

LESSON PLAN TEMPLATE

Lesson Title	Mastering Equations Reducible to Quadratic Forms
Learning Area/s	Mathematics
Name of Teacher/s	DEPED TAMBAYAN PH (www.depedtambayanph.net)
Grade Level and Section	Grade 10
No. of Sessions	4 Sessions
References	None specified
Declaration of AI use	This lesson plan was co-created using Gemini AI to assist with unpacking competencies into a 4-session learning design, structuring activities, and assessment formulation.

Intentions.

Meaningful learning experiences are anchored in how we frame them. Start by deciding what you want learners to master by the end of the lesson – keep it clear and simple.

Learning Competency and Curriculum Standards:	Learning Competency: Solve equations reducible to quadratic equations, e.g., $y = x^4 + 5x^2 + 4 = 0$. Content Standards: The learners should have knowledge and understanding of... • radical expressions • the roots of a quadratic equation • quadratic functions • equations reducible to quadratic equations • equation of a circle and the graph of a circle Performance Standards: By the end of the term, the learners are able to... • simplify, and perform operations, involving radical expressions. • determine the nature of roots of a quadratic equation. • determine the equation of a quadratic function. • solve equations reducible to quadratic equations and radical equations. • transform the equation of a circle from center - radius form to general form, and vice versa, and determine the center and radius from a given equation. • graph a circle from a given equation of the circle.			
	Session 1	Session 2	Session 3	Session 4
Learning	Identify equations	Analyze equations	Transform radical	Apply the concept of

Objectives:	that can be transformed into quadratic form using substitution. • Solve bi-quadratic equations (equations of the form $ax^4 + bx^2 + c = 0$) through the u-substitution method. • Explain the relationship between the degree of the equation and the number of roots.	with rational exponents that are reducible to quadratic form. • Solve equations involving fractional powers by applying the laws of exponents. • Verify solutions to ensure they satisfy the original equation.	equations into quadratic form by isolating radicals and squaring. • Identify and eliminate 'extraneous solutions' that do not satisfy the original radical equation. • Apply algebraic manipulation skills to simplify complex radical expressions.	equations reducible to quadratic form to solve contextualized real-world problems. • Construct mathematical models based on Philippine community scenarios. • Demonstrate mastery through a culminating problem-solving gallery walk.
Learner Context:	The Grade 10 learners show a high interest in visual pattern recognition but exhibit mixed readiness in algebraic factoring. While many can solve standard quadratic equations, a significant number struggle when the degree of the polynomial exceeds two. Learners respond well to 'step-by-step' visual guides. A potential barrier is the cognitive load of managing multiple variables during substitution.	Learners have recently mastered basic radical laws but often find fractional exponents intimidating. They perform better when these are related to real-life roots (e.g., square roots and cube roots). There is a tendency to forget the denominator's role in rational exponents, which acts as a barrier to setting up the substitution.	Learners are generally proficient in squaring binomials but often forget to square the entire side of an equation, leading to errors. They are interested in 'detective-style' tasks, which makes identifying extraneous roots an engaging concept. Math anxiety peaks when equations look 'cluttered' with multiple radical signs.	Learners are highly motivated by communal activities and local relevance. They show strengths in collaborative work (Bayanihan spirit) and visual presentation. Language barriers are minimized when math problems are phrased using familiar local contexts like 'Sari-sari store' inventory or 'Bangka' (boat) speeds.

Learning Experience.

A learning experience is like a thoughtfully designed journey. Each activity and interaction builds towards meaningful understanding and growth. Identify activities and interactions to help learners gain knowledge, skills, or understanding in a purposeful way.

Pre-Lesson:	● Flash Drill: Rapid-fire factoring of perfect square trinomials and general trinomials written on the board. ● Pattern Hunt: Show pairs of equations (e.g., $x^2 + 5x + 6 = 0$ and $x^4 + 5x^2 + 6 = 0$) and ask learners to identify similarities in structure.	● Review Loop: A quick game of 'Exponents Bingo' where students match radical forms to rational exponent forms (e.g., $\sqrt{x}$ to $x^{1/2}$). ● Mental Math: Evaluating simple fractional powers like $8^{2/3}$.	● Quick Recall: Squaring binomials like $(x + 3)^2$ and $(2x - 1)^2$. ● The 'True or False' Challenge: Present $\sqrt{x} = -2$ and ask if it has a real solution to spark discussion on principal roots.	● Community Connection : Show a picture of a Filipino 'Parol' (lantern). Discuss the geometric patterns and how area/side relationships might involve higher-order equations. ● Word Problem Decode: Translating phrases like 'the square of the square' into mathematical symbols.
Flow:	1. Introduction: Present the 'Secret Identity' concept where a complex equation is actually a quadratic in disguise. 2. Scaffolding: Demonstrate the 'u-substitution' technique using $y = x^4 + 5x^2 + 4 = 0$. Show how letting $u = x^2$ transforms it into $u^2 + 5u + 4 =$	1. Modeling: Present $x^{2/3} - 5x^{1/3} + 6 = 0$. Guide the class to see that $(x^{1/3})^2 = x^{2/3}$. 2. Guided Practice: Work through the substitution $u = x^{1/3}$ together. 3. Social Learning: 'Group Rotation' - Groups of 4 solve different equations on manila paper and rotate to check the	1. Demonstration: Solving $x - \sqrt{x} - 6 = 0$. Show two methods: u-substitution ($u = \sqrt{x}$) and isolating the radical then squaring. 2. Active Retrieval: Students list the steps of the 'Isolate-Square-Solve-Check' algorithm. 3. Inclusive	1. Contextualized Modeling: Present a problem about a local cooperative's revenue function $R(x) = x^4 - 10x^2 + 9$. 2. Social Learning: 'Gallery Walk' - Each group is assigned a unique local scenario (e.g., calculating dimensions for a community garden,

