San Bernardino Valley College
Curriculum Approved: November 7, 2005

I. COURSE DESCRIPTION:

A. Division: Police Science
Department: Police Science
Course ID: POLICE 069
Course Title: Traffic Reconstruction Investigation
Units: 4
Lecture: 56
Laboratory: 24
Prerequisite: POLICE 074
Departmental Advisory: None

B. Catalog and Schedule Description:
This is an advance technical course that includes higher mathematics, physics, momentum theories, vehicle dynamics, reconstruction methodology and motorcycle, auto-pedestrian/bicycle, and heavy duty articulated vehicle collision analysis. The student will build on concepts taught in basic, intermediate and advanced traffic accident investigation school.

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: One

III. EXPECTED OUTCOMES:

Upon successful completion of the course, the student should be able to:

A. Apply the knowledge, skill, and experience necessary to interpret the evidence available in a traffic collision.
B. Demonstrate their level of understanding and their ability to diagram and compute complex traffic collision reconstruction concepts in a clear and concise language.
C. Evaluate and recall the current trends in Traffic Collision Reconstruction and reproduce these techniques and methodologies in a controlled environment.
D. Design a momentum analysis and general application of approach and departure angles using weights and post-impact speeds when constructing a collision analysis.
E. Recognize angular (rotational) momentum when performing a speed analysis.
F. Differentiate factors affecting vehicle deformation in traffic accident investigation reconstruction.
G. Seek and develop special considerations and handling characteristics involving heavy vehicle collisions.
H. Recognize the human factor involved with encounters with law enforcement.

IV. CONTENT:

A. Introduction
    1. Orientation
    2. Overview of course
    3. Course Goals
B. Mathematics and Physics Review from Basic, Intermediate and Advanced Traffic Accident Collision Courses
    1. Mathematics
        a) Basic mathematics (hierarchy)
        b) Review of algebra and right-angle trigonometry
        c) Trigonometry
    2. Physics
        a) Newton’s Laws of Motions
            1) First law of motion
            2) Second law of motion
            3) Third law of motion
        b) Physics definition of acceleration and velocity
        c) Mass and weight

1) Definition of relationships
2) Concept of center of gravity

d) Work – Kinetic energy relationship
e) Impulse and momentum
1) Derived
2) Definition
3) Examples of application to vehicle collisions
f) Friction
1) Physics definition
2) Coefficient of friction, acceleration factors and G's
3) Review of resultant drag factors
g) Forces
1) Types of forces
2) Point of application
3) Force lines
4) Magnitude of the force

C. Vehicle Dynamics
1. Location of the Center of Mass
a) General concepts
b) Three dimensional
1) Longitudinal
2) Lateral
3) Vertical
2. Collision Types
a) Central collisions
1) Definition
2) Translation vs. rotation
b) Non-central collisions
1) Definition
2) Eccentric impacts
3) Rotation with translation
4) Flips and vaults
c) Complete collisions
1) Definition
2) Concept of speed match-up
d) Incomplete collisions
1) Definition
2) Sideswipes
3. Impact Sequence and Times
a) Initial contact
b) Maximum engagement
c) Separation
4. Secondary Collisions
a) Exterior collisions
b) Interior collisions
1) Occupant kinematics
5. Inferred Motion (Collision Placement)
a) Matching of physical damage and force lines
b) Matching vehicle wheels and contact points with the physical evidence
c) Development of dynamics diagram from inferred motion

D. Conservation of Momentum Analysis
1. Momentum Analysis-General Application
a) Momentum defined
b) Laws of Conservation of Momentum
1) Equation
c) Derivation of the Law of Conservation of Momentum

d) Application of the Law of Conservation of Momentum
1) Approach angles
a. Skid marks
b. Tire prints
c. Damage analysis
d. Dynamics diagrams
2) Departure angles
a. Skid marks
b. Tire prints
c. Gouges
d. Liquid dribble path
e. Final rest positions
f. Dynamics diagrams
3) Weights
a. Weight scales
b. Published data
4) Post-impact speeds
a. Post-impact collision analysis
b. Vehicle dynamic equations

2. Methods for Solving Momentum Problems
a) Parallelogram method (Vector diagramming)
1) Parallelogram defined
2) Vectors
3) Resultants
4) Scale
5) Calculation
b) Mathematical method
1) Equations and symbols
2) Coordinate system
a. X-axis
b. Y-axis
c) Collinear collision velocity analysis
1) With known pre-impact speed of one vehicle
2) Unknown pre-impact speeds
3) Solution process and examples
a. Head-on collisions
b. Rear-end collisions
d) Intersection collision velocity analysis
1) Coordinate system orientation
2) Application of X & Y axis conservation of momentum equations
3) Example problems

3. Momentum Analysis – Special Applications
a) Shallow entry angle and collinear collisions – unknown pre-impact speeds
1) Shallow entry angle collision defined
2) Discussion of problems associated with speed analysis
b) Large vehicle versus small vehicle collisions
1) Discussion of problems associated with speed analysis

