Semester 3

B. Tech 2nd year (3rd Semester) Mechatronics

Course No.	Course Title	Teaching Schedule				Allotment Marks				Duration of Exam
		L	T	P	Total	Sessional	Theory	Practical	Total	
MT - 201	Digital Electronics	3	1	-	4	50	100	-	150	3
MT – 203	Essential Mechanics & Fluids	3	1	-	4	50	100	-	150	3
MT – 205	Instrumentation and Measurements	3	1	-	4	50	100	-	150	3
MT – 207	Mathematical Foundations for Engineers	3	1	-	4	50	100	-	150	3
HUM-201 E/ MATH-201E	Basics of Economics & Management/ Mathematics IIIrd	3	1	-	4	50	100	-	150	3
MT – 209	Theory of Machines-I	3	1	-	4	50	100	-	150	3
MT – 211	Digital Electronics Lab	-	-	2	2	25	-	25	50	3
MT – 213	Instrumentation and Measurements Lab	-	-	2	2	25	-	25	50	3
MT – 215	Essential Mechanics & Fluids Lab	-	-	2	2	25	-	25	50	3
MT - 217	Theory of Machines-I lab	-	-	3	3	50	-	50	100	3
	Total	18	6	9	33	425	600	125	1150	

Students are allowed to use single memory, non-programmable scientific calculator during examination.

MT-201

Digital Electronics

L	T	P
3	1	-

Sessional: 50 Marks
Theory: 100 Marks
Total: 150 Marks
Exam Duration: 3 Hours

UNIT 1

FUNDAMENTALS OF DIGITAL TECHNIQUES: Digital signal, logic gates: AND. OR, NOT. NAND. NOR- EX-OR, EX-NOR, Boolean algebra. Review of Number systems. Binary codes: BCD, Excess-3. Gray codes. COMBINATIONAL DESIGN USING GATES: Design using gates. Karnaugh map and Quine Mcluskey methods of simplification.

UNIT 2

COMBINATIONAL DESIGN USING MST DEVICES Multiplexers and Demultiplexers and their use as logic elements. Decoders. Adders / Subtracters. BCD arithmetic Circuits. Encoders. Decoders / Drivers for display devices.

SEQUENTIAL CIRCUITS: Flip Flops: S-R- J-K. T. D, master-slave, Conversion of one flip-flop to another flip flop, excitation table, edge triggered- shift registers, its types: SISO, PISO,PIPO,SIPO. Counters. Asynchronous and Synchronous Ring counters and Johnson Counter, Design of Synchronous and Asynchronous sequential circuits.

UNIT 3

DIGITAL LOGIC FAMILIES: Switching mode operation of p-n junction, bipolar and MOS-devices. Bipolar logic families: RTL, DTL, DCTL. HTL, TTL, ECL, MOS, and CMOS logic families. Tristate logic. Interfacing of CMOS and TTL families.

UNIT 4

A/D AND D/A CONVERTERS: Sample and hold circuit, weighted resistor and R -2 R ladder D/A Converters, specifications for D/A converters. A/D converters: Quantization, parallel -comparator, successive approximation, counting type. Dual-slope ADC, specifications of ADCs. PROGRAMMABLE LOGIC DEVICES: ROM, PLA. PAL, Introduction to FPGA and CPLDs.

TEXT BOOK: 1. Modem Digital Electronics (Edition III): R. P. Jain; TMH

REFERENCE BOOKS: 1. Digital Integrated Electronics: Taub & Schilling: MGH 2. Digital Principles and Applications: Malvino & Leach: McGraw Hill. 3. Digital Design: Morris Mano: PHI,

Note:-

Examination :- The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

Assignment :- Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

Learning outcomes(LO's)

1. Solve a range of problems in electronics choosing an appropriate solution procedure and making use of the underlying concepts and principles	Application, Knowledge & Understanding
2. Interpret qualitative and quantitative data relating to electronics practical work and Communicate the results of the work by written reports and presentations, Incorporating structured coherent argument	Knowledge, Understanding, Reflection and Team working

MT-203

Essential Mechanics & Fluids

L	T	P
3	1	-

Sessional: 50 Marks
Theory: 100 Marks
Total: 150 Marks
Exam Duration: 3 Hours

Unit 1

Simple stresses & strains : Concept & types of Stresses and strains, Polson's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical.

Compound stresses & strains: Concept of surface and volumetric strains, two dimensional stress system, conjugate shear stress at a point on a plane, principle stresses & strains and principal- planes, Mohr's circle of stresses, Numerical.

Unit II

Shear Force & Bending Moments : Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexture under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii)combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Problems.

