DYNAMICS LABORATORY

AIM:
To apply the knowledge gained in kinematics and dynamics of machines to real system.

OBJECTIVES:
- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS:
1. Study of gear parameters.
2. Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
3. Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms
4. Kinematics of single and double universal joints.
5. Determination of Mass moment of inertia of Fly wheel and Axle system.
6. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
7. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
8. Motorized gyroscope – Study of gyroscopic effect and couple.
9. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell and Hartnell Governors.
10. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
11. Single degree of freedom Spring Mass System – Determination of natural frequency and verification of Laws of springs – Damping coefficient determination.
12. Multi degree freedom suspension system – Determination of influence coefficient.
13. Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.
14. Vibration Absorber – Tuned vibration absorber.
15. Vibration of Equivalent Spring mass system – undamped and damped vibration.
16. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
17. Balancing of rotating masses.
18. Balancing of reciprocating masses.
19. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
20. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
21. Determination of transmissibility ratio using vibrating table.

1. Tachometers – Contact and non contact
2. Dial gauge
3. Stroboscope
4. Accelerometers – Vibration pickups
5. Displacement meters.
6. Oscilloscope
7. Vibration Shaker
8. F.F.T. Analyzer and
9. Dynamic Balancing Machine.

AATDL01 CAM ANALYSIS APPARATUS

AATDL01 CAM Apparatus consists of a cam profile and study of cam follower system. The instrument consists of cam mounted shaft supported by ball bearing upon which three different type of cam can be mounted. The push rod for follower is supported vertically which can adopt three different type of followers that can be changed easily. Motor rotates the cam and dial gauge is provided for plotting of follower displacement W.R.T. cam position. Cam jump speed can be found by operating different speed and effect of speed and spring force on jump speed can also be studied.

UTILITIES REQUIRED:

Electricity 0.5 kW, 220 , Single Phase ; Stroboscope (Optional).

TECHNICAL DETAILS:

Cam Shaft: Material Stainless Steel
Cams: Tangent, Eccentric, Circular Arc type.
Followers: Roller, Knife edge, Mushroom
Compression Spring
Weights: 1 kg., 500gm, 200 gm & 100gm
Motor: Variable speed, ½ HP, 0-1500 RPM with speed controller
Dial Gauge: Baker & Mercer/Standard Make
Cam A : Base Dia 25 mm, Nose Dia 7mm Angle Of Sweep - 120°, Lift - 10mm
Cam B : Offset Cam
Motor : 1/8 hp AC, 230V
Followers: Knife-edged follower, Roller follower Mushroom follower, oscillating follower
L.C for Lift measurement: 1mm
Dimension (L X B X H) : 500 X 400 X 500 mm
Overall weight: 25kg
Cam A: Base Dia 25 mm, Nose Dia 7mm Angle Of Sweep - 120°, Lift - 10mm
Cam B: Offset Cam
Motor : 1/8 hp AC, 230V
Followers : Knife-edged follower, Roller follower Mushroom follower, Oscillating follower
L.C for Lift measurement: 1mm
Dimension (L X B X H): 600 X 400 X 500 mm
Overall weight : 25kg

AATDL02 MOTORIZED GYROSCOPIC APPARATUS

AATDL02 consist of heavy stainless steel disc mounted on a horizontal shaft, rotated by a variable speed motor. The rotor shaft is coupled to a motor mounted on a trunion frame having bearings in a yoke frame which is free to rotate about vertical axis. A weight pan on other side of disc balances the weight of motor. Rotor disc can be move about three axis. Torque can be applied by calculating the weight and distance of weight from the center of rotor. The gyroscopic couple can be determined.

