ATME College of Engineering

BPHYC202

Applied Physics for ME stream

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Course objectives

- To understand the types of oscillation, shock waves & its generation, and applications.
- To Study the elastic properties of materials and failures of engineering materials
- To Study the acoustics buildings and the essentials of radiometry and photometry.
- To understand the principles photonic devices and their application relevant to civil engineering.
- To understand the various natural disaster and safety

Teaching-Learning Process

- To accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Flipped Class
2. Chalk and Talk
3. Blended Mode of Teaching and Learning
4. Simulations, Interactive Simulations and Animations
5. NPTEL and Other Videos for theory topics
6. Smart Class Room
7. Lab Experiment Videos

Module -I: Oscillations and Shock waves:

Oscillations:

Simple Harmonic motion (SHM), Differential equation for SHM (No derivation), Sprigs: Stiffness Factor and its Physical Significance, Series and Parallel combination of springs (Derivation), Types of Springs and their applications. Theory of Damped oscillations (Qualitative), Types of Damping (Graphical Approach). Engineering applications of Damped oscillations, Theory of Forced oscillations (Qualitative), Resonance, Sharpness of resonance. Numerical Problems.

Shock waves:

Mach number and Mach Angle, Mach Regimes, Definition and Characteristics of Shock waves, Construction and working of Reddy Shock tube, Applications of Shock Waves, Numerical problems

Module -2 Elasticity

Stress-Strain Curve, Stress hardening and softening. Elastic Moduli, Poisson's ratio, Relation between Y, n and σ (with derivation), mention relation between K, Y and σ, limiting values of Poisson's ratio. Beams, Bending moment and derivation of expression, Cantilever and I section girder and their Engineering Applications, Elastic materials (qualitative). Failures of engineering materials - Ductile fracture, Brittle fracture, Stress concentration, Fatigue and factors affecting fatigue (only qualitative explanation), Numerical problems.

Module-3 Acoustics, Radiometry and Photometry

Acoustics:

Introduction to Acoustics, Types of Acoustics, Reverberation and reverberation time, Absorption power andAbsorption coefficient, Requisites for acoustics in auditorium, Sabine's formula (derivation), Measurement of absorptioncoefficient, Factors affecting the acoustics and remedial measures, Sound Insulation and itsmeasurements. Noise and its Measurements, Impact of Noise in Multi-storied buildings.

Radiometry and Photometry:

Radiation Quantities, Spectral Quantities, Relation between luminance and Radiantquantities, Reflectanceand Transmittance, Photometry (cosinelaw and inverse square law).

Module-4 Photonics

LASER

Properties of a LASER Beam, Interaction of Radiation with Matter, LASER action, Population Inversion, MetastableState,Requisites of a LASER System, Semiconductor LASER, LASER Range Finder, LIDAR, Road Profiling, BridgeDeflection, SpeedChecker, NumericalProblems.

OpticalFiber

Principle and Construction of Optical Fibers, Acceptance angle and Numerical Aperture (NA), Expression for NA, Modes of Propagation,Attenuation and Fiber Losses, Fiber Optic Displacement Sensor, Fiber Optic Temperature Sensor, Numerical Problems

Module-5 Natural hazards and Safety

Natural hazards and Safety

Introduction, Earthquake, (general characteristics, Physics of earthquake, Richter scale of measurement and earthquake resistant measures), Tsunami (causes for tsunami, characteristics, adverse effects, risk reduction measures, engineering structures to withstand tsunami), Landslide (causes such as excess rain fall, geological structure, human excavation etc., types of land slide, adverse effects, engineering solution for landslides). Forest Fires and detection using remote sensing. Fire hazards and fire protection, fireproofing materials, fire safety regulations and firefighting equipment-Prevention and safety measures. Numerical Problems.

Course outcome (Course Skill Set)

- **CO1** Elucidate the concepts in oscillations, waves, elasticity and material failures
- **CO2** Summarize concepts of acoustics in buildings and explain the concepts in radiation and photometry
- **CO3** Discuss the principles photonic devices and their application relevant to civil engineering.
- **CO4** Describe the various natural hazards and safety precautions.
- **CO5** Practice working in groups to conduct experiments in physics and perform precise and honest measurements.