Torsion of circular Members : Torsion of thin circular tube, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, combined bending and torsion, equivalent torque, effect of end thrust. Numerical.

Unit III

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium. Problems. Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net. Problems.

Unit IV

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, venturimeter, orifices, orificemeter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications. Problems.Potential Flow:

Uniform and vortex flow, flow past a Rankin half body, source, sink, source-sink pair and doublet, flow past a cylinder with and without circulation. Problems.

TEXT BOOKS

1. Ramamurtham.S and Narayanan.R, "*Strength of material"*, Dhanpat Rai Pvt. Ltd., New Delhi, 2001.
2. Bansal.R.K, "*Strength of Material"*, Lakshmi publications Pvt. Ltd., New Delhi, 1996.
3. Kumar.K.L, "*Engineering Fluid Mechanics"*, Eurasla publishers Home Ltd., New Delhi, 1995.
4. Bansal.R.K, "*Fluid Mechanics and Hydraulic Machines"* , Laxmi publications (P) Ltd., New Delhi, 1995.
5. Popov.E.P, "*Mechanics of Materials"*, Prentice Hall, 1982.
6. Timoshenko.S.P and Gere .M.J, "*Mechanics of Materials"*, C.B.S. publishers, 1986.

REFERENCES

1. Ferdinand P. Beer and Russell Johnston.E, "*Mechanics of Materials"*, SI metric Edition McGraw Hill, 1992
2. Srinath.L.N, "*Advanced Mechanics of Solids",*Tata McGraw Hill Ltd., New Delhi.
3. Ramamurthan.S, "*Fluid Mechanics and Hydraulics"*, Dhanpat Rai and Sons, Delhi, 1988.
4. Fox R.W and Mc. Donald .A.T, "*Introduction to fluid Mechanics"*, 5th Ed. John Wiley and Sons, 1999.

Note:-

Examination :- The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

Assignment :- Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

Learning outcomes(LO's)

1. Understand and estimate the stresses and deformation in solid bodies under the action of forces.
2. Understand and estimate the shear force and bending moment in different types of beams under the action of different types of loads.
3. Understand and estimate the displacement and stresses in deformable bodies under the action of forces and torque.
4. Understand the concepts and to solve problems in fluid statics, fluid kinematics and incompressible fluid dynamics.

MT - 205

Instrumentation and Measurements

L	T	P
3	1	-

Sessional: 50 Marks
Theory: 100 Marks
Total: 150 Marks
Exam Duration: 3 Hours

UNIT-I:

MEASUREMENT AND ASSOCIATED ERRORS: Methods of Measurement, Classifications of instruments, Errors in measurements and their analysis.

MEASUREMENT OF LOW, MEDIUM AND HIGH RESISTANCES: Wheat stone bridge, Carey-Foster Bridge, Kelvin double bridge, Measurement of Insulation resistance.

UNIT-II:

MEASUREMENT OF INDUCTANCES AND CAPACITANCES: A-C BRIDGES: Maxwell Inductance bridge. Maxwell Inductance Capacitance Bridge, Anderson's Bridge, Hay's Bridge, De-Sauty's Bridge, Schering's bridge and Wein's bridge.

INDICATING AND RECORDING DEVICES: Analog voltmeters, X-Y recorder, D.C Crompton's potentiometer, Oscillographs, Cathode - Ray Oscilloscopes, Energy Meter. Magnetic Measurements: Ballistic Galvanometers, Flux Meter, B-H Loop.

UNIT-III:

ELECTRONIC INSTRUMENTS: Wave analyzer, Distortion meter: Q-meter, CRO: Lissojous Pattern, CRT, Op-Amp circuits.

DIGITAL MEASUREMENTS:Concept of digital measurements,Comparison between analog type and digital display methods, digital voltmeter, frequency meter, spectrum analyzer.

UNIT-IV:

TRANSDUCERS: Classification of Transducers and their signal conditioning, Measurement

of displacement, velocity and acceleration (translational and rotational), force, torque, vibration and shock. Measurement of pressure, flow, temperature and liquid level. Measurement of pH, conductivity, viscosity and humidity.

Mathematical Foundations For Engineers

MT-207

L	T	P
3	1	-

Sessional: 50 Marks
Theory: 100 Marks
Total: 150 Marks
Exam Duration: 3 Hours

UNIT – I

Principle of Mathematical Induction:
Process of the proof by induction, motivating the application of the method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications.

Sets :
Sets and their representations. Empty set. Finite and Infinite sets.Equal sets.Subsets.Subsets of a set of real numbers especially intervals (with notations). Power set. Universal set. Venn diagrams. Union and Intersection of sets. Difference of sets. Complement of a set. Properties of Complement Sets.