4. Discussion of Angular (Rotational) Momentum

E. Speed from Crush
1. Introduction
a) Explanation of speed change vs. initial speed
b) Obtain more than one opinion when estimating speed from damage
c) Record estimates for comparison
d) Reliability of speed estimates from damage

2. Factors Affecting Vehicle Deformation
a) Available energy

b) Vehicle stiffness
c) Energy partition

3. Methods
   a) Visual estimates (Closing-in-Method)
   b) Chart comparisons
   c) Linear regression equations

F. Auto Collisions involving Pedestrians/Bicyclists
1. Automobile vs. Pedestrians
   a) Relative vehicle codes
   b) Visibility & conspicuity of pedestrians
   c) Evidence in automobile vs. pedestrian collisions
   d) Quadratic equations
   e) Pedestrian trajectories
      1) Wrap trajectory
      2) Forward projection
      3) Fender vault
      4) Roof vault
      5) Somersault
      6) Restricted fender vault
      7) Partial impact
2. Automobile vs. Bicyclists
   a) Relative vehicle codes
   b) Bicycle component failure
   c) Bicycle helmets
   d) Gear-inch formulae
   e) Evidence in automobile vs. bicyclists collisions
   f) Bicycle lean angles
   g) Bicycle braking distance formulae
      1) Dry conditions
      2) Wet conditions
   h) Misc. bicycle formulae
3. Resources
   a) Formulas
      1) Formula Verification
      2) Software, e.g.: UBANKS
      3) Quadratic Equations

G. Heavy Vehicle Collisions
1. Introduction
   a) Definition of vehicle types
   b) Terminology
2. Special Considerations and Handling Characteristics
   a) Center of mass positions and effects of loading
   b) Commercial vehicle tires and drag factors
   c) Brakes and loading considerations
      1) Types and adjustments
      2) Effects of load versus proper adjustment
   d) Roll-over threshold and critical speed scuffs
3. Resultant Drag Factors
   a) Loading
   b) Braking efficiency
   c) Tire composition and roadway conditions
4. Jackknifing Characteristics and Impacts
   a) Case Studies

H. Reconstruction Methodology
1. Introduction
   a) Step-by-step walk through of a collision reconstruction

b) Designed to put entire course in perspective

2. Scale Diagramming
    a) Necessity of scaling
    b) Use of scale diagram in the reconstruction process
    c) Scale models
3. Damage Analysis
    a) Identification of contact versus induced damage
    b) Detailed measurements
    c) Preparation of scale diagrams/models of damage and undamaged vehicles
        1) Use of the diagram/model in the reconstruction process
    d) Force line determination
    e) Inspection for mechanical defects and/or malfunctions
4. Position Analysis
    a) Establishing locations of vehicles on the diagram based on physical evidence
    b) Significance of vehicle fluid trails
    c) Gouges and other evidence
    d) Overlapping areas of contact damage
    e) Aligning force lines
    f) Plotting vehicle positions
5. Motion Analysis
    a) Vehicle movements with respect to the scene and each other
    b) Motion relative to the centers of mass
    c) Motion analysis should identify
        1) Area of impact
        2) Positions of rest
        3) Other significant positions/events
    d) Motions analysis should examine the effects of vehicle motion on the occupants
        1) Injury mechanisms
        2) Seating position
        3) Mode of ejection
        4) Restraint systems
6. Velocity Reconstruction
    a) Post-impact velocity analysis
        1) Evaluate how each vehicle moved from the area of impact to the point of rest
        2) Determine vehicle deceleration factors
        3) Calculate post-impact speeds
    b) Impact velocity analysis
        1) Determination of approach and departure angles from dynamics diagram and motion analysis
        2) Determination of weights of vehicles
        3) Unusual loading conditions
        4) Momentum analysis
        5) Calculations of impact speeds
    c) Pre-impact velocity analysis
        1) Pre-impact acceleration
        2) Combining velocities
    d) Speed changes
        1) Vector speed changes
        2) Comparisons with other known information to ensure consistency of calculated speeds

I. Human Factors
1. Introduction to Human Factors/Overview
2. Psychological Factors

a) Cultural – How different cultures impact encounters with law enforcement.
b) Emotional – Can differ among cultures, state of mind, age, sex, etc.
c) Suicidal
d) Homicidal

3. Physiological Factors
   a) Nervous system
   b) Senses
   c) Reaction times
      1) Perception
      2) Decision
      3) Reaction
   d) Reflex reaction
   e) Simple reaction
   f) Complex reaction
   g) Discriminative
4. Altered Physiological Factors
   a) Physical handicap
   b) Medical condition
   c) Alcohol and drugs
   d) Fatigue
   e) Environment
5. Witnesses
   a) Ability to perceive – cultural biases
   b) Field of view
   c) Cultural differences/perceptions/expectations – biases/fear, etc. of/with encounters from law enforcement
   d) Cultural expectations/experiences from authority and/or law enforcement
   e) Education and experience
   f) Emotional condition
   g) Bias/Prejudice
6. Collision trauma
7. Intentional versus accidental

J. Case Studies/Course Review
1. To illustrate to the students the application of various analytic techniques to “real world” accidents and how accidents occur
   a) To determine if the students have a good grasp of the techniques presented
   b) Each case study is reviewed in order to provide the student with an opportunity to discuss their findings and how they relate to the actual situation – considering cultural differences throughout.