Assessment Details (both CIE and SEE)

- The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.
- The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).
- The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50).
- A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.
- Total Marks scored (test + assignments) out of 80 shall be scaled down to 30 marks

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The 15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test (duration 03 hours) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for 20 marks.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component.
- The laboratory component of the IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included.
- The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks. The theory component of the IC shall be for both CIE and SEE.

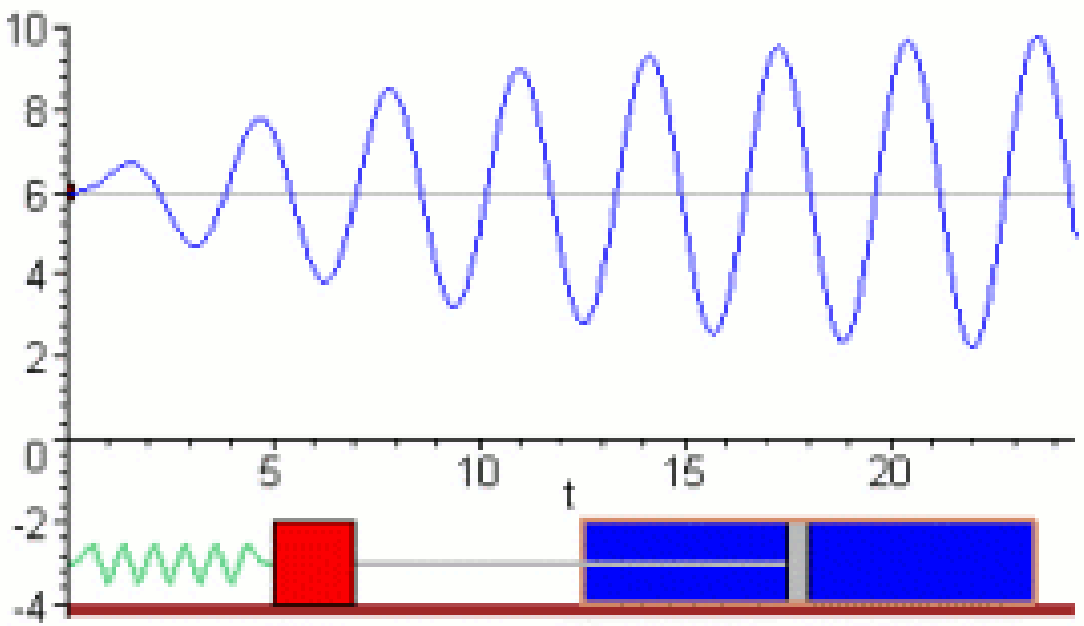
Semester End Examination(SEE):

- Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)
- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.

- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 subquestions), should have a mix of topics under that module

Module 1:

Free Oscillations



Simple Harmonic Motion

- The motion of an object is said to be simple harmonic motion if the restoring force (or acceleration) is directly proportional to the displacement and acts in the direction opposite to that of motion. Motion of the bob of an oscillating pendulum, spring mass system are the best examples of SHM. In general the equation for the displacement in SHM is given by

$$y = A\sin(\omega 0t + \phi)$$

Mechanical I Simple Harmonic Oscillator and Expression for SHM

According to Hooke's Law the restoring force is directly proportional to displacemen

$$f = -k\ y$$

Here k is called spring constant or stiffness factor or force constant.
Note : y is used since the displacement is along vertical direction.

