UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY

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SCHOOL OF ENGINEERING

(NYARUGENGE CAMPUS)

DEPARTMENT OF CIVIL, ENVIRONMENTAL & GEOMATICS ENGINEERING

ACADEMIC YEAR: 2024-2025 Trim: II

"LECTURE PLAN"

Name of the Staff: **Ir. Philbert HABIMANA (MSc. & BSc.)**
Name of the TA: **----------**
Module Code and Name: **TRE1262 MECHANICS OF MATERIALS**
Year**: I TRE**
Period: **From 27/01/2025 to 16/05/2025**

WEEK	Date & Time	Topics Covered (including mention CAT, Tutorials and Practicals)
1	**27/01/2025**	**COURSE PRESENTATION:** Presentation of the course outline and description, Course objectives, Pre-requisites, Course references, Assessment criteria: ASS (Open-ended assignment), CATS and Final examination. **(i) INTRODUCTION TO ENGINEERING MECHANICS** **(i). 1.** Classification of engineering mechanics **(i). 2.** Basic terminologies in mechanics **(i). 3.** Laws of mechanics **(i). 4**. Derived laws **(i). 5.** Units **(i). 6.** Characteristics of a force **(i). 7.** System of forces
1	**27/01/2025**	**(ii) RESULTANTS OF FORCE SYSTEMS IN 1 D, 2 D AND 3 D** **(ii). 1.** 1 Dimension / Resultant **(ii). 2.** 2 Dimensions / Resultants **(ii). 3.** Composition of forces by method of resolution **(ii). 4.** 2 D Forces systems **(ii). 4. 1.** Rectangular components of force **(ii). 4. 2.** Resultants (2 D & 3D) rectangular component in space **(ii). 5.** 3 D Forces systems **(ii). 5. 1.** Rectangular components of a force in space **(ii). 6.** Composition of coplanar non-concurrent force system **(ii). 7.** Numerical examples
2	**03/02/2025**	**(iii) EQUILIBRIUM OF A FORCE** **(iii). 1.** Concepts **(iii). 2.** Lami's theorem **(iii). 3.** Problems involving the equilibrium of a particle **(iii). 4.** Resolution of a force **(iii). 5.** Rectangular components **(iii). 6.** Equilibrium of a particle **(iii). 7.** Numerical examples

2	**03/02/2025**	**(iv) TYPES OF LOADS** **(iv). 1.** Point load or concentrated load **(iv). 2.** Uniformly distributed load **(iv). 3.** Uniformly varying load **(iv). 4.** External moment (applied moment) **(v) TYPES OF SUPPORTS** **(v). i.** Roller support **(v). ii.** Pin/hinged support **(v). iii.** Fixed support **(vi) TRUSSES** **(vi). 1.** Free body diagrams **(vi). 2.** Support reactions **(vi). 3.** Method of joints **(vi). 4.** Method of sections **(vi). 5.** Numerical problems **(vii) STATIC DETERMINACY** **(vii). 1.** Trusses **(vii). 2.** Beams **(vii). 3.** Numerical problems **1st ASSIGNMENT**
3	**10/02/2025**	**(viii) PROPERTIES OF AREAS** **(viii). 1. Introduction** **(viii). 2. Centroid and/or centre of gravity** **(viii). 2. 1.** Concept of gravity **(viii). 2. 2.** Gravitational force **(viii). 2. 3.** Centroid and centre of gravity **(viii). 2. 4.** Methods for centre of gravity **(viii). 2. 5.** Numerical examples **(viii). 3. First moment of area or statical moment of area** **(viii). 3. 1.** What is a 1st /statical moment of area **(viii). 3. 2.** Methods for 1st /statical moment of area **(viii). 3. 3.** Numerical examples
3	**10/02/2025**	**(Viii). 4. Second moment of area or Moment of inertia** **(viii). 4. 1.** What is moment of inertia? **(viii). 4. 2.** Methods for moment of inertia **(viii). 4. 3.** Polar moment of inertia (Theorem of perpendicular axis) **(viii). 4. 4.** Theorem of parallel axis **(viii). 4. 5.** Numerical problems **(viii). 5. Section modulus** **(viii). 5. 1.** Section modulus **(viii). 5. 2.** Formulae/equation of section modulus **(viii). 5. 3.** Numerical examples **(viii). 6. Radius of gyration** **(viii). 6. 1.** Radius of gyration of an area **(viii). 6. 2.** Numerical examples **(viii). 7.** A typical application of properties of area
4	**17/02/2025**	**(ix) FRICTION** **(ix). 1.** Introduction **(ix). 2.** Coefficient of friction **(ix). 3.** Laws of dry friction **(ix). 4.** Angle of friction **(ix). 5.** Angle of repose

