MODULE DESCRIPTION FORM

نموذج وصف مادة نظرية المكائن والاهتزازات

Module Information معلومات المادة الدراسية					
Module Title	**Theory of Machines and Vibrations**			**Module Delivery**	
Module Type	**C**			☐ **Theory** ☒ **Lecture** ☒ **Lab** ☐ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	UOMU02012061				
ECTS Credits	**5**				
SWL (hr/sem)	**116**				
Module Level		3	**Semester of Delivery**		1
Administering Department		PM	**College**	TE	
Module Leader	Sami Mohsin Dakhina		**e-mail**	Sami.mohsin@uomus.edu.iq	
Module Leader's Acad. Title		**Lecturer**	**Module Leader's Qualification**		Ph.D
Module Tutor	None		**e-mail**	E-mail	
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date		20/06/2023	**Version Number**		1.0

Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	MPAC108 MPAC206	Semester	L1,S2 L2,S2
Co-requisites module	None	Semester	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Aims	1. To identify and enumerate different link based mechanisms with basic understanding of motion. 2. To understand and illustrate various power transmission mechanisms using suitable method. 3. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine. 4. Vibration analysis is a process of looking for anomalies and monitoring change from the established vibration signature of a system. The vibration of any object in motion is characterized by variations of amplitude, intensity, and frequency. 5. Vibration is highly applicable for investigating the operational conditions and status of rotating machinery and structures. Vibrations can be represented in different forms, including displacement, velocity and acceleration.
Module Learning Outcomes	Upon completion of the course, students should be able to: 1. Balance the rotating masses to reduce (or even eliminating) the unbalanced forces and couples in a mechanical system. 2. Learn and understand how the motion can be transmitted by two or more toothed wheels. 3. Learn that there are many types of governors and the main function of a governor is to regulate the mean speed of an engine within certain limits, when there are variations in the load. 4. The student will learn how the belts or ropes are used to transmit power from one shaft to another by means of pulleys which rotate at the same speed or at different speeds. 5. Learn to calculate the braking torque for different types of brake, and learn how to dealing with the braking of a vehicle. 6. Learn general information about the cam, and also learn the type of motion of follower. 7. Understand the engineering principles in mechanical system to identify. 8. Formulate and solve the problem of mechanical engineering. 9. Able to find the source of engineering problems in mechanical system through research that includes identification, formulation, analysis, data interpretation based on engineering principles. 10. Able to formulate the solution of engineering problem in mechanical system by considering economy, safety, environment and energy conservation. 11. Analyze mechanical vibration on 1 and 2 degree of freedom system. 12. Explain basic concept of free body diagram and vibration mathematics model system. 13. Formulate movement equation and analyze vibration respond from undamped and damped in free and forced excitation with various excitation.
Indicative Contents	Indicative content includes the following. Balancing of a Single Rotating Mass by a Single Mass Rotating in the Same Plane, balancing of a Single Rotating Mass by Two Masses Rotating in Different Planes,