$$\mathrm{m}a = -k\ y$$

Applying equation of kinematics of motion the equation could be written as

$$m\frac{d^2y}{dt^2} = -ky$$

$$\frac{d^2y}{dt^2} = \frac{-k}{m}y$$

$$\frac{d^2y}{dt^2} + \frac{k}{m}y = 0$$

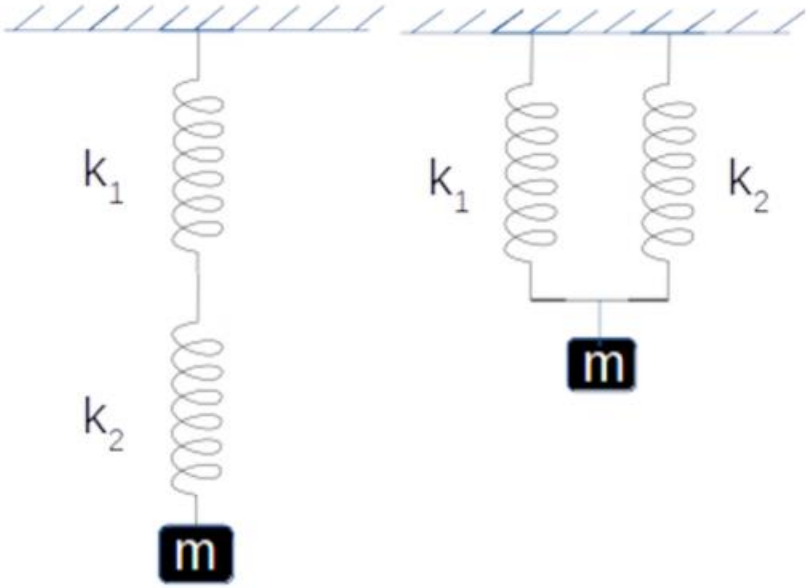
$$\frac{d^2y}{dt^2} + \omega_0^2 y = 0$$

$$y = A\sin(\omega_0 t + \phi)$$

Characteristics of SHM

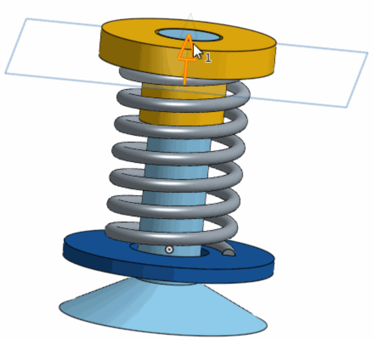
- Too and Fro motion
- Periodic Motion
- Acceleration or Force is proportional to the displacement.
- Acceleration is in the opposite direction of displacement.
- Restoring force is essential for SHM.