		(ix). 6. Cone of friction
4	**17/02/2025**	**(ix). 7.** Friction and its applications **(ix). 8.** Force of static friction **(ix). 9.** Force of kinetic friction **(ix). 10.** Rolling friction **(ix). 11.** Friction on a belt or a rope **(ix). 12.** Numerical problems
5	**24/02/2025**	**(x) DYNAMICS** **(x). 1.** Introduction **(x). 2.** Kinematics of a particle **(x). 2. 1.** Rectilinear motion **(x). 2. 2.** Types of application **(x). 2. 3.** Numerical problems **(x). 3.** Kinetics of particles **(x). 3. 1.** Method of work and energy **(x). 3. 1. 2.** Work **(x). 3. 1. 2. 1.** Work done **(x). 3. 1. 2. 2.** Work done against gravity **(x). 3. 1. 2. 3.** Work of a force **(x). 3. 1. 3.** Power **(x). 3. 1. 3. 1.** Power and efficiency **(x). 3. 1. 4.** Energy **(x). 3. 1. 4. 1.** Kinetic energy **(x). 3. 1. 4. 2.** Potential energy **(x). 3. 1. 4. 3.** The principle of work and energy **(x). 3. 1. 4. 4.** Work - energy relationship **(x). 3. 1. 4. 5.** Conservation of energy **(x). 3. 1. 4. 6.** Energy transformation **(x). 3. 1. 4. 7.** The flow of energy **(x). 3. 1. 4. 8.** Work – energy theorem **(x). 3. 1. 4. 9.** Conservation of energy when work is done **(x). 3. 1. 4. 10.** Numerical problems **SUBMISSION of the 1st ASSIGNMENT**
5	**24/02/2025**	**(x). 3. 2.** Circular or rotating motions **(x). 3. 2. 1.** Define radians **(x). 3. 2. 2.** Angular position **(x). 3. 2. 3.** Angular velocity **(x). 3. 2. 4.** Angular acceleration **(x). 3. 2. 5.** Relations between angular and linear quantities **(x). 3. 3.** Momentum, impulse and conservation of momentum **(x). 3. 3. 1.** Definition of impulse **(x). 3. 3. 2.** Definition of linear momentum **(x). 3. 3. 3.** Linear impulse and linear momentum **(x). 3. 3. 3. 1.** Linear impulse – Momentum principle **(x). 3. 3. 3. 2.** Impulse – Momentum equation **(x). 3. 3. 3. 3.** Impulse – Momentum diagram **(x). 3. 3. 3. 3. 1.** Impulsive forces **(x). 3. 3. 3. 3. 1.** Non-impulsive forces **2nd ASSIGNMENT**

	28/02/2025	**CAT-1 (Friday from 14:0 - 15:45 ; Einstein Block – 1R09)**
6	**03/03/2025**	**(xi). MECHANICAL PROPERTIES OF MATERIALS USED IN STRUCTURAL ENGINEERING, DESIGN AND CONSTRUCTION** **(xi). 1.** Introduction **(xi). 2.** Properties of materials **(xii). SIMPLE STRESSES AND STRAINS** **(xii). 1.** Simple stress **(xii). 1. 1.** Introduction **(xii). 1. 2.** Types of stresses: **(xii). 1. 2. 1.** Normal and shear stresses **(xii). 1. 2. 2.** Thermal stresses
6	**03/03/2025**	**(xii). 2.** Simple strains **(xii). 2. 1.** Volumetric and shear strains (**xii). 3.** Stress-strain diagram **(xii). 3. 1.** Permanent deformation **(xii). 3. 2.** Elongation **(xii). 3. 3.** Yield point **(xii). 3. 4.** Ultimate strength of material and rupture of material **(xii) .4.** Elastic constant **(xii). 4. 1.** Modulus of elasticity (*E*) **(xii). 4. 2.** Hooke's law **(xii). 4. 3.** Shear modulus or modulus of rigidity (*G*) **(xii). 4. 4.** Bulk modulus (*K*) **(xii). 4. 5.** Poisson's ratio (μ) **(xii). 4. 6.** Relationship between *K*, *E* and μ **(xii). 4. 7.** Relation between *K*, *G* and *E* **(xii). 5.** Load and stress limit **(xii). 5. 1.** Allowable stress **(xii). 5. 2.** working load **(xii). 5. 3.** Factor of safety **(xii). 5. 4.** Selection of factor of safety **(xii). 6.** Numerical problems
7	**10/03/2025**	**(xiii) STRAIN ENERGY** **(xiii). 1.** Introduction **(xiii). 2.** Strain energy in compression or tension **(xiii). 3.** Strain energy due to shear stress **(xiii). 4.** Numerical problems
7	**10/03/2025**	**(xiv). COMPOUND STRESSES AND STRAINS** **(xiv). 1.** Introduction **(xiv). 2.** State of stress at a point **(xiv). 3.** Principal planes and principal stresses **(xiv). 4.** Three special cases derived from general 2D system **(xiv). 4. 1.** Biaxial direct stress, **(xiv). 4. 2.** Uniaxial direct stress **(xiv). 4. 3.** Pure shear
8	**17/03/2025**	**(xiv). 5.** Mohr's cycle for stresses **(xiv). 5. 1**. Introduction of Mohr's cycle **(xiv). 5. 2.** construction of Mohr's cycle **(xiv). 6.** Principal strains and strain energy due to principal stresses **(xiv). 7.** Numerical problems

