

## IV B.Tech I Semester

## 15AME59-MECHANICAL VIBRATIONS

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**Course Objective:**

- To make the students to learn about basic concepts and definitions of mechanical vibrations and to write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.
- To make the students to learn about basic concepts of forced vibrations, vibration transmissibility and isolation and seismic instruments. Further to understand about various vibration control methods.
- To familiarize the students about theory of vibrations of two degree freedom system and various types of vibration absorbers.
- To analyze the two degree and multi degree of Freedom systems.

**UNIT I**

Single Degree Freedom Systems: Un-damped free vibration: Classical method, Energy method, equivalent systems, torsional systems. Damped free vibration- Viscous damping, under damping, critical damping, over damping. Coulomb damping, equivalent damping coefficient. Simple problems.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit students are able to find natural frequency of un-damped single degree freedom systems and the behavior of single degree freedom systems with damping

**UNIT II**

Forced vibrations of Single Degree Freedom Systems : Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping, General theory of seismic instruments, accelerometer and vibrometer, methods of vibration control- excitation reduction at source, system modification.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit, students are able to solve vibration problems with forcing function. to know about various instruments.

**UNIT III**

Two Degree Freedom Systems: Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit the students are able to analyze the two degree freedom systems with and without damping and to solve problems on vibration absorber

**UNIT IV**

Multi Degree Freedom Systems: Lagrangion method for formulation of equation of motion Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit the students are able to analyze the multi degree freedom systems using Stodola method, Holzer's method and Matrix iteration method.

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**UNIT V**

**VIBRATION OF CONTINUOUS SYSTEMS:** Longitudinal vibration of bars, torsional vibrations of circular rods or shafts, lateral vibrations of beams and shafts.

**WHIRLING OF SHAFTS:** Critical speed of shafts, Rayleigh's upper bound approximation, Dunkerley's lower bound approximation, critical speed of shafts with damping.

**Learning Outcome & Suggested Student Activities:**

After completion of this unit the students are able to find lowest natural frequency of the shaft using Rayleigh's upper bound approximation and Dunkerley's lower bound approximation.

**TEXT BOOKS:**

1. Elements of Vibrations Analysis L. Meirovich Tata McGraw Hill.
2. Mechanical Vibrations by Groover.
3. Vibration of Mechanical Systems, C. Nataraj, Cenage Learning, 1<sup>st</sup> edition, 2012.

**REFERENCE BOOKS:**

1. Mechanical Vibrations, S. Graham Kelly, Tata McGraw Hill.
2. Vibration Theory and Applications, William Thomson, Pearson Education, New Delhi
3. Vibration problems in Engineering, Timeoshenko and Young, John Wiley and sons Publishers, Singapore.
4. Singrasu S. Rao, Mechanical Vibrations, Pearson Education, New Delhi.

**SUGGESTED LINKS:**

- <http://nptel.iitm.ac.in/video.php?subjectId=112104114>
- <http://www.cdeep.iitb.ac.in/nptel/Mechanical/Dynamics%20of%20Machines/TOC.html>
- <http://www.freestudy.co.uk/dynamics/forced%20vibrations.pdf>
- <http://aerade.cranfield.ac.uk/ara/arc/rm/2854.pdf>
- <http://www.youtube.com/watch?v=klqMuDDb0Tc&list=PL46AAEDA6ABAFCA78>
- <http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-20-structural-mechanics-fall-2002/lecture-notes/unit22.pdf>
- <http://www.youtube.com/watch?v=h7dUHXxfP9w&list=PL46AAEDA6ABAFCA78>
- <http://web.itu.edu.tr/~gundes/2dof.pdf>
- [http://www.iitg.ernet.in/scifac/qip/public\\_html/cd\\_cell/chapters/r\\_tiwari\\_dyn\\_of\\_mach/Chapter\\_12\\_Vibration%20of%20two-degree-of-freedom%20system.pdf](http://www.iitg.ernet.in/scifac/qip/public_html/cd_cell/chapters/r_tiwari_dyn_of_mach/Chapter_12_Vibration%20of%20two-degree-of-freedom%20system.pdf)
- <http://www.youtube.com/watch?v=6gX4ox-r5t0&list=PL46AAEDA6ABAFCA78>
- <http://www.iitr.ac.in/outreach/web/CIRCIS/PG/AVN/RC/Revision%20of%20concepts4SD OF-Forced.pdf>
- <http://www.freestudy.co.uk/dynamics/forced%20vibrations.pdf>
- <http://www.youtube.com/watch?v=irudCaBrij0&list=PL46AAEDA6ABAFCA78&index=30>
- <http://www.youtube.com/watch?v=tCiHYyPX6NM&list=PL46AAEDA6ABAFCA78&index=28>
- <http://www.youtube.com/watch?v=DMILEZMXOmc>
- <http://www.newagepublishers.com/samplechapter/001216.pdf>
- <http://www.youtube.com/watch?v=fwpat51ffSs&list=PL46AAEDA6ABAFCA78&index=27>

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