	Balancing of Several Masses Rotating in the Same Plane Using Analytical and Graphical Methods, Balancing of Several Masses Rotating in Different Planes. [4 hrs] Classification of Gears, Spur Gears, Velocity Ratio (Gear Ratio), Center to Center Distance, Gear Trains, Velocity Ratio of Simple Gear Trains, Velocity Ratio of Compound Gear Trains, Epicyclic Gear Trains, Simple Epicyclic Gear Trains, Compound Epicyclic Gear Trains. [4 hrs] Types of Governors, Watt Governor, Porter Governor, Proell Governor, Hartnell Governor. [4 hrs] Types of Belts, Types of Flat Belt Drive, Selection of Belt Drive, Velocity Ratio of Open Belt Drive, Effect of Belt Thickness on Velocity Ratio, Slip of the Belt, Velocity Ratio of a Compound Belt Drive, Length of Open and Cross Belt, Ratio of Driving Tension for Flat Belts, Determination of Angle of Contact for Open and Cross belt., Power Transmitted by a Belt, Centrifugal Tension, Maximum Tension in the Belts, Initial Tension in the Belt, V – Belt Drive and Rope Drive. [4 hrs] Types of Brakes, Simple Block or Shoe Brake (Single and Double Block), Band Brake (Simple and Differential Band Brake), Band and Block Brake, The Braking of a Vehicle. [4 hrs] Types of Followers, Nomenclatures for Cam Profile, Motions of the Follower, Uniform Motion or Uniform Velocity of a Follower, Simple Harmonic Motion of Follower, Uniform Acceleration and Uniform Retardation, Cam profile construction. [4 hrs] Basic concepts of vibration, Oscillatory motion, Second Order Differential Equations with Constant Coefficients. [4 hrs] Undamped Free Vibrations of Single degree of Freedom Systems, Torsional Oscillation of Elastic Shafting, Energy Methods. [4 hrs] Damped Free Vibrations of Single degree of Freedom Systems, Logarithmic Decrement, Forced Vibrations of Undamped Single Degree of Freedom Systems, Force Vibrations of Damped Single Degree of Freedom Systems, Forced Angular Oscillations of Rigid Bodies. [4 hrs] Influence of Frequency Ratio and Damping Factor on Steady State Response, Force Transmission and Vibration Isolation. [2 hrs] Natural Frequency of Transverse Vibrations of Shafts or Beams Under Different Types of Loads and End Conditions, Natural Frequency of Transverse Vibration of a System of Several Loads Attached to the Same Shaft (Energy and Dunkerley's Methods). [2 hrs] Whirling Speeds or Critical Speeds. [2 hrs] Free Vibrations of Undamped Systems with Two Degree of Freedom. [2 hrs] Free Vibrations of Damped Systems with Two Degree of Freedom. [2 hrs]

	Forced Vibrations for Systems with Two Degree of freedom. [2 hrs] Natural Frequency of Free Torsional Vibrations, Free Torsional Vibrations of a Single Rotor System, Free Torsional Vibrations of a Two Rotor System. [2 hrs] Free Torsional Vibrations of a Three Rotor System, Torsional Equivalent Shaft. [2 hrs]

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Assessment is based on hand-in assignments, written exam, Quizzes, Practical testing.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem)	116	**Structured SWL (h/w)**	8
Unstructured SWL (h/sem)	9	**Unstructured SWL (h/w)**	1
Total SWL (h/sem)	125		

Module Evaluation تقييم المادة الدراسية					
		Time/Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	3	10% (10)	2, 5, 12	LO # 1-15
	Assignments				
	Practical / Lab	2	20% (20)	Continuous	
	Report / Lab	1	10% (10)	14	LO # 1-7
Summative assessment	**Midterm Exam**	2 hr	10% (10)		LO # 1-7
	Final Exam	3hr	50% (50)		All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري محتوى كل اسبوع يجب ان يغطي الوقت المحدد	
	Material Covered
Week 1	Balancing of Rotating Masses Balancing of a Single Rotating Mass by a Single Mass Rotating in the Same Plane Balancing of a Single Rotating Mass by Two Masses Rotating in Different Planes Balancing of Several Masses Rotating in the Same Plane (a) Analytical Method (b) Graphical Method Basic concepts of vibration Oscillatory motion. (a) Harmonic motion. (b) Periodic motion. Vibration terminology.
Week 2	Balancing of Several Masses Rotating in Different Planes Solve Problems. Second Order Differential Equations with Constant Coefficients. Solve Problems. Undamped Free Vibrations of Single degree of Freedom Systems. (a) Simple Harmonic Oscillation (Equilibrium Method). (b) Angular Oscillations of Rigid Bodies. Torsional Oscillation of Elastic Shafting. Solve Problems.
Week 3	Classification of Gears Spur Gears Velocity Ratio (Gear Ratio) Center to Center Distance Gear Trains Velocity Ratio of Simple Gear Trains Velocity Ratio of Compound Gear Trains Solve Problems
Week 4	Epicyclic Gear Trains Simple Epicyclic Gear Trains Compound Epicyclic Gear Trains Energy Methods. Equivalent Spring Constants. Solve Problems.
Week 5	Solved Problems Damped Free Vibrations of Single degree of Freedom Systems. Logarithmic Decrement. Forced Vibrations of Undamped Single Degree of Freedom Systems. Solve Problems.

