

STUDENT ASSESSMENT SUMMARY

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(See Portfolio Sections B.9.a,b,c,d, and B.9.e.1-5; also, A.5 and A.7)

Excerpt from Student Assessment Summary, B.9

Once the 2005 test analyses were completed and we determined that there were no performance assessments in any of the courses, the professors designed and developed new midterm and final exams for the 2006 course. Using the results of those analyses diagnostically and the new 2006 student learning outcomes, the professors developed a Table of Specifications to guide their creation of a new midterm and final exam for the 2006 course. They each developed an objective test item bank of multiple questions for each student learning outcome. Once the objective test items were developed, they chose items for each exam, midterm and final, and assembled the tests. If they preferred to include problems to solve, those were added as well. The program leaders provided feedback throughout the entire analysis and development process. To further ensure that the test items and assembled tests actually measured knowledge or skills inherent in an outcome, the professors mapped the outcomes to the corresponding tests and specific items. This helped them realize where they needed more items or a different type of item and, especially, where there were gaps in the measurement of critical outcomes. (See worksheet below and other examples in B.9.2.e.1-5.) Although the tests were not perfect, they were greatly improved. (See Portfolio Section B.9.a for the comparison for differences between the 2005 and 2006 tests; see Program Description, Portfolio Section A.7, for further information on the Test Analysis and Development program components.)

Faculty examples of their course outcomes to test and test item analysis are copied below.

B.9.e.1: IENG370 Operations Research – R. Moraga (Explanation in B.9)

Student Learning Objectives and Outcomes				Assessments: Test Alignments Midterm & Final
	Student Learning Objectives/Outcomes-Major	student learning objectives - minor		Corresponding Tests and Test Items
1	1. To apply fundamental methods of deterministic operations research models to solve industrial engineering problems (related to planning, scheduling, budgeting, etc.) 1.1. To apply linear programming (LP) models	a	To formulate LP models	Exam1, MC1-4/SA17-20; Final, MC1-3/MTF17-20
		b	To solve a LP model by applying the Simplex Algorithm (SA)	Exam1, MC5-8; Final, MC4,5
		c	To analyze and interpret results by applying sensitivity analysis	Exam1, MC9-16 Exam2
		d	To examine special cases of LP models (transportation and networks) and to solve them using modified SA versions	Exam2
2	1. To apply fundamental methods of deterministic operations research models to solve industrial engineering problems (related to planning, scheduling, budgeting, etc.) 1.2. To apply integer programming (IP) models to solve industrial problems.	a	To formulate IP models	Exam2
		b	To solve IP models by using the branch and bound algorithm (BBA)	Final, MC8-11/SA13-16
3	1. To apply fundamental methods of deterministic operations research models to solve industrial engineering problems (related to planning, scheduling, budgeting, etc.) 1.3. To acquire basic knowledge of dynamic programming (DP) modeling to solve LP models.	a	To reformulate a LP model using DP modeling.	Final, MC6,12
		b	To apply the dynamic programming recursive approach.	
4	2. Students will apply the appropriate LP model to solve a real-world problem. 2.1. To choose a real-world problem from the following sector: manufacturing, services, banking, transportations, educational, or health care.			Project
5	2. Students will apply the appropriate LP model to solve a real-world problem. 2.2. To define the problem	a	To describe context situation.	Project
		b	To identify at least 10 decision variables for the problem	
		c	To identify at least 10 constraints for the problem	
6	2. Students will apply the appropriate LP model to solve a real-world problem. 2.3. To formulate the problem using a LP model	a	To apply assumptions of LP models	Project
		b	To define decision variables and technological coefficients	
		c	To define and construct a performance criterion	

		d	To construct the region of feasible solutions	
7	2. Students will apply the appropriate LP model to solve a real-world problem. 2.4. To solve the problem using SA	a	To reduce any LP model to the standard form	Project
		b	To apply steps of the SA and its fundamental algebra	
8	2. Students will apply the appropriate LP model to solve a real-world problem. 2.5. To analyze and interpret results			Project
9	2. Students will apply the appropriate LP model to solve a real-world problem. 2.6. To communicate results in a manner that unites theory, reasoning, analysis, and criticism in speaking and writing.	a	To write a technical report	Project
		b	To present the report	

This class has three exams. MC: Multiple Choice; SA: Short Answers; MTF: Multiple True-False