	0. 3. Check for Understanding: Use a 'Whiteboard Parade' where students write the appropriate substitution for different equations. 4. Collaborative Practice: In pairs, students solve three bi-quadratic equations. 5. Active Retrieval: Students explain to their partners why they must substitute back the original variable at the end to find the final roots.	previous group's work. 4. Error Analysis: Show a purposely incorrect solution where the exponent laws were misapplied; students must 'Find the Bug.' 5. Synthesis: Summarize the rule: u is always the middle term's variable part if the leading term's exponent is double the middle term's.	Practice: Provide 'Flowchart Guides' for students who struggle with multi-step processes. 4. Scaffolding: Start with one radical, then move to equations where the radical must be isolated first. 5. The 'Detective' Phase: Students solve and then 'interrogate' their answers by plugging them back in to find the 'imposter' (extraneous root).	optimizing fuel for a jeepney trip). They solve on a poster. 3. Peer Review: Groups move from poster to poster, leaving 'sticky note' feedback on the accuracy of the substitution and the final roots. 4. Expert Consultation: Teacher acts as a consultant, visiting groups that are struggling with the modeling aspect. 5. Wrap-up: A summary discussion on why these complex equations are vital for engineering and economics.
Learning Resources:	• Laptop and Projector • PowerPoint Slide: 'The Art of Substitution' • Printed Activity Sheet: 'The Great Disguise' • Chalkboard for manual derivations	• Smart TV for interactive graphing (Desmos) to show roots • Worksheet: 'Fractions in Power' • Colored Chalk for distinguishing u-terms	• Slide Presentation : 'Radical Transformations' • Flowchart Handouts: 'The Solving Path' • Practice Problems Set: 'Root or Imposter?'	• Large Poster Papers and Markers • Real-world Problem Cards (Contextualized) • Calculator for complex root verification
Opportunities for integration:	Integration with Arts through the concept of 'Transformation' and Biology by discussing how certain growth patterns in nature follow power laws that can be	Integration with Physics: Discussing how light intensity or sound decibels might follow power functions that require these solving techniques.	Integration with Agriculture: Solving for dimensions of a 'Pet nang Palay' (rice plot) where the diagonal involves a radical expression.	Integration with T.L.E. (Technology and Livelihood Education): Measuring area and volume for carpentry or tailoring projects. Social Studies:

	modeled by these equations.			Analyzing population growth trends.
Assessment. Assessments reveal what learners have gained and what they still need help with. These are helpful in providing you with information to guide your future instruction throughout the entire session.				
Formative Assessment:	'Stoplight Exit Slip': Students solve one bi-quadratic equation. Red: I am stuck on substitution. Yellow: I solved for u but forgot to find x. Green: I found all four roots successfully.	'Pair-Check': One student solves the substitution, the other performs the back-calculation. They switch roles for the next problem. Teacher circulates to monitor 'Checks for Understanding'.	'Show Me' Board: Students solve $x - 5\sqrt{x} + 6 = 0$ and hold up their boards. The teacher checks specifically for the checking step of the roots.	Performance Task: The completed 'Gallery Walk' poster and the peer-review feedback serve as the primary evidence of learning and mastery of the competency.
Ways Forward. Meaningful learning can also happen beyond the classroom – for both the learners and the teacher. Pause and reflect on what happened today.				
Extended learning opportunities:	Provide a challenge set for advanced learners involving equations like $(x^2 - 1)^2 + (x^2 - 1) - 6 = 0$. For struggling learners, provide a 'Substitution Template' that color-codes the u-variable.	Assign a research task: Find one example of a 'Power Law' in Philippine economics (e.g., wealth distribution) that uses exponents.	Create a short video or poster explaining why extraneous roots occur (squaring can create 'ghost' solutions). Use local language/Taglish for better peer-to-peer explanation.	Interview a local professional (e.g., a carpenter, an engineer, or a small business owner) to ask how they use 'formulas' or 'squaring' in their daily work. Share findings in the next class.
Reflections:	Reflect on how many students struggled with 'back-substitution' (finding x after finding u). Consider if more time is needed on	Reflect on whether the transition from integers to fractions was too abrupt. Did the 'Find the Bug' activity effectively address common	Observe if students are consistently checking for extraneous roots. If not, design a more punitive 'game' where keeping an extraneous root	Reflect on the effectiveness of the local context. Did it make the abstract u-substitution more concrete? Note which groups needed the most

	the concept of square roots of roots.	misconceptions?	loses points for the 'detective' team.	help in the 'modeling' phase for future intervention.
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