UNIT-II

Binomial Theorem: Statement and proof of the binomial theorem for positive integral indices. General and middle term in binomial expansion, simple applications.

Sequence and Series: Sequence and Series. Arithmetic Progression (A. P.). Arithmetic Mean (A.M.) Geometric Progression (G.P.), general term of a G.P., sum of first n terms of a G.P., infinite G.P. and its sum, geometric mean (G.M.), relation between A.M. and G.M.

UNIT-III

Mathematical Reasoning: Mathematically acceptable statements. Connecting words/ phrases - consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics.

Validating the statements involving the connecting words, Difference between contradiction, converse and contrapositive.

UNIT-IV

Statistics: Measures of position - mean, median, mode,

Measure of dispersion - range, inter-quartile range, variance, standard deviation, Measure of skewness

Text Book

1. Foundation Mathematics, A. Croft and R. Davidson, Addison-Wesley 1997, ISBN: 0201178044
2. Discrete Mathematics for Computer Scientists, J. Truss, Addison-Wesley 1999, ISBN: 0201360616

DATA ACQUISITION SYSTEMS: Elements of data acquisition systems, Analog to Digital and Digital to Analog converters, Analog and Digital Data Acquisition Systems, Interfacing of transducers, Multiplexing, Telemetry.

TEXT BOOK: A Course in Electrical and Electronics Measurements and Instrumentation: A.K. Sawhney; Dhanpat Rai & Sons.

REFERENCE BOOKS: 1. Electronics Instrumentation and Measurement Techniques: Cooper W.D & Helfrick A.D.; PHI 2. Doeblin E.O., Measurement Systems: Application & Design, Mc Graw Hill.

Note:-

Examination :- The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

Assignment :- Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

Learning outcomes(LO's)

1. Describe the basic principles of instrumentations and measurements associated with Engineering, design and the general technology applications.	Knowledge & Understanding
2. Use and calibrate common sensors and instruments.	Application & Enquiry
3. Select an appropriate sensor/s and instrument/s for the task under consideration.	Team Working

Reference Book

1. Advanced Engg. Mathematics : E. Kreyzig
2. Higher Engg. Mathematics : B.S. Grewal

Note:-

Examination :- The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

Assignment :- Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

Learning outcomes(LO's)

1) Understand about Binomial Theorem, PMI and Sets
2) Understand about Mathematical Reasoning & Statistics

MATHEMATICS - III
MATH-201E

L	T	P
3	1	-

Sessional: 50 Marks
Theory: 100 Marks
Total: 150 Marks
Exam Duration: 3 Hours

UNIT – I

Fourier Series : Euler's Formulae, Conditions for Fourier expansions, Fourier expansion of functions having points of discontinuity, change of interval, Odd & even functions, Half-range series.

Fourier Transforms : Fourier integrals, Fourier transforms, Fourier cosine and sine transforms. Properties of Fourier transforms, Convolution theorem, Perseval's identity, Relation between Fourier and Laplace transforms, Fourier transforms of the derivatives of a function, Application to boundary value problems.

UNIT-II

Functions of a Complex Variables : Functions of a complex variable, Exponential function, Trigonometric, Hyperbolic and Logarithmic functions, limit and continuity of a function, Differentiability and analyticity.

Cauchy-Riemann equations, Necessary and sufficient conditions for a function to be analytic, Polar form of the Cauchy-Riemann equations, Harmonic functions, Application to flow problems, Conformal transformation, Standard transformations (Translation, Magnification & rotation, inversion & reflection, Bilinear).

UNIT-III

Probability Distributions : Probability, Baye's theorem, Discrete & Continuous probability distributions, Moment generating function, Probability generating function, Properties and applications of Binomial, Poisson and normal distributions.

UNIT-IV

Linear Programming : Linear programming problems formulation, Solution of Linear Programming Problem using Graphical method, Simplex Method, Dual-Simplex Method.

Text Book

3. Higher Engg. Mathematics : B.S. Grewal
4. Advanced Engg. Mathematics : E. Kreyzig

Reference Book

1. Complex variables and Applications : R.V. Churchil; Mc. Graw Hill
2. Engg. Mathematics Vol. II: S.S. Sastry; Prentice Hall of India.
3. Operation Research : H.A. Taha
4. Probability and statistics for Engineer : Johnson. PHI.

Note:-

Examination :- The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

Assignment :- Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

Learning outcomes(LO's)

1) Understand about Fourier Transforms and series and Probability Distributions.
2) Understand about Functions of a Complex Variables and Linear Programming.