B.9.e.2: Course Title and Number (Explanation in B.9) Abul Azad, Technology 277

Student Learning Objectives and Outcomes			Assessments: Test Alignments Midterm & Final	
	Student Learning Objectives/Outcomes- Major	student learning objectives - minor	Corresponding Tests and Test Items	
1.	To examine the components of a digital system.	a	To contrast between analog and digital signals	Multiple choice: 1aA1, 1bC1, 1cC1, 1cC2, 1dK1, 1dK2, 1eC1
		b	To classify binary digits, logic levels, and digital waveforms	
		c	To compare basic logic operations	
		d	To categorize fixed function integrated circuits	
		e	To interpret the operation of simple digital systems	
2.	To examine the structures for various number systems.	a	To distinguish between various parts of number systems.	Multiple choice: 2aC1, 2aA1, 2bC1, 2bC2 Short answer: 2aK1, 2aK2, 2aK3, 2aC1
		b	To examine the counting in binary, octal, decimal, and octal.	
3.	To distinguish the conversion methods for various number systems.	a	To convert between binary and decimal	Multiple choice: 3aA1, 3aA2, 3aA3, 3aA4, 3aA5, 3bA1, 3bA2, 3bA3, 3cA1, 3cA2 Short answer: 3cC1, 3bA2, 3bA3, 3cA1, 3cA2
		b	To convert between binary and hexadecimal	
		c	To convert between binary and octal	
4.	To perform different binary arithmetic operations: addition, subtraction, 1's complement, 2's complement, and signed numbers.	a	To examine the basic rules involving each of the operations.	Multiple choice: 4aC1, 4aC2, 4aC3, 4bA1, 4bA2, 4bA3, 4bA4. Short answer: 4bA1, 4bA2, 4bA3, 4bA4, 4aK1
		b	To use the rules to perform each of the operations.	
5.	To examine the operation and use of various logic gates with different input patterns: AND, OR, and NOT, NAND, NOR, XOR and XNOR.	a	To develop the truth tables of various logic gates using established rules.	Multiple choice: 5bC1, 5bC2, 5cA1, 5dA1, 5dA2, 5cA2, 5dA4, 5dA5. Short answer: 5bC1, 5bC2, 5bC3, 5bC4, 5bC5, 5bC6, 5dC1, 5dC2
		b	To use the truth tables to identify output pattern of a logic gate for a given set of input.	
		c	To predict output logic levels for a pulse input pattern.	
		d	To recommend the use of appropriate logic gate(s) for a given application.	
6.	To analyze the properties of fixed-function logic integrated circuits (IC): Complementary Metal Oxide Semiconductor (CMOS) and Transistor-Transistor Logic (TTL).	a	To identify various supply voltage and power requirements for CMOS and TTL ICs.	Multiple choice: 6aA1, 6aA2, 6bA2, 6bA3, 6cA1, 6dC1, 6fC1, 6fC2 Short: 6aK1, 6aK2, 6aK3, 6aK4, 6bK1, 6bK2, 6bK3, 6bK4, 6cK1, 6cK2, 6cC1, 6eC2, 6fK1, 6fK2, 6fK3, 6fK4, 6fK5, 6fK6, 6fK7, 6fK8.
		b	To analyze the generic numbering convention for CMOS and TTL ICs.	
		c	To classify common logic gate ICs according to their <u>standard identifier digit</u> .	
		d	To examine the logic gate configuration within an IC.	
		e	To compare alternative logic symbols for representing logic gates while drawing a circuit diagram.	
		f	To examine the voltage values for input output logic levels for CMOS and TTL ICs.	

