B.Tech IV Year I Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

19AME74c- MECHANICAL VIBRATIONS

(Professional Elective-III)

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Course Objectives: The objectives of the course are to make the students learn about

- Demonstrate basic concepts and definitions of mechanical vibrations. To write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.
- To train the students 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 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: **10 Hrs**

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.

Whirling of shafts: Transverse vibrations: Dunkerley's lower bound approximation, Critical speed of shafts.

Learning Outcomes:

At the end of this unit, the student will be able to

- Find natural frequency of un-damped single degree freedom systems **L4**
- Find the behavior of single degree freedom systems with damping **L4**

UNIT – II: Forced vibrations of Single Degree Freedom Systems **10Hrs**

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.

Learning Outcomes:

At the end of this unit, the student will be able to

- Solve vibration problems with forcing function. **L5**
- Calculate transmissibility and isolation. **L4**
- Explain different types of isolators and power absorbers. **L2**

UNIT – III: Two Degree Freedom Systems: **10Hrs**

Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

Learning Outcomes:

At the end of this unit, the student will be able to

- Analyze the two degree freedom systems with and without damping **L4**
- Solve problems on vibration absorber **L5**

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UNIT – IV: Multi Degree Freedom Systems: **8 Hrs**

Lagrangian 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 Outcomes:

At the end of this unit, the student will be able to

- Analyze the multi degree freedom systems using Stodola method, Holzer"s method and Matrix iteration method. **L5**
- calculate natural frequencies with Rayleighs method and Dunkerleys method **L4**

UNIT – V: Vibration measurement and Applications **8Hrs**

Transducers: variable resistance transducers, Piezoelectric transducers, electrodynamic transducers and linear variable differential transformer transducer; Vibration pickups: vibrometer, accelerometer, velometer and phase distortion; Frequency-measuring instruments; Vibration exciters- Mechanical exciters and electrodynamic shaker.

Learning Outcomes:

At the end of this unit, the student will be able to

- Identify various transducers **L3**
- Use different vibration pickups **L4**
- Explain mechanical exciters and electro dynamic shaker **L2**

Text Books:

1. Singrasu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018.
2. G.K.Groover, Mechanical Vibrations, 8/e, 2009

Reference Books:

1. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, 1986
2. S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 1996
3. William Thomson, Theory of Vibrations with Applications, 5/e, Pearson, 2008
4. William Weaver, Timeoshenko, and Young, Vibration Problems in Engineering, 5/e, John Wiley, 2013
5. C. Nataraj, Vibration of Mechanical Systems, 1/e, Cenage Learning, 2012

Course Outcomes:

At the end of this Course the student will be able to

- find natural frequency of un-damped single degree freedom systems. **L4**
- analyze the two degree freedom systems with and without damping. **L4**
- Calculate transmissibility and isolation. **L4**
- Solve problems on vibration absorber. **L5**
- Calculate natural frequencies of multi degree freedom system. **L4**

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