THEORY OF MACHINES-I
MT 209

L	T	P	
3	1	-	**Sessional: 50 Marks**
			Theory: 100 Marks
			Total: 150 Marks
			Exam Duration: 3 Hours

UNIT I

Kinematics, introduction to analysis and 1, Kinematics' pairs, Degree of freedom, Dynamitic chain mechanism, Machine, Four-bar chain, inversions, Single and double slider crank chain, Quick return mechanisms, Introduction to function generation, Path generation and rigid bodied guidance.

Velocity determination; Relative velocity methods, Instantaneous center method Acceleration determination, Kennedy's Space cent rode and body cent rode,

UNIT II

Centripetal and tangential accelerations, Acceleration determination by graphical method using velocity polygons, Cariole's component of acceleration, Klein's and other constructions.

Introduction, Velocity and Acceleration of a Particle Moving with Simple Harmonic Motion, Differential Equation of Simple Harmonic Motion, Terms Used in Simple Harmonic Motion, Simple Pendulum, Laws of Simple Pendulum, Closely-coiled Helical Spring. Compound Pendulum, Centre of Percussion, Bifilar Suspension, Trifilar Suspension (Torsional Pendulum).

UNIT III

Pantograph, straight-line motion mechanisms (Peculiar, Hart, Scott Russell, Grasshopper, Watt, Kemp's Tchybishev, Parallel linkages) Indicator mechanisms (Simplex Crosby, Thomson, etc) Automobile steering gears (Davis and Ackerman), Hooks joint (universal coupling), Double hooks joints.

Types of friction, Laws of dry friction, Motion along inclined plane Screw threads, Wedge, Pivots and collars, Plate and cone clutches, Antifriction bearings, friction circle and friction axis, bearings and lubrication. Motion along inclined plane and screws, Pivots and Collars Thrust Bearings lubrication

UNIT IV

Types of cams and followers, various motions of the follower, Construction of cam profiles, Analysis for velocities and accelerations of tangent and circular arc cams with roller and flat –faced followers.

Open and crossed belt drives, velocity ratio, slip , material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts ratio of tensions, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drive, chain length, classification of chains

Suggested reading:

1. Theory of machines: S. S. Rattan, Tata McGraw Hill Publications
2. Theory of Mechanism and Machines: Jagdish Lal, Metropolitan Book Co.
3. Mechanism synthesis and analysis: A.H. Soni, McGraw Hill Publications.
4. Mechanism: J.S. Beggs.
5. Mechanics of Machines: P.Black, Pergamon Press.
6. Theory of Machines: P.L.Ballaney, Khanna Publisher.

Note:-

Examination :- The Examiners will set eight questions, taking two from each unit. The students are required to attempt five questions in all selecting at least one from each unit. All questions will carry equal marks.

Assignment :- Assignment based upon learning outcomes, as mention below, will be set by lecturer where the student will be required to achieve the LO's as mentioned below. The assessment of assignment will be done based upon the learning made by the student.

Learning outcomes(LO's)

1) Understand about Velocity determination
2) Understand about Pantograph, straight-line motion mechanisms
3) Understand about Types of cams and followers and various motions

MT-211

Digital Electronics Lab

L	T	P
-	-	2

Sessional: 25 Marks
Practical: 25 Marks
Total: 50 Marks
Duration of Exam:3 Hrs

List of Experiment

Note:- Student will be required to perform total of 10 experiment. 7 experiments will be from the below given list and 3 experiments will be designed based upon the curriculum.

- For Learning outcomes refer to Digital Electronics (MT-201).

1. Familiarization with Digital Trainer Kit and associated equipment.
2. Verify Truth Table of TTL gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
3. Design and realize a given function using K-Maps and verify its performance.
4. To verify the operation of Multiplexer and Demultiplexer.
5. To verify the operation of Comparator.
6. To verify the truth table of S-R, J-K, T, D Flip-flops.
7. To verify the operation of Bi-directional shift register.
8. To design and verify the operation of 3-bit asynchronous counter.
9. To design and verify the operation of synchronous Up/down counter using J-K flipflops & drive a seven-segment display using the same
10. To design and verify the operation of asynchronous Decade counter.
11. Study of TTL logic family characteristics.
12. Study of Encoder and Decoder.
13. Study of BCD to 7 segment Decoder.

MT - 213

Instrumentation and Measurement Lab

L	T	P	
-	-	2	**Sessional: 25 Marks**
			Practical: 25 Marks
			Total: 50 Marks
			Duration of Exam:3 Hrs

Note:- Student will be required to perform total of 10 experiment. 9 experiments will be from the below given list and 1 experiments will be designed based upon the curriculum.