7.	To analyze the performance characteristics and parameters for logic gates and evaluate their significance in digital design.	a	To estimate the propagation delay for a given logic gate and realize its significance in digital design.	Multiple choice: 7aA1, 7aC1, 7bA1, 7cA1, 7dC1 Short answer: 7aC1, 7aA1, 7bA2, 7cA1, 7dC1
		b	To estimate the speed-power product as a measure of the performance of a logic circuit.	
		c	To estimate fan-out and loading conditions while designing a logic circuit.	
		d	To interpret data sheets for different logic gate ICs.	
		e	To evaluate data sheet information while making design decisions.	
8.	To use Laws and Rules of Boolean algebra and DeMorgan's Theorems for manipulating Boolean expressions.	a	To use the commutative, associative, and distributive laws to manipulate Boolean expressions.	Multiple choice: 8aK1, 8aC1, 8bC1, 8cA1, 8cA2 Short answer: 8aK1, 8aK2, 8aK3, 8aK4, 8aK5
		b	To examine the use of Boolean rules while manipulating Boolean expressions.	
		c	To use DeMorgan's Theorems for manipulating Boolean expressions.	
		d	To adapt the Boolean laws, Boolean rules, and DeMorgan's Theorems while minimizing Boolean expressions.	
9.	To analyze digital logic circuits using Boolean algebra.	a	To develop a Boolean expression for a given logic circuit.	Multiple choice: 9aA1, 9aA2, 9cA1, 9cA2 Short answer: 9aC1, 9aC2
		b	To evaluate a Boolean expression and prepare a truth-table for the logic circuit.	
		c	To demonstrate the use of Boolean algebra while minimizing Boolean expressions.	
10.	To develop and analyze standard forms of Boolean expressions: Sum-of-Products (SOP) and Product-of-Sums (POS).	a	To manipulate Boolean expressions to form SOP and POS.	Multiple choice: 10aC1, 10aC2, 10aC3, 10bA1, 10bA2
		b	To implement SOP and POS expressions using available logic gates.	
		c	To convert Boolean expression between Standard SOP and POS forms.	
11.	To evaluate the relationship between truth tables and standard forms of Boolean expressions (SOP and POS).	a	To transform SOP expression to truth table format.	Multiple choice: 11cA1, 11cA2, 11dA1, 11eA1 Short answer: 11cC1, 11dc!, 11eC1
		b	To transform POS expressions to truth table format.	
		c	To develop standard form of expressions from a truth table.	
		d	To convert non-standard forms SOP forms to standard SOP form	
		e	To convert non-standard forms POS forms to standard POS form	
12.	To minimize logic expressions using Karnaugh map (K-map).	a	To develop K-maps with different size of input variables (1 to 4).	Multiple choice: 12cA1, 12cA2 Short: 12bC1, 12bC2, 12cA1, 12cA2, 12dA1
		b	To map SOP expressions on K-maps.	
		c	To develop minimized expressions from K-maps.	
			To construct K-map from a non-	

		d	structured SOP expression.	
13.	To analyze digital systems using combinational logic.	a	To design a combinational logic system for a given problem.	Multiple choice: 13fA1, 13fA2 Short answer: 13fA1
		b	To design a logic circuit using standard logic gates from a given Boolean expression.	
		c	To design a logic circuit from a truth table.	
		d	To design logic circuit only with NAND or NOR gates.	
		e	To analyze the operation of a combinational logic circuit with pulse inputs.	
		f	To develop Boolean expression from a given logic circuit	
14.	To evaluate combinational logic circuits for commonly used digital functionalities: Half-adders and full-adders, parallel binary adders, comparators, BCD to decimal decodes, BCD to 7-segment decoders, encoders, multiplexers, and demultiplexers.	a	To examine their design principles	Multiple choice: 14aC1, 14aC2, 14aA1, 14aA2, 14aC3, 14aC4, 14cC1, 14dK1, 14dA1, 14dK2, 14fK1, 14dK3, 14fK2, 14fK3, 14fK4, 14fK2, 14iK1, 14gK3, 14gK4, 14gK5, 14jK1, 14jK2 Short answer: 14aK1, 14aK2, 14bK2, 14dC2, 14fK1, 14gK1, 14iA1, 14jK1, 14jK1
		b	To develop combinational logic circuits using commercially available ICs to implement these common digital functionalities.	
		c	To analyze the design of a magnitude comparator.	
		d	To analyze the function of a decoder.	
		e	To design and develop higher size decoder using smaller size decoder ICs.	
		f	To explain the use of BCD-7-Segment decoder for a real-life application.	
		g	To explain the design of encoders using commercial ICs.	
		h	To analyze the function of an encoder.	
		i	To evaluate the operation of multiplexers and their implementation using commercially available ICs.	
		j	To evaluate the operation of demultiplexers and their implementation using commercially available ICs.	
15.	To evaluate the properties of Latches, Flip-Flops, and timers.	a	To contrast between Latches and Flip-Flops.	Multiple choice: 15aK1, 15bK1, 15cK1, 15dK1, 15eC1, 15gK1 Short answer: 15aK1, 15bC1, 15bC2, 15bC3, 15bC4, 15cC1, 15cC2, 15dC1, 15dC2, 15eA1
		b	To evaluate the properties of edge-triggered J-K Flip-Flop.	
		c	To evaluate the properties of edge-triggered D Flip-Flop.	
		d	To evaluate the properties of edge-triggered S-R Flip-Flop.	
		e	To utilize the asynchronous Preset and Clear inputs of Flip-Flops.	
		f	To examine the operating characteristics of Flip-flops, such as propagation delay times, set-up time, hold time, Maximum clock frequency, Pulse width, and Power dissipation.	
		g	To compare the properties of commercially available Flip-Flop ICs.	