V. METHODS OF INSTRUCTION:

x Lecture
x Class and/or small group discussion
_ Critical evaluation of texts, newspapers, journal articles, and other printed research
x Critical evaluation of films, videotapes, audiotapes, or other media forms
x Classroom demonstrations
x Field trips
x Guest speakers
_ Other:
_ Other:
_ Other:

VI. TYPICAL OUT-OF-CLASS ASSIGNMENTS:

A. Reading Assignment. Reading assignments are required and may include (but are not limited to) the following: After reading the chapter on diagramming out of class, student will return to discuss in small groups the elements of diagramming traffic collision scenes. Relate your discussion to recent traffic accidents that you have investigated.

B. Writing Assignment. Writing assignments are required and may include (but are not limited to) the following: Select two statutes from the California Vehicle Code to read. It is recommended that you review the most often used sections that will become important in collision investigations. Decide which of the four categories they may fall within (Definitive Section, Procedural Section, Authoritative Section, or Punitive Section) and decide if code may relieve or impose authority on you during the course of your daily law enforcement activities. Be sure to highlight both the similarities and the dissimilarities. Prepare a 2-4 paper, which details your analysis.

C. Critical Thinking Assignment. Critical thinking assignments are required and may include (but are not limited to) the following: After watching videos of traffic collisions, prepare written explanations for following questions:

a. What is the hydroplane velocity of the first vehicle?
b. Given the diagram in the video, what are the approach angles of the two vehicles and their respective departure angles? Explain your process.

VII. EVALUATION(S):

A student's grade will be based on multiple measures of performance and will reflect the objectives explained above. A final grade of "C" or better should indicate that the student has the ability to successfully apply the principles and techniques taught in this course. These evaluation methods may include, but are not limited to, the following:

___Portfolios
___Projects
_x_Written papers or reports
_x_Presentations (oral and visual)
___Work performance (internships or field work)
_x_Lab work
_x_Comprehensive examination s (cumulative finals or certifications)
_x_Peer evaluation
_x_Self evaluation
_x_Classroom participation
___Homework
___Other:
___Other:

VIII. TYPICAL TEXT(S):

Faulkner, David. Collision Investigation for the Patrol Officer, San Clemente, CA: LawTech Publishing Co., Ltd., 1996.

IX. OTHER SUPPLIES REQUIRED OF STUDENTS:

A. Scientific Calculator
B. Protractor
C. Compass

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PREREQUISITE/COREQUISITE/ADVISORY
COURSE GRID FORM

Target Course: **Traffic Reconstruction Investigation**

Prerequisite Course: **POLICE 074: Advanced Traffic Collision Investigation**

Instructions:

1) List exit competencies (skills) from Prerequisite Course. These skills are listed in the "Student Outcomes" section of the Course Outline ("upon completion of the course, the student should be able to…")
2) Indicate which of the listed exit competencies (skills) are necessary entry skills needed for success in the target course. Mark with an "X" each needed skill.
3) Indicate the degree of importance of each needed entry skill for course success, using the following rating scale:

1=Critical 2=Very Helpful 3=Desirable

Skills Analysis

Entry skills in Target Course	Exit skills provided by prerequisite course (Mark with an X if needed, and indicate prerequisite course if more than one).	Degree of Importance (rate 1 – 3)
1. Distinguish and use advanced collision photography and photogrammetry	X	2
2. Conduct environmental examinations and formulate and express collision scene measurements	X	1
3. Distinguish and use techniques for preparing scale diagrams	X	1
4. Explore human factors and mechanisms of injury	X	1
5. Construct time-position and freefall analysis	X	1

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NEW COURSE CHECKLIST

1. Need for this new course:

a. Accident Reconstruction is the fourth class in a series for those officers who are interested in becoming accident reconstructionists. This course will provide students with on going traffic accident training, in order to conduct safer and more efficient traffic reconstruction investigations. Accident training has primarily been centered on the principles of physics and math but new technology increases the need for up to date training will always

2. Cultural diversity:

Culturally diverse issues and how they relate to traffic accident reconstruction investigation will be addressed in this course. Students are lectured in the human factors portion of this course to always be aware of basic differences and perceptions that may form due to cultural diversity. It is stressed that officers/students must try to understand and empathize with the victims and witnesses no matter what their own biases dictate.

3. Rationale for other requests:

a. Course repeatability: N/A
b. Credit/No-Credit grading only: N/A
c. Cross-listed courses: N/A

4. Feasibility –Budget implications

a. Is new equipment needed? No
b. Will new faculty need to be hired? No
c. Must facilities be modified or acquired? No

5. Articulation: N/A

6. Resources: N/A