		(xv). EQUILIBRIUM OF BEAMS-SHEAR FORCE AND BENDING MOMENT **(xv). 1.** Introduction - Degree of indeterminacy **(xv). 2.** Types of loading **(xv). 2. 1.** Concentrated/point load, **(xv). 2. 2.** Uniform distributed load (UDL) **(xv). 2. 3.** Uniformly varying load (UVL) **(xv). 2. 4.** Applied couple/moment. **(xv). 3.** Types of beams **(xv). 3. 1.** Cantilever beam **(xv). 3. 2.** Simply supported beam **(xv). 3. 3.** Overhanging beam **(xv). 3. 4.** Fixed ends beam **(xv). 3. 5.** Continuous beam **SUBMISSION of the 2nd ASSIGNMENT**
8	**17/03/2025**	**(xv). 4.** Shear force and bending moment diagrams **(xv). 5.** Sign conventions for shear force and bending moment **(xv). 6.** Important points for drawing shear force and bending moment diagrams **(xv). 7.** Methods for construction shear force and bending moment diagrams in beams **(xv). 8.** Shear force and bending moment diagrams for simply supported beam with a point load at the centre of the beam **(xv). 9.** Shear force and bending moment diagrams for simply supported beam with an eccentric load **3rd ASSIGNMENT**
	21/03/2025	**CAT-2 (Friday from 14:00 - 15:45 ; Einstein Block – 1R09)**
9	**24/03/2025**	**(xv). 10.** Shear force and bending moment diagrams for a cantilever beam with appoint load at the free end **(xv). 11.** Shear force and bending moment diagrams for simply supported beam carrying a UDL **(xv). 12.** Shear force and bending moment diagrams for simply supported beam carrying a uniformly varying load from zero at one end to q per unit length at the other end **(xv). 13.** Relationships between load, SF and BM
9	**24/03/2025**	**(xv). EQUILIBRIUM OF BEAMS-SHEAR FORCE AND BENDING MOMENT** **(xv). 14.** Numerical problems
10	**31/03/2025**	**(xvi) BENDING AND SHEAR STRESSES IN BEAMS** **(xvi). 1.** Introduction **(xvi). 2.** Assumptions made in simple bending **(xvi). 3.** Theory of simple bending **(xvi). 4.** Expression for bending stresses **(xvi). 5.** Moment of resistance **(xvi). 6.** Bending stresses in symmetrical sections **(xvi). 7.** Section modulus **(xvi). 8.** Bending stresses in unsymmetrical sections **(xvi). 9.** Relationship between bending moment and bending stress **(xvi). 10.** Enhancing bending moment sign convention **(xvi). 11.** Some key observations **(xvi). 12.** Numerical problems

10	**31/03/2025**	**(xvi) BENDING AND SHEAR STRESSES IN BEAMS** **(xvi). 13.** Shear stresses in beams **(xvi). 13. 1.** Introduction **(xvi). 13. 2.** Shear stress formula **(xvi). 14.** Numerical problems
12	**14/04/2025**	**(xvii) COMBINED DIRECT AND BENDING STRESSES** **(xvii). 1.** Introduction **(xvii). 2.** Resultant stress when a column of rectangular section is subjected to eccentric load **(xvii). 3.** Stress distribution due to the position of the applied load **(xvii). 4.** Resultant stress when a column of rectangular section is subjected to a load which is eccentric to both axes **(xvii). 5.** Numerical problems
12	**15/04/2025**	**(xviii) DEFLECTION OF BEAMS** **(xviii). 1.** Introduction **(xviii). 2.** Relationships between loading, SF, BM, slope and deflection of a beam **(xviii). 3.** Methods for determining deflection in beams **(xviii). 4.** Formulae for slope and deflection of beams
	18/04/2025	**CAT-3 (Friday from 14:00 – 15:45 ;Einstein Block – 1R09)**
13	**21/04/2025**	**(xviii) DEFLECTION OF BEAMS** **(xviii). 5.** Numerical problems
13	**22/04/2025**	**(xix) TORSION** **(xix). 1.** Introduction **(xix). 2.** Pure torsion **(xix). 3.** Polar moment of inertia **(xix). 4.** Torsion rigidity **(xix). 5**. Power transmitted by a shaft **(xix). 6.** Composite shafts **SUBMISSION of the 3rd ASSIGNMENT**
14	**28/04/2025**	**(xix) TORSION** **(xix). 7.** Numerical problems
14	**29/04/2025**	**(xx) EXERCISES ON VARIOUS TOPICS**
15	**05/05/2025**	**(xx) EXERCISES ON VARIOUS TOPICS**
15	**06/05/2025**	**(xx) EXERCISES ON VARIOUS TOPICS**
16	**12/05/2025**	**(xx) EXERCISES ON VARIOUS TOPICS**
16	**13/05/2025**	**(xx) EXERCISES ON VARIOUS TOPICS**
17	**19/05/2025**	**REVISION WEEK**

- *Quizzes, Assignments, Site Visits and Reports, Mini Projects and Lab works are part of Continuous Assessment. Please follow the assessment criteria mentioned in the module description.* ***NO CATS will be conducted in REVISION WEEK.***
- *End of every week lectures, the class chief must bring this form to HOD for discussion and approval*