16.	To examine the use of Flip-Flops in practical applications.	a	To design parallel data storage using Flip-Flops.	<u>Multiple choice:</u> 16aK1, 16bK1, 16aA1, 16aA2, 16cC1, 16cC2, 16cA1, 16cA2 <u>Short answer:</u> 16bA1, 16cA1
		b	To implement frequency division using Flip-Flops.	
		c	To design binary counter using Flip-Flops.	
17.	To design applications using the 555 Timer	a	To use 555 timer for monostable operation.	<u>Multiple choice:</u> 17cC1, 17bC1, 17cC1, 17cA1, 17bA1, 17aA1
		b	To use 555 timer for bistable operation.	
		c	To use 555 timer for astable operation.	
18.	To design and study of counter applications using Flip-Flops.	a	To design and analyze asynchronous binary counters.	<u>Multiple choice:</u> 18aC1, 18cC1, 18aA1, 18aA2
		b	To design and analyze asynchronous decade counter.	
		c	To design and analyze synchronous binary counter.	
		d	To design and analyze synchronous BCD decade counter	
		e	To design and analyze up/down synchronous counter	
19.	To design and study of various shift register applications.	a	To demonstrate the use of D Flip-Flop as a shift register.	<u>Multiple choice:</u> 19aC1, 19bC1, 19cA1
		b	To design and develop serial In/ serial Out shift register.	
		c	To design and develop serial In/ parallel Out shift register.	
		d	To design and develop parallel In/ serial Out shift register.	
		e	To design and develop parallel In/ parallel Out shift register.	
		f	To design and develop bi-directional shift register.	

Student Learning Objectives and Outcomes			Assessments: Test Alignments Midterm & Final
	Student Learning Objectives/Outcomes-Major	Student Learning Objectives - minor	Corresponding Tests and Test Items
I	To learn to use a specific set of analytical tools for technical decision making under uncertainty.	A Students will be able to construct/create a decision tree to aid in determining the best course of action for a given set of circumstances <ol style="list-style-type: none"> 1. To define the states of nature of the system, process, or situation 2. To develop the branch structure of the tree <ol style="list-style-type: none"> a. To identify decision nodes; what are the items the decision maker chooses b. To identify the chance nodes; the events that occur by chance with a given probability c. To draw the arcs, which define the sequences and relationships between nodes 3. To identify the outcomes <ol style="list-style-type: none"> a. To define the choices for a decision node b. To define the possible outcomes of a chance node, which are a set of mutually exclusive outcomes c. To define the “consequence,” or the final outcome of a branch 4. To solve for the expected value of the decision tree (EV, EMV) <ol style="list-style-type: none"> a. To construct the joint, conditional, and marginal probabilities b. To calculate all branch probabilities of the tree <ol style="list-style-type: none"> i. To apply Baye’s Theorem ii. To implement the inverse tree structure technique 5. To find and compare the expected value of both sample and perfect information (EVPI, EVSI) <ol style="list-style-type: none"> a. To construct the decision trees to calculate EVPI and EVSI b. To evaluate the relevance and importance of the values obtained for EVPI and EVSI to the decision process 	HW #1 (A) HW #2 (A) HW #3 (B,C) HW #4 (D) HW #5 (E) Performance Task #1 (A) Midterm # 1-18 (A) Midterm # 19-21(B) Midterm # 22-30 (C) Final # 19-22 (A) Final # 6-10, 23-25 (C) Final # 1-5 (D) Final # 11-18 (E)