- For Learning outcomes refer to Instrumentation and Measurement (MT-205).

List of Experiments

1. To measure the unknown Inductance in terms of capacitance and resistance by using Maxwell's Inductance bridge.
2. To measure unknown Inductance using Hay's bridge.
3. To measure unknown capacitance of small capacitors by using Schering's bridge.
4. To measure 3-phase power with 2-Wattmeter method for balanced and unbalanced bridge.
5. To measure unknown capacitance using De-Sauty's bridge.
6. To measure unknown frequency using Wein's frequency bridge.
7. To measure unknown low resistance by Kelvin's Double bridge.
8. To test the soil resistance using Meggar (Ohm meter).
9. To calibrate Energy meter using standard Energy meter.
10. To plot the B-H curve of different magnetic materials.
11. To calibrate the Voltmeter using Crompton Potentiometer.
12. To convert the Voltmeter into Ammeter using Potentiometer.
13. Insulation testing of cables using Digital Insulation Tester.

MT - 215

Essential Mechanics and Fluids Lab

L	T	P
-	-	2

Sessional: 25 Marks
Practical: 25 Marks
Total: 50 Marks
Duration of Exam:3 Hrs

NOTE:

1. At least ten experiments/ jobs are to be performed/ prepared by students in the semester.

2. At least 8 experiments/ jobs should be performed/ prepared from the below list, remaining two may either be performed/ prepared from the above list or designed & set by the concerned institution as per the scope of the syllabus of Essential Mechanics and Fluids and facilities available in the institute.

3. For Learning outcomes refer to Essential Mechanics and Fluids (MT-203).

LIST OF EXPERIMENTS

1. To perform Torsion test on mild steel specimen
2. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
3. To perform any one hardness test (Rockwell, Brinell & Vicker's test) and determine hardness of materials.
4. To perform compression test on C.I. and to determine ultimate compressive strength.
5. A simply supported beam is carrying point loads, Uniformly distributed load and uniformly varying loads. Draw the SFD and BMD for the beam.
6. To find the moment of inertia of fly wheel.
7. To compare the actual value of pressure with calculated value with centre of pressure apparatus.
8. To determine the hydrostatic force on a curved surface under partial submerge and full submerge condition.
9. To perform Charpy and Izod impact test on steel specimen
10. To perform Double shear test on steel specimen
11. To perform Compression test on brick
12. Determination of coefficient of discharge of orifice meter
13. Determination of coefficient of discharge of venturi meter
14. Major losses in pipe flow
15. Verification of Bernoulli's theorem
16. Minor losses - expansion and contraction losses in pipes

THEORY OF MACHINES-I LAB.

MT 217

L	T	P
-	-	3

Sessional: 50 Marks
Practical: 50 Marks
Total: 100 Marks
Duration of Exam: 3 Hrs

NOTE:

1. At least ten experiments/ jobs are to be performed/ prepared by students in the semester.

2. At least 7 experiments/ jobs should be performed/ prepared from the below list, remaining three may either be performed/ prepared from the above list or designed & set by the concerned institution as per the scope of the syllabus of Kinematics of Machine and facilities available in the institute.

3. For Learning outcomes refer to Theory of Machine (MT-209).

List of experiments

1. To determine the modulus of rigidity of the material of a closed coil helical spring and the stiffness of a spring
2. To determine the value of coefficient of friction for a given pair of surfaces using friction apparatus
3. To determine the modulus of rigidity of horizontal shaft
4. To determine experimentally the ratio of the cutting time to idle time (cutting stroke to idle stroke) of the crank and slotted lever (QRM)/ Whitworth and compare the result to theoretical values plot the following
    a. θ v/s X (displacement of slider).
    b. θ v/s velocity.
    c. θ v/s Acceleration and to compare the values of velocities
    (Take angles θ =45˚, 90˚, 135˚, 225˚, 270˚ &335˚, ω = 1 rad/s)
5. To determine the value of coefficient of friction between the screw and nut of the jack, while:
    a. Raising the load
    b. Lowering the load
6. To draw experimentally a curve of the follower-displacement v/s cam-angle. Differentiate the above curve to get velocity and acceleration plot and compare the values with those obtained analytically.
7. To determine the coefficient of friction between belt and pulley and plot a graph between $\log_{10} T_1/T_2$ v/s, θ.
8. To determine the displacement, velocities, & accelerations of the driven shaft of a Hooke's joint for a constant speed of the driver shaft.
9. Study of bifilar and trifilar suspension system
10. Study of the inversions of the single slider crank mechanism.
11. To verify the law of moment using Bell- crank lever.