failure.

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 report claims 30% savings but hides which parts and labor costs were omitted.

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

Baseline $1,000 and revised $760. Calculate apparent savings and identify the missing-data risk.

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

Perform a peer reproducibility audit using a deliberately incomplete synthetic report.

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 structured technical paper with abstract, methods, results, discussion, references and appendices.

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

Technical writing; research integrity; reproducible analytics.

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 | Stakeholder review, critique and decision defense

Lecture / theoretical framework

Independent review should probe assumptions and high-consequence failure modes rather than merely compliment a polished presentation. Prepare the evidence for reviewers with different expertise: technical, operations, safety and student assessment. Response to critique must be traceable to a revised deliverable.

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 external reviewer rejects an energy-system proposal because failure response was not evaluated.

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

Eight reviewer comments are received; six are resolved with evidence and two require redesign. What share is closed?

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

Hold a supervised formal design-review simulation with written findings and action tracking.

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

Deliver a rebuttal memo and revised technical dossier with tracked changes.

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

Peer review; design assurance; professional communication.

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 capstone exhibition, written exam and oral defense

Lecture / theoretical framework

The final performance is an integrated demonstration of research competence, systems reasoning, ethical communication and professional limits. A strong capstone is narrow enough to test, transparent enough to audit and humble enough to identify unresolved hazards. Students must demonstrate that they can defend a conclusion without equating confidence with proof.

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 simulated industry review board asks whether a proposed tool should be piloted in production despite limited data.

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 trial includes 18 acceptable outcomes from 24 trials. Report observed success proportion and a clear limitation.

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

Present a supervised capstone artifact or reproducible simulation, portfolio, and oral questioning with evidence checks.

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 20-25 page research-quality capstone, appendices, final exam and 15-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

Research method; statistical inference; RV safety standards; industry practice.

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