		<p>B Students will be able to construct the formulae for conditional likelihood ratios and to calculate the probabilities/ratios</p> <ol style="list-style-type: none"> 1. To calculate the conditional likelihood ratio (CLR) associated with a particular observation 2. To calculate the CLR for multiple observations 3. To compare these results with Baye's Theorem 	
		<p>C Students will be able to construct a single-attribute utility function</p> <ol style="list-style-type: none"> 1. To propose a lottery that would be appropriate for evaluation of risk 2. To calculate the necessary values from the lotteries needed for analysis <ol style="list-style-type: none"> a. To calculate the certainty equivalent b. To calculate the risk premium c. To calculate the selling price d. To calculate the buying price e. To calculate the insurance premium 3. To translate the lotteries into a mathematical function 4. To create a graphical interpretation of the function 5. To analyze and compare two lotteries at a time, to be used when a reference point is needed 	
		<p>D Students will be able to develop and analyze fault trees</p> <ol style="list-style-type: none"> 1. To describe the events of a tree for a given scenario <ol style="list-style-type: none"> a. To identify the top event b. To define primary and secondary failures and command faults c. To identify the sequence of events 2. To create the fault tree for a given scenario (such as the safety analysis of a system) using deductive analysis <ol style="list-style-type: none"> a. To define the "and" and "or" gates b. To implement the logic symbols into the tree 3. To develop and analyze dual fault trees <ol style="list-style-type: none"> a. To translate the meaning of a system failure into the reliability of the system 	

		E	<p>Students will be able to construct a multi-attribute utility function</p> <ol style="list-style-type: none"> 1. To construct a graphical model for the function 2. To develop a mathematical model for the function 	
II	To apply analytic decision making techniques for technical decision making under uncertainty and to analyze and evaluate the results.	A	<p>Students will be able to perform sensitivity analysis on a decision tree scenario</p> <ol style="list-style-type: none"> 1. To construct a graph to interpret the results <ol style="list-style-type: none"> a. To plot the two dimensional plane for a single chance node sequence <ol style="list-style-type: none"> i. To interpret the graph b. To plot the plane for two sequential chance events (plot the pq plane) <ol style="list-style-type: none"> i. To interpret the graph 2. To determine the threshold probability levels <ol style="list-style-type: none"> a. To decide if the current solution is a good one and justify the decision b. To determine the salient factors (variables) in the decision being modeled by the current tree c. To make recommendations for improvements 	<p>HW #1 (A)</p> <p>HW #2 (A)</p> <p>HW #3 (B,C)</p> <p>HW #4 (D)</p> <p>HW #5 (E)</p> <p>Performance Task #2</p> <p>Midterm # 1-18 (A)</p> <p>Midterm # 19-21(B)</p> <p>Midterm # 22-30 (C)</p> <p>Final # 19-22 (A)</p> <p>Final # 6-10, 23-25 (C)</p> <p>Final # 1-5 (D)</p>
		B	<p>Students will be able to make inferences about a system based on the values of the conditional likelihood ratios</p> <ol style="list-style-type: none"> 1. To determine the pass or fail rates allowed for a given set of specification limit 2. To determine probabilities of occurrence for multi-variate systems based on the values of the CLR's 	<p>Final # 11-18 (E)</p>

		<p>C Students will be able to evaluate a given utility function</p> <ol style="list-style-type: none"> 1. To analyze the degree of risk aversion from the utility function; risk prone, risk averse, risk neutral 2. To assess the process being modeled; is the model sufficient <ol style="list-style-type: none"> a. To determine if the model needs to have more attributes 3. To recommend any changes in the model <ol style="list-style-type: none"> a. To decide if more iterations are necessary for the lotteries b. To decide if any of the lotteries need to be referenced c. To determine if the utility function is consistent with the behavior of the decision maker 	
		<p>D Students will be able to evaluate the scenarios modeled by a fault tree</p> <ol style="list-style-type: none"> 1. To determine the reliability and failure probability relationships 2. To propagate the probabilities through the gates 3. To perform a qualitative evaluation <ol style="list-style-type: none"> a. To determine cut sets, as well as the minimal cut set 4. To perform a quantitative evaluation <ol style="list-style-type: none"> a. To determine cut sets, as well as the minimal cut set b. To develop the equivalent fault tree c. To obtain the numerical probability that a given cut set induces failure of the system 5. To implement the additive model for multi-attribute scenarios 	
		<p>E Students will be able to implement the additive model for multi-attribute utility theory</p> <ol style="list-style-type: none"> 1. To assess a two-attribute utility function 2. To determine the weights of the functions (the k's) 	

