Table B.5.a.3.1: Discipline Course Outline

Course Disciplinary Content	**Science(s) Foundation Required** (Id. Physics, Chemistry, Biology, etc.)	**Mathematics Foundation Required**	**Communication Foundation/ Skills Required**
I. Unit A. Review of Dynamics 1. Particle Kinematics 2. Rigid Body Kinematics a) Relative Velocity b) Relative Acceleration 3. Particle and Rigid Body Kinetics a) Force-Mass-Acceleration b) Work-Energy c) Impulse-Momentum 4. Explain how to decide what Method to use by identifying variables	A. Physics, Chemistry, Bio? 1. 1. Dynamics (Particle and Rigid Body FBD, MAD, Kinematics, Kinetics)	A. Calculus 1. Vector Algebra 2. Integration 3. Differentiation	
B. Basic Concepts and Classification of Vibration 1. Elementary parts 2. Degrees of Freedom 3. Types of Vibration	B. Dynamics 1. Coordinate Systems		
C. Spring, Mass, and Damping Elements 1. Equivalent spring 2. Equivalent mass	C. Dynamics 1. Potential energy of spring and gravity 2. Kinetic Energy of mass		
D. Harmonic motion & Analysis of periodic function 1. Definitions 2. Fourier Series 3. Lab on Fourier Series	3. Ability to use spectrum analyzer	D. Mathematics 1. Develop equations of graphs shown 2. Integration over a domain 3. Ability to use Matlab	Writing

II. Unit

A. Free Vibration of Undamped and Damped Vibration	A. Dynamics	A. Mathematics
1. Equation of motion from FBD&MAD	1. Force-Mass-Acceleration	1. (Solution of 2^{nd} order ordinary differential equations)
2. Equation of motion using other methods	2. Conservation of energy	
3. Solution of equation of motion		
4. Examples (how complicated models are simplified)		
5. Reverse analysis (moment of inertia of rigid body from compound pendulum analysis)		
6. Experiment on determination of natural freq. of SDOF	6. Ability to use FFT Analyzer Some digital signal processing issues	Writing
B. Free Vibration of Damped System	B. Dynamics	B. Mathematics
1. Viscous Damping	1. Force-Mass-Acceleration	1. (Solution of 2^{nd} order ordinary homogenous differential equations)
2. Damping ratio, under,critical,& over damped		
3. Log decrement, energy dissipated		
4. Other types of damping		

III. Unit

A. Harmonically Excited Vibration of SDOF	A. Dynamics	A. Mathematics
1. Response of an undamped system	1. Force-Mass-Acceleration	1. (Complementary Solution and particular integral of non-homogenous diff eqns)
2. Response of a damped system	2. Same	2. Same
3. Quality factor and bandwidth		
3. Base Excitation		
4. Transmissibility and Vibration Isolation	3. Same	4. Same
4. Rotating unbalance	4. Same	4. Same

IV. Unit

A. Forced vibration of SDOF subjected to general Vibration conditions	A. solution of diff. eqn
1. Response under periodic force	
2. Response under transient force	

V. Unit

A. Two Degree of Freedom Systems	A. Dynamics (Force-Mass-Acceleration)	A. Matrix algebra
B. Concept of natural frequencies and associated Mode shapes		
C. General eigenvalue problem		C. Matlab solutions
D. Determination of natural frequencies And mode shapes	D. Understand how FRF is used to obtain modal properties	D. Complex matrix algebra
E. Steady State response due to Harmonic excitation - Direct method		

VI Unit

A. Multiple Degree of Freedom Systems		
B. Eigenvalue Problem		
C. Orthogonal property and mass normalization of modes		
D. Vibration of undamped systems using modal Analysis		
E. Lab on MDOF		Writing