UTILITIES REQUIRED:

- Electricity 220 V, Single Phase; Tachometer.
- Stop Watch Electronic
- Weights: 2 kg, 1 kg, ½ kg
- Stainless Steel
- Accurately marked scale & pointer to measure precession rate

TECHNICAL DETAILS:

- Materials : Stainless Steel
- Disc rotor-30 cm dia.10 m.m. Thick.
- Drive-A.C./D.C. single phase motor.
- Overall size-30 cm dia. base, 60 cm. height.
- Weight- 1kg, 750 gms, 500 gms

EXPERIMENTS:

- To study the gyroscopic effect of the rotating disc
- Observation of gyroscopic effect of rotating disc
- Experimental justification of equation for calculating the gyroscopic couple by observation and measurements of results for independent vibrations in applied couple T and precession wp.

AATDL03 GOVERNOR APPARATUS

AATDL03 Governor Apparatus drive unit consists of a DC electric motor connected through belt and pulley arrangement. Motor and test set up are mounted on a M.S. fabricated frame. The governor spindle is driven by motor through V belt and is supported in a ball bearing. The optional governor mechanisms can be mounted on spindle. Digital speed is controlled by the electronic control unit. The rpm indicator with sensor is used to determine the speed. A graduated scale is fixed to the sleeved and guided in vertical direction. The center sleeve of the porter and propel governors incorporates a weight sleeve to which weights may be added. The hart Nell governor provides means of varying spring rate and initial compression level and mass of rotating weight. This enables the hart Nell governor to be operated as a stable or unstable governor. The unit is designed to exhibit the characteristics of the spring loaded governor and dead weight governor.

UTILITIES REQUIRED:

50/60 Hz, as standard supply ± earthed A.C. Single Phase Electrical Supply, 200/250V
Weights: 2 kg, 1 kg, ½ kg

TECHNICAL DETAILS:

- Spindle - Material Stainless Steel
- Governor Mechanism : Four different types of governor mechanism with spring and weights.

  Watt Governor
  Porter Governor
  Hartnell Governor
  Proell Governor

- Motor :0.5HP Variable speed Motor.
  Control Panel For speed control of motor

EXPERIMENTS:

- For all type of governors.
  A) Determination of characteristic curve of sleeve position against speed of rotation.
  B) Derivation of the actual controlling force curves from the above characteristic and Comparison with theoretically predicted controlling force curves.
- Porter and Proell governors.
  A) The effect of varying the mass of the centre sleeve.
- Hartnell governor.
  A) The effect of varying spring compression

Nomenclature	Specifications
Dimension (L X B X H)	500 X 420 X 500mm
Motor	1/2 hp AC, 230V, 3F
Minimum Equilibrium Position	12mm.
Max Equilibrium Position	115 mm.
Arm length	U-110mm, L- 175mm.
Resolution of linear measurement	0.5mm.
Central load(Hartnell)	1kg.
Overall weight	45kg.

AATDL04 WHIRLING OF SHAFTS

This apparatus (AATDL04) displays various modes of whirl for a range of shafts with both free ends, and with one fixed end and other free end. The experiments can be conducted on various shaft diameters. This efficient device is highly beneficial in studying the phenomenon of whirling of shafts for different end conductors and determining whirling frequency for various nodes.

UTILITIES REQUIRED:

- 50/60 Hz, as standard supply ± earthed A.C. Single Phase Electrical Supply, 200/250V

TECHNICAL DETAILS:

- Shafts made from steel and of the following nominal dimensions.
- Diameter mm. (inch) Length mm. (inch).
  4.5 or (3/16) 900 or (36).
  6 or (1/4) 900 or (36).
  7.5 or (5/16) 900 or (36).
- One kinematic coupling and bearing for fixed or free ends without resistance .
- An electric motor: Universal, 5000 rev/min. frictional horse power.
- A dimmer stat for controlling speed of motor.
- Services Required:
- Suitable floor space area to mount the instrument.
- 230 V., 15 A. A. C. electric supply with earthing connection.
- Tachometer to measure the speed.

