LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering (710)

Bachelor of Engineering (B.E.) – Semester - II

Course Code:	017102291		Teaching Scheme				
Course Name:	**Engineering Mechanics**		Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
Category of Course:	Engineering Science Course (ESC)		4	1	2	6	50
Prerequisite Course:	Mathematics - I (017101191), Physics (017101192)						

Syllabus				
Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Introduction**			5 (10%)
	1.1 Introduction of Mechanics, Fundamental concepts (Definition of scaler and vector quantities) and idealization of mechanics, Fundamental principles and laws of mechanics (Law of transmissibility, principle of superposition, equilibrium conditions)	---		
	1.2 Scalar and Vector Quantities	Basic physics (017101192-Unit-01)		
	1.3 System of Units			
02	**Coplanar Concurrent Forces**			6 (12%)
	2.1 Introduction of Force, Effect of force and Characteristics of force, Types of force, Type of force systems	Laws of motion (force and inertia) (017101192-Unit-1.3)	Governors (017103502- Unit-5.3), Balancing of Rotating Masses (017103601- Unit-1.1), Undamped Free Vibrations (017103601- Unit-4.1), Damped Forced Vibration (017103601- Unit-6.1, 6.6), Static Forces on Surface (017103491, Unit-3.1, 3.2, 3.4)	
	2.2 Principle of Transmissibility, Parallelogram Law of forces, Law of triangle of forces, Resultant of coplanar concurrent force system by analytical and graphical method	---		
	2.3 Resolution of a single force, Resolution method for coplanar concurrent force system	Laws of motion (force and inertia) (017101192-Unit-1.3)		
03	**Moments and Couples**			5 (10%)
	3.1 Moment of a force, Principle of moments, Couples, Equivalent couples	---	Flywheels- Turning Moment Diagram (017103392- Unit- 9.2), Contact stresses (017103402- Unit-4.2), Governors (017103502- Unit-6.1), Friction Devices: Brakes (017103502- Unit-8.3), Dynamometers and Strain Gauges (017103502- Unit-9.2), Balancing of Rotating Masses (017103601-Unit-1.2), Gyroscope (017103601-Unit-10.1,10.2), Buoyancy and Metacentric Height (017103491, Unit-4.4), Impact of Jet (017103491, Unit-2)	
	3.2 Characteristics of moment and couple	---		
	3.3 Varignon's theorem and its Application.	---		
04	**Coplanar Non-Concurrent Force System**			4 (8%)
	4.1 Introduction	---	Static Forces on Surface (017103491, Unit-3.1, 3.2, 3.4)	
	4.2 Resultant of coplanar non-concurrent force system	---		
05	**Equilibrium of Rigid Bodies**			5 (10%)
	5.1 Equilibrium, Resultant and Equilibrant	---	Pressures and Head (017103491, Unit-2.2), Buoyancy and Metacentric Height (017103491, Unit-4.2, 4.3)	
	5.2 Free body diagram and Lami's theorem	Trigonometry and geometry (017101191-Unit-02)		
	5.3 Condition of equilibrium for Coplanar concurrent forces and Coplanar non-concurrent forces	---		
06	**Support Reactions**			4 (8%)
	6.1 Types of load, supports and beams	---	Shear Force and Bending Moment (017103391- Unit- 4.1), Toothed Gears (017103392- Unit- 5.3), Levers (017103402- Unit-5.1)	
	6.2 Support reaction for Statically determinate beam	---		
07	**Friction**			6 (12%)
	7.1 Friction and its applications, Types of friction	Friction, power and torque (017101192-Unit-1.5)	Belt Drives (017103502- Unit-5.1), Friction Devices: Clutches (017103502- Unit-7.1), Friction Devices: Brakes (017103502- Unit-5.6), Theory of Metal Cutting (017103302, Unit-2.4), Resistance, Solid State and Thermochemical Welding processes (017103401, Unit-7.1 to 7.5), Limitations and Applications of Second Law of	
	7.2 Laws of dry friction	---		
	7.3 Angle of friction, Angle of repose, Coefficient of friction	---		
	7.4 Block Friction, Ladder friction, Wedge friction	---		

				Thermodynamics (017103403, Unit-5.2)	
08	**Centroid and Centre of Gravity**				**5 (10%)**
	8.1 Concept of centre of gravity	---	Flexural Stresses (017103391-Unit-5.3), Shear Stresses (017103502- Unit-5.6)	
	8.2 Centroids of Linear elements and Planar elements	---		
	8.3 Centroids of Composite sections (1D, 2D, 3D)	---		
09	**Moment of Inertia of Planar Cross Sections**				**5 (10%)**
	9.1 Concept of Moment of Inertia	Rigid body and inertia effects of rigid body (017101192-Unit-10.3)	Flexural Stresses (017103391-Unit-5.3), Shear Stresses (017103391- Unit-6.2), Torsion (017103391- Unit- 9.2), Flywheels (017103392- Unit- 10.1)	
	9.2 Derivation of equation of moment of inertia of standard lamina (Rectangle, Triangle, Circle) using first principle.	Basic differentiation and integration (017101191-Unit-03)		
	9.3 Polar moment of inertia, radius of gyration of areas	---		
	9.4 Parallel and perpendicular axes theorems and its application	---		
10	**Fundamentals of Kinematics and Kinetics of Particles**				**5 (10%)**
	10.1 Rectilinear motion, Curvilinear motion, Motion of rigid bodies, Velocity and acceleration (Definition and basic numerical).	---	Introduction of Mechanisms and Machines (017103392- Unit- 1.1), Kinematics: Velocity Analysis (017103392- Unit- 3.1), Kinematics: Acceleration Analysis (017103392- Unit- 4.1), Toothed Gears (017103392- Unit- 5.2), Flywheels- Turning Moment Diagram (017103392- Unit- 9.1), Flywheels (017103392- Unit- 10.1, 10.3)	
	10.2 Newton's law of motion, Energy and momentum	---		