VI. Unit

A. Vibration Isolation	Same
B. Tuned Absorber	

Table B.5.a.3.2: Content Schedule and Styles, Models, Bloom's Analysis

Week	**Content Topic:** *Factual, Conceptual, Procedural, Meta-cognitive*	**Content Source** *Text, etc.*	**Teaching Style** *a-k; fpfd*	**Learning Style** *CE, AE, AC, RO*	**Teaching Model** *1-24 name*	**Dale's Cone** *Active or Passive*	**Bloom's Traditional** *Evaluation, Synthesis, Analysis, Application, Comprehension ,Knowledge*	**Bloom's Revised** *Create, Evaluate, Analyze, Apply, Under stand, Remember*	**Critical Thinking High (H), Medium (M), Low(L)**	**Centered?** *Teacher, Knowledge Assessment, Learner*
1	Introduction	Prof.	a,b	AR	Lecture, Concept formulation Conceptualization	passive	knowledge	PK	H	
	Review of Dynamics	Prof, Dyn text	a,b,d,f	AA	Advance organizer	Passive, active	Comprehension,	MK	H	
	Basic Concepts	Prof, Text	A,b	AR,aa	Lecture	passive	knowledge	CK	M	
2	Equivalent Spring, mass	Text	A,b,d	AR,AA	Simulations	passive	application	PK	M	
	Harmonic Motion	Text	A,b	AR	Lecture	passive	comprehension	CK	L	
	Fourier series	Text	A,b,f	AR	Lecture	passive	comprehension	PK	M	
3	Free Vib of SDOF Undamped Translational syst, Lab on Fourier series	Text Manuals, Tutorial	A,b,f,c	CR,CA,AR	Lecture Cooperative Learning	Passive, active	comprehension	PK	H	
	Free Vib of SDOF Undamped Rotational syst	Text, prof	A,b	CR	Lecture	passive	knowledge	PK	M	
	Examples	prof	A,b,f	AA	Conceptualization	passive	application	PK	M	
4	Free Vib of damped syst., damping ratio,	text	A,b	AA,AR	Lecture	passive	comprehension	CK	H	
	Log Decrement, Energy dissipated	text	A,b	AA	Lecture	passive	knowledge	PK	M	
	Other types of damping	Text prof	A,b	CR	Lecture	passive	knowledge	PK	M	
5	Response of undamped syst. excited harmonically,	Text Manuals	A,b,c,d,f	AR,AA	Lecture, Cooperative learning	Passive, active	comprehension	PK	H	

	Lab SDOF free vib.									
	Response of damped syst. excited harmonically	Text	A,b	AR,AA	Lecture	passive	knowledge	CK	H	
	Quality factor & bandwidth	Text Prof	A,b	AA	Lecture	passive	comprehension	PK	M	
6	Exam#1					active	comprehension	PK	H	
	Base excitation	Text	A,b	AR	Lecture	passive	knowledge	CK	M	
	Transmissib, Isolation	Text, Prof.	A,b	AR,AA	Lecture, concept Presentation, conceptualization	passive	comprehension	PK	H	
7	Rotating Unbalance	Text	A,b	AR	Lecture	passive	knowledge	CK	M	
	Review					Passive,active	application	MK	M	
	Response of SDOF sub. to Periodic force	Text	A,b	AR	Lecture	passive	comprehension	CK	M	
8	Response of SDOF sub. to transient force	Text, Prof	A,b	AR	Lecture	passive	comprehension	CK	H	
	Matlab solutions	Prof.	A,b,f	AA	Lecture,	passive	comprehension	PK	H	
	Free vib of undamped 2DOF	Text	A,b	AR	Lecture	passive	knowledge	CK	M	
9	Natural freq. & mode shapes	Text, Prof	A,b	AR	Lecture, conceptualization	passive	comprehension	PK	H	
	Coordinate coupling	Text	A,b	AR,AA	Lecture	passive	application	PK	M	
	Review		A,b,f			Passive,active	comprehension	MK	M	
10	Exam#2					active	application	MK	H	
	Steady state response due to harmonic excitation - direct method	Text	A,b	AR	Lecture	passive	knowledge	PK	M	
	Multiple DOF	Text	A,b	AR	Lecture	passive	comprehension	PK	M	
11	Eigenvalue prob	Text,Prof	A,b	AR,AA	Lecture	passive	knowledge	PK	M	