EXPERIMENTS:

- Display of the various modes of whirl for a range of shafts with
- Both ends directionally free
- One end fixed and the other free
- Modes of vibration can be studied & The Frequency can be measured in each case
- Experiments can be performed on various shaft diameters

AATDL05 STATIC AND DYNAMIC BALANCING

This apparatus(AATDL05) can be used effectively for simple demonstrations and experiments in the dynamic balancing of rotating and reciprocating systems. The rotating system is essentially a shaft, mounted on bearings, supported in a rigid frame, and driven by a small variable speed motor attached to the frame. Four discs, to which masses may be attached, are rigidly secured to the shaft. Each disc is suitably drilled and the sets of holes are positioned so that various conditions of un-balance in a rotating system can be simulated and the normal methods used to determine the magnitude and position of the counter-balance masses.

The unit is supported on springs attached to the main support frame so that the oscillations set up by any unbalanced forces may be observed. The centre section of the shaft is in the form of a crank. A sleeve, piston and connecting rod are provided and may be fitted to the unit so that single cylinder engine balance conditions can be simulated. Various sector plates of suitable mass can be attached to the two inner discs so that the student can observe the effect on the oscillations of various conditions of partial balance of the reciprocating masses.

UTILITIES REQUIRED: A.C. Single Phase Electrical Supply, 200/250V

TECHNICAL DETAILS:

- Precision shaft mounted in ball bearings to a study frame.
- Slotted adjustable discs - 4 nos
- Calibrated weight - 8 nos
- A small motor to rotate the shaft - 1/6 HP
- Dimension (L x B x H) - 600 x 300 x 600 mm

EXPERIMENTS:

- Static balancing of system using steel balls
- Dynamic balancing of a simple rotating mass system.
- Observation of effect of unbalance in a rotating mass system

AATDL06 VIBRATION TEST APPARATUS

Universal Vibration Test Rig(AATDL06) apt for conducting various experiments such as single pendulum, compound pendulum, bifilar suspension for determination of M.I., spring mass system with damped vibrations and others. Advanced machines and equipment are used to manufacture this apparatus so that it results in better functionality and provides precise outputs. A mechanical oscillation recorder and digital indicator for indicating forcing frequency, a stop clock to measure the time period are given.

UTILITIES REQUIRED: A.C. Single Phase Electrical Supply, 200/250V

TECHNICAL DETAILS:

- Dimension (L X B X H) - 1200 x 1000 x 1200 mm
- Motor - 1/6 hp Dc
- Beam - 1200mm and 800 mm length
- Speed measurement - Digital, 4-digit display with proximit
- Speed Controller - 0 -230V
- Damper type - hydraulic (smooth movable)
- Recorder - Graphical type
- Motor (Recorder) - fractional hp Geared type
- Coupling - vibrating set up is coupled with driver motor
- Using flexible coupling. (Spring type)
- Overall weight - 82kg(approx)

EXPERIMENTS:

- Simple Pendulum and Compound Pendulum
- Bifilar Suspension for determination of M.I
- Spring mass System with damped vibrations
- Spring mass System with undamped vibrations
- Equivalent Spring Mass System
- Torsional Vibrations Single Rotor
- Torsional Vibrations Two Rotor
- Forced Vibrations Lateral
- Single rotor Viscous damping
- Dunkerly's System

AATDL07 GEAR MODELS

AATDL07 is used for determination of gear - Train valve of compound gear trains and Epicyclic gear trains. This system comes in motorized drive with proximity pickup and digital rpm indicator. Compound Gear Train Set up is mounted on 500 (L) x 400(W) x 300(H) rugged steel platform with housing. Epicyclic Gear train setup with housing size is 350(L) x 400(W) x 350(H) frame.