III	To structure and solve complicated decision problems	A	Students will be able to define a scenario to be analyzed with the decision analysis techniques <ol style="list-style-type: none"> 1. To research an area in which the tools can be applied, and to choose a problem for study 2. To define the scope for the problem chosen 3. To determine a set of objectives for the given problem 	HW #2 Performance Task #2 Performance task #3
		B	Students will be able to formulate/design a possible solution approach to the given problem <ol style="list-style-type: none"> 1. To determine an appropriate solution technique to be applied to the problem from the set of available tools 2. To formulate the solution 	
		C	Students will be able to implement the solution techniques to obtain a first round solution <ol style="list-style-type: none"> 1. To solve the formulation 	
		D	Students will be able to analyze the solution found in order to assess the current state <ol style="list-style-type: none"> 1. To assess/analyze the value of the solution found (does it make sense numerically?) 2. To evaluate the significance of the solution (what does this mean for the decision maker?) 	
		E	Students will be able to recommend a course of action based on the original solution <ol style="list-style-type: none"> 1. To establish if the decision maker is risk averse, risk prone, or risk neutral 2. To recommend the path that the decision maker should embark upon, based on the results 	

		F	<p>Students will be able to assess the usefulness of the solution and recommend any changes in the process</p> <ol style="list-style-type: none"> 1. To evaluate if the current solution adequately answers the most important questions facing the decision maker 2. To analyze the solution for computational accuracy 3. To decide if the solution should be improved upon <ol style="list-style-type: none"> a. To conclude if factors (attributes) need to be added b. To conclude if factors (attributes) need to be removed c. To determine if the correct probabilities were utilized 	
IV	To identify and define any limitations of the models and techniques for rational decision-making.			Performance Task #2
				Performance Task #3
V	To demonstrate an ability to effectively present the problem, solution, and recommendations of a complicated decision scenario	A	Students will explain results via a formal presentation	Performance Task #2
		B	Students will explain results via a formal written technical report	Performance Task #3

MEE 321 Mechanical Vibrations I

Student Learning Objectives and Outcomes		Assessments: Test Alignments Midterm & Final	
	Student Learning Objectives/Outcomes- Major	Student Learning objectives - minor	Corresponding Tests and Test Items Midterm abbreviated as M Final abbreviated as F
1	A. Classify types of Vibration	<p>a Discuss common vibration phenomenon</p> <p>i) Identify if vibration is Deterministic and classify as a) Sinusoidal, b) Periodic, and c) Transient</p> <p>ii) Identify if vibration is Random and classify as a) Stationary and b) Non Stationary</p> <p>b Identify the source of excitation as i) Free or ii) Forced Vibration</p> <p>c Identify possible source of energy loss and classify as i) Undamped or ii) Damped</p> <p>d Classify the system as i) linear or ii) nonlinear</p>	M -1, 2
	B. Solve Kinematics and Kinetics problems involving particle and rigid body analyses.	<p>a Define degrees of Freedom</p> <p>b Solve Particle Kinematics problems for i) Velocity analysis, and ii) Acceleration analysis</p> <p>c Solve Rigid Body Kinematics problems for i) Relative Velocity analysis ii) Relative Acceleration analysis</p> <p>Decide how to choose</p>	<p>M-3, M-4, M-20, M-30</p> <p>M-5</p> <p>M-6, M-9, M-32</p> <p>M-6,</p>

2	C. Convert a real life vibration to a mathematical statement	d	Particle and/or Rigid Body formulation	
		e	Solve the kinetics problem	M-6, M-7, M-8, M-9
			i) Identify method of solution by identifying list of variables ii) Draw FBD and MAD to solve for instantaneous forces/accelerations	M-21, M-22, M-31, M-32
		a	i) Convert a complex system to simple sub-systems ii) Draw the Schematic of the sub-systems	M-10
				M-11
	D. Identify basic elements used to solve vibration problem.	a	Compute equivalent stiffness for i) springs in series ii) springs in parallel, or iii) combined effect in a SDOF system	M-12, M-13, M-36
			Compute equivalent mass	
	E. Analyze vibration of a system subjected harmonic and periodic motion	b	Define basic vibration terminology for sinusoidal motion	M-14
		a	i) Obtain Fourier series expansion for periodic motion	M-15, M-16
			ii) Reconstruct a periodic wave from first few harmonics	
A. Solve for free undamped vibration of a Single Degree of Freedom System	a	Identify the degree of freedom	M-17, M-20	
	b	i) Derive equation of motion for undamped translation system	M-17, M-18	
		ii) Solve the differential equation of motion and compute natural frequency	M-19	
		i) Derive equation of		