	Orthogonality of modes and mass normalization	Text Prof	A,b	AR	Lecture, conceptualization	passive	comprehension	CK	M	
	Vibration of undamped syst. using modal analysis	Text	A,b	AR,AA,CR	Lecture	passive	application	PK	H	
12	Forced vib. of damped syst, Lab on free vib. of MDOF	Text Prof	A,b,c,d,f	AA,AR	Lecture, cooperative learning	passive, active	application	PK	H	
	Matlab solutions	Prof	A,b,f	AA		passive	comprehension	PK	H	
	Review					passive,active	application	MK	M	
13	NVH issues	Prof.	A,b,f	CR	Lecture, Advance Organizer	passive, active	application	MK	M	
	Single plane unbalancing	Text	A,b	AA	Lecture	passive	knowledge	CK	M	
	Vibration Isolation	Text	A,b	AR	Lecture	passive	comprehension	PK	M	
14	Designing of systems	Prof	A,b,c,d,e,f	CA	Lecture, reciprocal learning, Cooperative learning	active	synthesis	MK	H	
	Tuned undamped absorber	Text	A,b	AA	Lecture	passive	comprehension	CK	M	
	Lab on balancing	Text	A,b	AR	Cooperative learning	active	comprehension	CK	M	
15	Industrial issues	Prof.	A,b	CR	Lecture	passive	analysis	MK	M	
	Review					passive,active	application		M	
	Review					passive, active	comprehension		M	
16	Final Exam or Project					active	comprehension	MK	H	
Note: There is a practice by some professors to give the final exam before or during the **last week of CLASS**, rather than the **FINAL EXAM WEEK**. This essentially means that you are "cheating" the students out of one day of content, learning, etc. We should have 15 weeks of learning, including exam, quizzes, or project days, but to make the **final week of class** the **FINAL exam week** is unethical by NIU standards, regardless of who does it. **What is your practice? I GIVE FINAL EXAM ONLY AT TIME SCHEDULED IN CATALOG (AND NOT DURING FINAL WEEK OF CLASS)**										

Table B.5.a.3.3: Instructional Design Gaps Analysis Table

ABET/ NAIT Standard **a-k Eng** **A-Q Tech**	**NIU General Ed Goals (embedded)** **a-I, ii, iii, iv** **b-I, ii, iii, iv** **c and d**	**Student Learning Objectives listed on syllabus**	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***	**Knowledge Sources** **Professor, Text, Cases, Speaker, References, etc.**	**Student Assessments listed on syllabus**	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***	**Test Items or Projects/ Rubrics**	**Bloom/Dale** ***Evaluation Synthesis Analysis Application Comprehension Knowledge***	**Performance** ***IF any; if none, leave blank***	**Bloom/Dale** ***Evaluation/Active Synthesis/Active Analysis/Active Application/Active Comprehension/P Knowledge/Passive***
A, E, I, J		To learn basic theories behind vibrating mass or equipment	Application	Professor, text	Hw, tests	Analysis	Exam2: Prob1, 2,3 Final Exam: Prob2,3,4			
K		To familiarize with various Equipment and software used to run equipment	Comprehen.	Professor, TA, References	lab	Comprehen.				
B, D		To perform experiment to verify the theories	Application	Professor, TA	lab, test	Application	Final Exam: Prob1			
G		To learn how to write a laboratory report	Knowledge	Professor, TA	lab	Knowledge				
C,E,K		To apply major commercially available mathematical and engineering software. Matlab solutions of differential equations in vibration related problems	Application	Professor	hw	Application				
A,C,E,H,J, and K		To design structures where failure from vibration is prevented	Synthesis	Professor, references	Hw, tests	Application	Exam2: Prob2, Finalexam Prob2,4			