GUJARAT TECHNOLOGICAL UNIVERSITY

AERONAUTICAL ENGINEERING (01)

ANALYSIS OF MECHANISM & MACHINE ELEMENTS

SUBJECT CODE: 2130103

B.E. 3RD SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Understanding the basic principle of theory of machine and machine design of engineering is required in aeronautical field

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)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to mechanism & machine : link, kinematic pair, degrees of freedom, classification of kinematic pairs, inversions of four bar chain, slide crank mechanism & double slider crank mechanism.	04	45
2	Velocity and Acceleration analysis – Velocity analysis: Absolute & relative motion, vectors, motion of a link, Velocity analysis of four-link mechanism & slider crank mechanism, angular velocity of links, velocity of rubbing, I- centre method, Kennedy's theorem, and centrode. Acceleration analysis: Acceleration, Acceleration analysis of four-link mechanism & slider crank mechanism,	10	
3	Force Analysis – Static force analysis: Introduction to static force analysis, superposition, principle of virtual work, Dynamic force analysis: D'Alembert's principle, dynamic analysis of slider crank chain, velocity & acceleration of piston, engine force analysis, inertia of connecting rod.	06	
4	Introduction to Simple Stresses : Definition, classification, general procedure, physical & mechanical properties of materials, stress strain diagram, Tensile stress & strain, compressive stress & strain, shear stress & strain, crushing & bearing stress, factor of safety, linear & lateral strain, Poission's ratio, volumetric strain, impact stress.	04	25
5	Riveted and Welded joints – Riveted joints: Methods of riveting, types of rivet heads, types of riveted joints, terminology, and strength of a riveted joint, efficiency of a riveted joint, riveted joints for structural use.	08	

	Welded joints: Advantages & disadvantages of welded joints over riveted joints, welding processes, types of welded joints, strength of transverse fillet welded joint, strength of parallel fillet welded joint, strength of butt joint, stresses on welded joints.		
6	Pressure vessels: Classification, stresses in thin shell cylinders due to internal pressure, Hoop stress, longitudinal stress, change in dimension, thick cylindrical shell subjected to internal pressure.	06	10
7	Shafts : Types of shafts, material of shafts, ASME codes for shaft design, stresses in shaft, design of shafts subjected to twisting moment only, design of shafts subjected to bending moment only, design of shafts subjected to combined twisting & bending, design of shafts subjected to axial load in addition to combined twisting & bending. Combined twisting & bending, design of shaft on the basis of rigidity.	07	20

Reference Books:

1. Shigley, J.E and Uicker, J.J: Theory of Machines and Mechanisms, Oxford University Press
2. Rattan S.S.: Theory of Machines Tata McGraw-Hill Publishing Co. Ltd. New Delhi,
3. Theory of Machines by R.S.Khurmi.
4. Wilson, Kinematics and Dynamics of Machinery, 3rd Edition, Pearson Education.
5. P.C Sharma and D. K. Aggarwal " Machine Design", S.K. Kataria & Sons 2009
6. V. B. Bhandari "Design of Machine Elements", Tata McGraw Hill Publishingc Co.
7. P.S. Gill, Machine Drawing by S.K. Kataria & Sons New Delhi
8. Design of Machine elements by R.S.Khurmi.

Course Outcome:

After learning the course the students should be able to

1. Understanding principles and law of analyzed the Mechanism.
2. To understand instantaneous centre method and kennedy's theorem, which are used to solve the kinematic & dynamic problem.
3. Students could be easily done the force analysis .
4. Understand the different types of stresses acting on machine elements and its analysis
5. How the design can be performed for riveted & welded joints, which are required for joining the wall structural elements for air-frame.
6. How the Thin wall pressure vessel can be designed for internal pressure ,longitudinal & circumferential stresses
7. Design of structural elements, which are subjected to torsional & bending moments.

List of Practicals:

1. To understand the construction and working principle of various types of mechanism.
2. To understand the construction of velocity analysis.
3. To understand the construction of acceleration analysis.
4. To understand the various types of welded and riveted joints.
5. To understand the various stresses and principle theory.
6. To understand the construction of Pressure vessel.
7. To understand uses of shaft and its construction and working.

Open Ended Problems:

1. Develop a various model of single and double slider crank chain mechanism.

2. Develop a prototype of various four bar chain mechanism.
3. Develop a prototype of shaft mechanism.
4. Develop a small pressure vessel.
5. Develop riveted and welded joints on thin sheet.

Major equipment: Model of Beam engine (crank and lever mechanism), Coupling rod of a locomotive (Double crank mechanism), Watt's indicator mechanism (Double lever mechanism), Pendulum pump or Bull engine , Oscillating cylinder engine ,Rotary internal combustion engine or Gnome engine , Crank and slotted lever quick return motion mechanism, Whitworth quick return motion mechanism , Elliptical trammels , Scotch yoke mechanism, Oldham's coupling and shaft mechanism.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.