3	B. Apply modeling of free vibration of undamped System	<p>c motion for undamped rotational system</p> <p>ii) Solve the differential equation of motion and compute natural frequency</p>	M-17, M-18
	C. Check system stability	<p>a i) Use compound pendulum for solving moment of inertia</p> <p>ii) Compute center of percussion and use it for sports applications</p> <p>a Compute equivalent mass and system and check if system is stable</p>	M-19, M-23
	A. Solve for free vibration of a viscously damped Single Degree of Freedom System	<p>a Derive equation of motion of a viscously damped SDOF system</p> <p>b Compute Critical Damping Constant and Damping ratio</p> <p>c Solve for the response of i) underdamped, ii)critically damped and iii) overdamped system due to given initial conditions</p> <p>d Compare the undamped and damped natural frequencies and understand its relevance in terms of comparison of theory and experiment</p>	M-20, M-21, M-22, M-23, M-24, M-33
	B. Solve for free vibration for other types of damping	<p>e Use log decrement to measure damping.</p> <p>a Identify other types of damping.</p> <p>b Derive the equation for columb damping</p>	M-24, M-34
			M-25, M-26, M-27, M-28, M-29

		c	Compute energy loss for hysteretic damping	
4	Solve for forced vibration of Single Degree of Freedom Systems	a	Derive the equation of motion from FBD & MAD	M-30, M-31, M-32
		b	i) Use the FBD and MAD to solve for the steady state solution due to harmonic excitation ii) Compute the total response iii) Estimate damping ratio from half power bandwidth	M-35, M-41
		c	Define transmissibility and observe the effect of damping and frequency ratios on transmissibility.	M-39, M-40
		d	Solve for the response of a system due to motion of base	M-38
		e	Solve for the response of a system subjected to rotating unbalance	F-1, F-2, F-3, F-4
		f	Design systems for desired vibration isolation.	F-5, F-6, F-7, F-8, F-9
5	Solve for free vibration of a 2DOF system	a	i) Identify the appropriate 2DOF ii) Construct FBD and MAD in terms of the chosen 2DOF	F-10, F-11, F20, F-21
		b	Use the FBD and MAD to derive equations of motion	F-12, F-13
		c	Identify mass, stiffness, and damping matrices from the equations of motion.	F-14, F-15, F-22, F-23, F-28, F-29
		d	Solve for undamped natural frequencies and mode shapes.	F-16, F-17, F-18, F-19, F-27
		e	Solve for modal properties of a semidefinite systems	F-24, F-25, F-26, F27, F-30, F-31, F-32
6	Solve for forced vibration of 2DOF systems	a	Use the equation of motion to solve for steady state response due to harmonic excitation directly by impedance method	
		b	Use Matlab to solve the equations of motion directly-by state space method.	

7	Solve for general eigenvalue problem	a	Derive equations for MDOF systems & solve for natural frequencies and mode shapes in closed form.	F-28, F-29, F-30, F-31, F-32
		b	i) Check orthogonality of mode shapes with respect to mass and stiffness matrices ii) Use the orthogonality to decouple equations of motion. iii) Compute mass normalized mode shapes.	F-33
		c	Solve for natural frequencies and mode shapes by Matlab	
		d	i) Define Proportional and non proportional damping ii) Solve for damping ratios for the case of proportional damping	
		e	i) Decouple equations of motion using separation of variables ii) Solve for the response using mode shapes and generalized coordinates iii) Solve response of a large DOF systems in terms of first few modes and generalized coordinates	
8	Use various vibration measuring equipment	a	Use function generator to generate a periodic wave and use the analyzer to measure the Fourier components.	
		b	i) Measure natural frequency of a SDOF system using impact hammer, accelerometer, and FFT analyzer ii) Measure damping ratio using half power points	F-34, F-35

			iii) Understand various sources of error including digital signal processing issues and effect of sensors.	F-35, F-36, F-38
		c	i) Measure natural frequencies and mode shapes of a 2DOF system using impact hammer, accelerometer, and FFT analyzer. ii) Use imaginary part of transfer functions to obtain modal parameters. iii) Obtain damping ratios	F-37 F-39
9	Use commercial software such as Matlab	a	Reconstruct a periodic wave from first few harmonics and plot using Matlab	
		b	To solve for complete solution for response of a SDOF using Matlab	
		b	Solve for eigenvalues (square of natural frequencies) and eigenvectors (mode shapes) of undamped 2DOF and MDOF systems using eig command	
		c	Solve equation of motion for a 2DOF system such as automobile using state space method.	
10	Design a structure to prevent failure from vibration	a	i) Formulate equation of motion of SDOF system and suggest appropriate stiffness/damping for desired vibration isolation ii) Formulate equation of motion of 2DOF systems and suggest appropriate stiffness/damping for desired vibration isolation	

