Chapter – 7 Conclusions and future scope of work

When the operational speed increases, inertia forces, being proportional to the square of the speed, could rise drastically. Hence the need for light mass links in applications involving high speeds. This brought about a new challenge for the designer. The flexibility of such links increased and high precision motion could no longer be guaranteed. In applications were high precision is required, mechanisms such as robot manipulators are made very stiff which means with high inertia if the components are made of commercial materials such as steel. This limits their use to relatively low operating speeds due to the torques and forces required for their operation. The other alternative is to use high stiffness to density ratio materials such as fiber reinforced composite materials.

The following conclusions have been drawn from the dynamic analysis of mechanism with rigid and flexible links. The effect of number of elements, link cross section and its orientation, length of links and flexibility of links on coupler strain have been studied. The RMS values of coupler strain have been used for comparison and validation purpose.

- The results obtained for rigid body analysis with help of MATLAB and ANSYS has been compared with experimental result mentioned in literature [13] and found to be in agreement.
- The pin joint forces in rigid body analysis have reached to maximum at 310° of crank rotation when the transmission angle is highest.
- In Fig. 6.8 the variation of the transmission angle through one cycle is given. From this figure it is noticed that the maximum value of the transmission angle is 82° occurs at, $\theta_2 = 180^\circ$ and the minimum at, $\theta_2 = 0^\circ$. The optimum value for the transmission angle is 90° as discuss in section 3.1.2. It is also seen that the mechanism being studied has a good as transmission angle as it lies in the recommended band.
• Torque required to drive the mechanism is maximum at $\theta_2 = 180^\circ$ because transmission angle is maximum at this position.

• In flexible dynamic analysis, the RMS value of coupler strain for ANSYS analysis is found to be closer to its experimental result’s RMS value than the MATLAB analysis’ RMS value.

• The RMS value in ANSYS has improved by 74.20% due to the considerations of more elements in ANSYS analysis as compared to MATLAB analysis.

• It is observed that the stiffness of coupler has changed with cross section shape and its orientation.

• The RMS value of coupler strain has reduced by 80% in circular cross section and 84% in rectangular cross section orientation 2 ($I_{yy}$) as compared to rectangular cross section facing orientation 1 ($I_{xx}$), while it has increased by 96% in elliptical cross section.

• Increase of rocker length leads to higher coupler strain.

• It is found that RMS value of coupler strain has reduced with increase of coupler length.

• The flexibility consideration of links other than the coupler link also affects the RMS value of coupler strain.

• It is observed that the flexibility of coupler and rocker has reduced the RMS value of coupler strain by 95.27%.

• The modeling and simulation of six bar mechanism in ANSYS software and found out the strain developed in link 3 and link 5.

**Future scope of work:**

• The analysis can be carried out by considering the damping factor and to study effect of damping on strain in coupler.

• Experimental work can be carried out to verify the result of six bar planar mechanism.

• The analysis can be carried out by considering the flexibility of joints and their clearance, friction etc.
• A study can be carried out to observe the effect of C. G. of links on strain in coupler.