TECHNICAL DETAILS:

Simple Gear Trainer	
Nomenclature	Specifications
Dimension (L X B X H)	400X250X200 mm
Type of gear	Spur or helical
Operation	Manual.
Speed ratio	0.5-0.7
Overall weight	5kgs
a) No of teeth	50 to 65
b) Speed ratio	1.3
c) No of shaft	2 nos

bevel gear	
Nomenclature	Specifications
Dimension (L X B X H)	400 X 250 X 150 mm
Type of gear	Straight bevel gear
Angle of transmission	90 Degree
Operation	Manual
Speed ratio	0.5-0.8
Overall weight	7kg(approx)

Compound gear train	
Nomenclature	Specifications
Dimension (LXBXH)	400 X 250 X 300 mm
Driver motor	1/6 hp AC Variable
Speed controller	0-230V, 2 Amps Variac.
No. Of Shaft used	3nos (driver, intermediate, driven)
Type of gear used	Spur gear.
Speed ratio	0.5-0.7
Resolution for speed measurement	1 RPM (Tachometer, Proximity sensors)
Housing	Acrylic sheet (Transparent)
Overall weight	12kg
a) Speed ratio	0.44
b) Overall space	500 x 400 mm
c) Motor variable speed	0-6000 RPM - (BSPIL-DYN-04012A)

Differential gear train	
Nomenclature	Specifications
Dimension (LXBXH)	600 X 400 X 400 mm
Driver motor	1/6 hp AC Variable
Speed controller	0-230V, 2 Amps Variac.
Sensor	Proximity sensor
Sensor range	0-10000 RPM
Resolution for speed measurement	1RPM
Overall weight	30kg

AAT DL08 EPICYCLIC GEAR TRAIN

EPICYCLIC GEAR TRAIN

Epicyclic Gears train made of two simple gears duly coupled together. Driver shaft is having handle to operate and to transmit power to the driven gear through single follower. Entire system is mounted on Plywood duly finished with Polymer Beading.

SPECIFICATIONS :

- **Dimension (L X B X H) - 400 x 420 x 380 mm**
- **Variable speed : 0**-6000 rpm
- **SUN** : 19 teeth
- **Planet** : 29 teeth
- Enclosed in a wooden box.
- Available in different models & sizes and can be custom designed depending on the requirement.

ACCESSORIES (Optional) :

- ❖ This system also comes with motorized drive.

Range of Experiments:

- To Study velocity ratios of Epicyclic Gear Train.

AAT DL09 UNIVERSAL JOINT MECHANISM

The universal joint / universal coupling is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction and is commonly used in shafts that transmit rotary motion.

The Realistic Model of Universal Joint comprises :
One shaft is fitted with handle, the second shaft is inclined to 30 degrees to the driver shaft. The motion is transmitted from driver shaft to driven shaft by the manual operation.. The setup is fitted inside the Acrylic Encapsulation.

ACCESSORIES (Optional) :

- ❖ This kinematic Mechanism also comes with motorized drive.

SPECIFICATIONS :

- **Dimension (LXBXH) :** 400 X 250 X 250mm
- **Angle of transmission :** 20 ° - 30 °
- **No. of Shafts :** 2 No's
- **No of joints :** 3 No's
- **Resolution for Angular measurement :** 1 °
- **Overall weight :** 5kgs

RANGE OF EXPERIMENTS :

- To Study the kinematics of Universal joint.

AAT DL10 KINEMATICS OF ENGINEERING MECHANISMS

The Kinematics of Engineering Mechanisms are studied to understand the operations of various mechanisms and the detailed study of their motion.

This system is designed in such a manner to easily understand the functionality of the Connecting Rod, Cranks, Rocker Arm.

SPECIFICATIONS :

- **Length of Connecting Rod** - 250mm
- **Length of Cranks** - 100 mm
- **Length of Rocker Arm** - 200mm

Four Bar Mechanism :

- **Dimension (L X B X H) :** 500 X 400 X 200 mm
- **Crank diameter :** 20mm
- **Cylinder bore diameter :** 22mm
- **Stroke length :** 65mm
- **Overall weight :** 6 Kg

❖ Available in different models & sizes and can be custom designed depending on the Mechanism requirement.

RANGE OF EXPERIMENTS :

- Study of Four Bar Mechanism.
- Study of Single Slider Mechanism.
- Study of Double Slider Mechanism.