GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (MACHINE DESIGN) (09)

ADVANCED ENGINEERING DYNAMICS

SUBJECT CODE: 2710907

M.E. 1st SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: This course addresses the fundamentals and techniques for the formulation and solution of problems in mechanics that lie within the realm of classical mechanics. The course aims to provide a strong working knowledge of both the important results of analytical mechanics and their application to engineering problems through numerical analysis

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
4	0	2	5	70	30	20	10	20	0	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Kinematics and Kinetics Of Particles**: Path Variables: Tangent and Normal, Parametric Description of curves, binormal direction and torsion of a curve; Rectangular Cartesian Coordinates; Curvilinear Coordinates: cylindrical and polar coordinates, spherical coordinates; Arbitrary curvilinear coordinates: Coordinates and unit vector, kinematical relations; Mixed kinematical description. Coordinate transforms: velocity and acceleration analysis using moving reference frame Generalized Newton's second Law, Work-Energy, Impulse-Momentum, Conservation of Energy and Momentum, Mass Flow: Steady and Variable.	20	25
2	**Rigid Bodies:** General Equations of constrained rigid body kinematics, Eulerian angles, Interconnections and Linkage, Rolling; Inertia effects of rigid bodies: Linear and angular momentum, Inertia properties, Rate of change of angular momentum.	10	20
3	**Newton-Euler Equations of Motion:** Fundamental Equations, Planar Motion, Newton-Euler Equations for a system, Momentum and Energy Principles. Application to modelling of single and two DOF system vibration problems.	09	20
4	**Lagrange's equation:** Generalized coordinates and kinematic constraints, virtual work, generalized forces, Derivation of Lagrane's Equation, Langrage's Multipliers. Application to modelling and analysis of simple mechanisms.	08	20
5	**Alternative Formulations:** Hamilton's principle, Generalized momentum principles, Formulations with Quasi-Coordinates. Application to modelling and analysis of simple mechanisms.	07	15

Reference Books:

1. Engineering Dynamics Jerry Ginsberg Cambridge University Press.
2. Dynamics: Theory and Application Thomas Kane and David Levinson McGraw-Hill, available at: http://ecommons.library.cornell.edu/handle/1813/638
3. Vector Mechanics for Engineers: Dynamics Beer F P, Johnston E R, Mazurek D F, Cornwell P J, McGraw-Hill.
4. Analytical Dynamics: A New Approach Udwadia F E and Kalaba R E Cambridge University Press.
5. Applied Dynamics: With Applications to Multibody and Mechatronic System F C Moon. Wiley.
6. Engineering Mechanics: Dynamics Merian J M and Kraige L G. Wiley India.
7. Analytical Dynamics Baruh H McGraw-Hill.
8. Introduction to Statics and Dynamics Ruina A, Pratap R available at: http://ruina.tam.cornell.edu/Book/

List of Experiments:

At least 8 Experiments should be designed to include the contents of the syllabus. The practical should be designed for computational exercise using Matlab or equivalent platform

Open Ended Problems:

1. Solve equation of motion of a particle following a path defined by an analytical equation and write a computer programme for the same.
2. Modelling and Analysis of Inertia Effects in simple mechanisms

Course Outcome:

After learning the course the students should be able to

1. Students will develop understanding kinetics of mechanical systems
2. Students will be model and analyse dynamic systems