Sr No.	Practical Title	Link to Theory Syllabus
1	Equilibrium of coplanar & concurrent forces.	Unit-2
2	Verification of Varignon's theorem.	Unit-3
3	Equilibrium of coplanar & Nonconcurrent forces.	Unit-4
4	To find support reaction for simply supported beams.	Unit-6
5	Friction apparatus.	Unit-7
6	Analysis of problems based on Block friction.	Unit-7
7	Analysis of problems based on Ladder friction.	Unit-7
8	Analysis of problems based on Center of gravity.	Unit-8
9	Analysis of problems based on Moment of inertia.	Unit-9
10	Velocity and Acceleration diagram for kinematic pair.	Unit-10

Major Components/ Equipment	
Sr. No.	**Component/Equipment**
1	Force Table, Pulleys, String, Dead Weight
2	Drawing Sheet, Wooden Board, Pulleys, String, Dead Weight
3	Simply supported beam, weighing scale, Dead weight
4	Inclined wooden plane, Wooden blocks, Strings
5	Drawing Sheet, Wooden Board, Pulleys, String

Proposed Theory + Practical Evaluation Scheme by Academicians (% Weightage Category Wise and it's Marks Distribution)					
L:	**4**	**T:**	**1**	**P:**	**2**
Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject. Each Test will be of 25 Marks. Each Test Syllabus Weightage: Range should be 20% - 30%					
Group (Theory or Practical)	**Group (Theory or Practical) Credit**	**Total Subject Credit**	**Category**	**% Weightage**	**Marks Weightage**
Theory	**5**	**6**	MCQ	17%	20
Theory			Theory Descriptive	0%	0
Theory			Formulas and Derivation	8%	10

					Numerical	58%	70
Theory					Numerical	58%	70
Expected Theory %	**83%**				**Calculated Theory %**	**83%**	**100**
Practical					Individual Project	0%	0
Practical					Group Project	0%	0
Practical		**1**			Internal Practical Evaluation (IPE)	12%	70
Practical					Viva	5%	30
Practical					Seminar	0%	0
Expected Practical %	**17%**				**Calculated Practical %**	**17%**	**100**
Overall %	**100%**					**100%**	**200**

Course Outcome

	Upon completion of the course students will be able to
1	Demonstrate and adopt understanding of various forces and their influences on practical engineering problems.
2	Analyze the impact of forces, moments, and couples on the stability of bodies, showcasing an ability to apply theoretical knowledge to real-world scenarios.
3	Apply fundamental concepts of friction, centroid and center of gravity. Also, analyze structural problems.
4	Develop the ability to employ theoretical knowledge in solving complex engineering problems related to the motion and forces acting on particles.

Suggested Reference Books

1	Engineering Mechanics by R S Khurmi, S. Chand Publications
2	Engineering Mechanics by S Bhavikatti
3	Engineering Mechanics (Statics and Dynamics) By Beer and Johnston
4	Mechanics of Materials By Beer and Johnston
5	Mechanics of Structures Vol-I By Junarkar S.B. and Shah H.J.; Charotar publishing house, Anand

List of Open Source Software/Learning Website

1	http://nptel.ac.in/
2	http://www.coursera.org
3	http://www.edx.org

Practical Problem/ Hands on Project

Sr. No.	Real Practical Problem/ Hands on Project	Linked with Unit
1	To understand basic definitions of Mechanics and its branches. To convert Unit systems in to the Working Unit System.	Unit 01
2	How to determine the resultant of a system of concurrent forces and how to resolve force vectors into given directions. Find Out Resultant force of all forces generated in the strings of parachute, to reduce the speed of free fall of the person.	Unit 02
3	Find force required to design a Door Closer, Steering mechanism, Screw jacks etc.	Unit 03,04
4	Find force required to lift the load in the construction site.	Unit 05
5	Find out support requirement of bridges.	Unit 06
6	Reduce the value of friction force for smooth the working of Bearings, belt rope drives. Calculate safe value of friction force in the case of ladders.	Unit 07
7	Calculate Centre of gravity and Moment of inertia in the unoccupied and occupied cases of wheel chair to ensure stability.	Unit 08, 09
8	Determine Projection territory of the cannon for complete range of angles.	Unit 10