		b	Design a tuned absorber system for vibration prevention at a resonant forcing frequency while satisfying design constraints such as maximum displacement	
11	Solve for forced vibration of a SDOF system due to general forcing functions.	a	Identify various sources of periodic forces and use Fourier analysis to solve for response of SDOF system subjected to periodic force	
		b	Identify various sources of transient forces and solve for response of SDOF system subjected to the transient forces	
		c	Define response spectrums and discuss their use in structural design.	

B.9.e.5: TECH 344-Materials and Processes in the Plastics Industry (Explanation in B.9)

Student Learning Objectives and Outcomes			Assessments: Test Alignments Midterm (M) & Final (F)
	Student Learning Objectives/Outcomes-Major	Student Learning Objectives - minor	Corresponding Tests and Test Items
A.	Students will Describe the Fundamental Structure of Plastics:	1. Students will draw & explain basic organic molecules. a. Students will label the atoms and bonding types. b. Students will differentiate & give examples of alkanes, alkenes, alkynes, and aromatics.	M1,M2,M3,M4 M10,M12,M14 F11,F13
		2. Students will interpret & draw polymer chains. a. Students will compare polymerization reactions. b. Students will compare & contrast functional groups & tacticity. c. Students will describe chain topology.	M16,M17,M18,M19,M20,M21 M23 M24 M26
		3. Students will compare & contrast structure & applications of thermoplastics & thermosets. a. Students will select commodity and engineered plastics. b. Students will differentiate crystalline & amorphous plastics.	M27,M28,M29,M30,M31 M33,M34 M37
		4. Students will name, draw, and label elastomers. a. Students will explain elastomers. b. Students will summarize polyisoprene. c. Students will select & qualify other elastomers.	M38 M44 M45
B.	Students will Predict Plastics Properties:	1. Students will describe effects of structural features on plastics properties.	M46

		<p>a. Students will quantify & solve molecular weight distribution.</p> <p>b. Students will qualitatively evaluate crystallinity effects.</p>	M48 M49
		<p>2. Students will state force and stress vs. strain relationship.</p> <p>a. Students will name & illustrate forces.</p> <p>b. Students will subdivide stress-strain curves.</p> <p>c. Students will compare stress-strain curves for different plastics.</p>	F50 F51 F52
		<p>3. Students will distinguish & explain mechanical, physical, thermal, environmental, electrical, and optical properties.</p> <p>a. Students will select ASTM techniques.</p>	F53,F55,F56,F57,F58,F60,F61,F62,F64,F54,F59,F63 F65
		<p>4. Students will explain interactions of modifiers.</p> <p>a. Students will classify additives, fillers, & reinforcements.</p>	F66,F67,F68,F69,F70,F71,F72
C.	Students will Describe Plastics Design and Finishing Processing:	<p>1. Students will differentiate design methods.</p>	F73
		<p>2. Students will classify ways of assembling plastics.</p> <p>a. Students will select machining methods.</p>	F75,F76,F77,F78.F74 F79
		<p>3. Students will explain methods of finishing plastics.</p> <p>a. Students will give examples of joining & decorating.</p>	F80,F81 F82,F83,F84
		<p>4. Students will compare & contrast rapid prototyping procedures.</p>	F85,F86
D.	Students will Observe Plastics Processing Techniques:	<p>1. Students will recite observed processing methods.</p>	F87

E.	Students will Recognize the Environmental Aspects of Plastics:	1.	Students will recite recycling codes.	F88,F89,F90,F91,F92
2.		Students will explain waste reduction techniques. a. Students will evaluate source control, recycling, regeneration, degradation, landfills, & incineration.	F93,F94,F95,F97,F96	
F.	Students will Analyze, in Depth, Specific Plastics Topic:	1.	Students will construct the history of a plastics topic, or	
2.		Students will differentiate a plastic, or		
3.		Students will detail a plastics processing method, or		
4.		Students will describe, in detail, a plastic product.		