Week 6	Types of Governors Watt Governor Porter Governor (a) Equilibrium Method (b) Instantaneous Center Method Solve Problems tions of Damped Single Degree of Freedom Systems. Forced Angular Oscillations of Rigid Bodies. Solve Problems.
Week 7	Proell Governor Hartnell Governor Solve Problems Influence of Frequency Ratio and Damping Factor on Steady State Response. Force Transmission and Vibration Isolation. Base Excitation.
Week 8	Types of Belts Types of Flat Belt Drive Selection of Belt Drive Velocity Ratio of Open Belt Drive Effect of Belt Thickness on Velocity Ratio Slip of the Belt Velocity Ratio of a Compound Belt Drive Length of Belt (a) Open Belt (b) Cross Belt Ratio of Driving Tension for Flat Belts Natural Frequency of Transverse Vibrations of Shafts or Beams Under Different Types of Loads and End Conditions. (a) Natural Frequency of a Shaft Carrying a Single Concentrated Load. (b) Natural Frequency of a Shaft Carrying a Uniformly Distributed Load. Natural Frequency of Transverse Vibration of a System of Several Loads Attached to the Same Shaft. (a) Energy or (Rayleigh's) Method. (b) Dunkerley's Method. Solve Problems.
Week 9	Determination of Angle of Contact (a) Open Belt (b) Cross Belt Power Transmitted by a Belt Centrifugal Tension (T_c) Maximum Tension in the Belts (T_{max}) Condition for the Transmission of Maximum Power Initial Tension in the Belt (T_o) V – Belt Drive and Rope Drive Whirling Speeds or Critical Speeds. Solve Problems.
Week 10	Solve Problems

	Free Vibrations of Undamped Systems with Two Degree of Freedom. Solve Problems.
Week 11	Types of Brakes Simple Block or Shoe Brake (a) Single Block or Shoe Brake (b) Double Block or Shoe Brake Band Brake (a) Simple Band Brake Differential Band Brake Free Vibrations of Damped Systems with Two Degree of Freedom. Solve Problems.
Week 12	Band and Block Brake Internal Expanding Shoe Brake The Braking of a Vehicle (a) Value of Retardation When the Brakes are Applied to Rear Wheels Only (b) Value of Retardation When the Brakes are Applied to Front Wheels Only (c) Value of Retardation When the Brakes are Applied to All the Wheels Solve Problems Forced Vibrations for Systems with Two Degree of freedom. Solve Problems.
Week 13	Types of Followers Nomenclatures for Cam Profile Motions of the Follower (a) Uniform Motion or Uniform Velocity of a Follower Free Torsional Vibrations of a Three Rotor System. Torsional Equivalent Shaft. Solve Problems.
Week 14	(b) Simple Harmonic Motion of Follower (c) Uniform Acceleration and Uniform Retardation Cam profile construction Free Torsional Vibrations of a Three Rotor System. Torsional Equivalent Shaft. Solve Problems.
Week 15	Solve Problems

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Lab 1: How to balance rotating masses. Mass – Spring system.
Week 2	Lab 2: How to get force equilibrium.

	Simple and Compound Pendulums.
Week 3	Lab 3: Explain the principle work of gear and gear train. Mass Moment of Inertia Estimation-Part one: Bifilar Suspension.
Week 4	Lab 4: Explain the principle work of governor. Mass Moment of Inertia Estimation-Part two: Auxiliary Mass Method.
Week 5	Lab 5: How plane surface friction calculated. Undamped Forced Vibration.
Week 6	Lab 6: Explain friction of flat belt. Transverse Vibration of a Beam.
Week 7	Lab 7: How frictional clutch operate. Undamped vibration absorber.

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Recommended Texts	➢ "Theory of Machines", Burasia Publishing House (PVT.) Ltd, 1988, by Khurmi R. S. and Gupta J. K. ➢ "Theory of Machines", Laxmi Publications (P) Ltd, 2004, by Brar J. S. and Bansal R. K. ➢ "Theory of Machines", S. Chand & Company Ltd, 2005, Khurmi R. S. and Gupta J. K.	Yes

Grading Scheme
مخطط الدرجات

Group	Grade	التقدير	Marks (%)	Definition
Success Group (50 - 100)	**A** - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria

Fail Group (0 – 49)	**FX** – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.