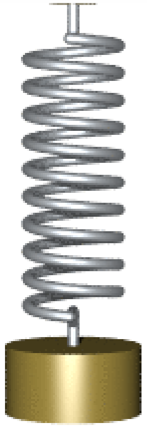
Springs in Series and Parallel

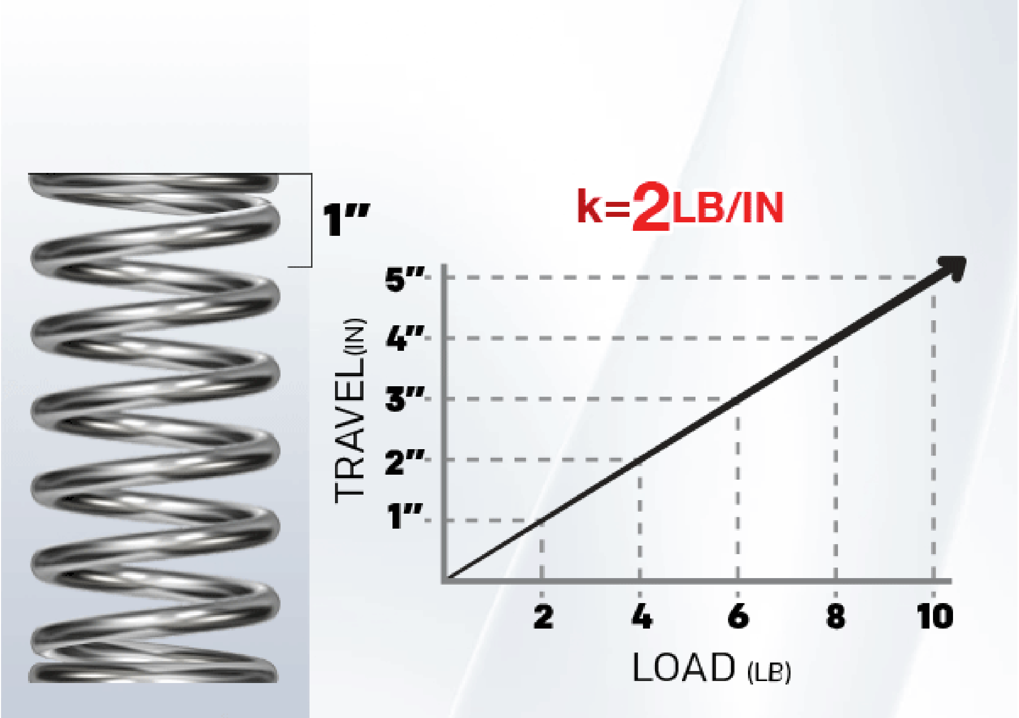


Compression Springs

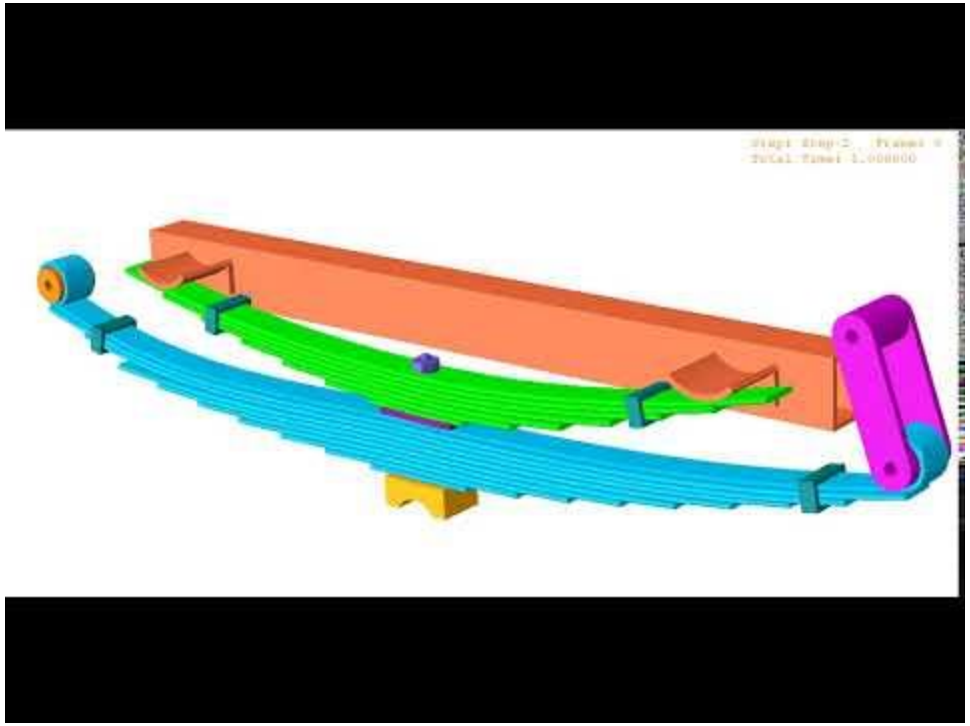
Compression Spring



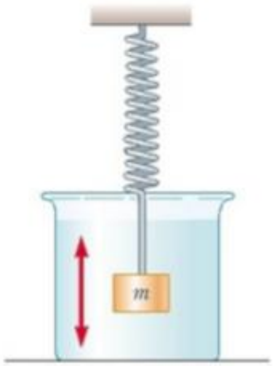


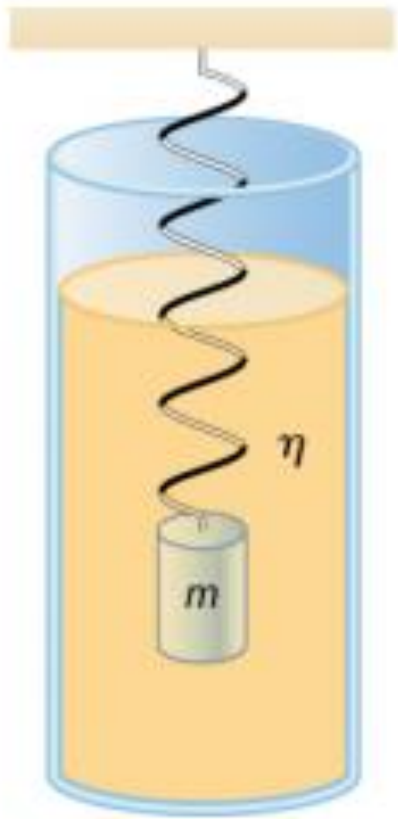


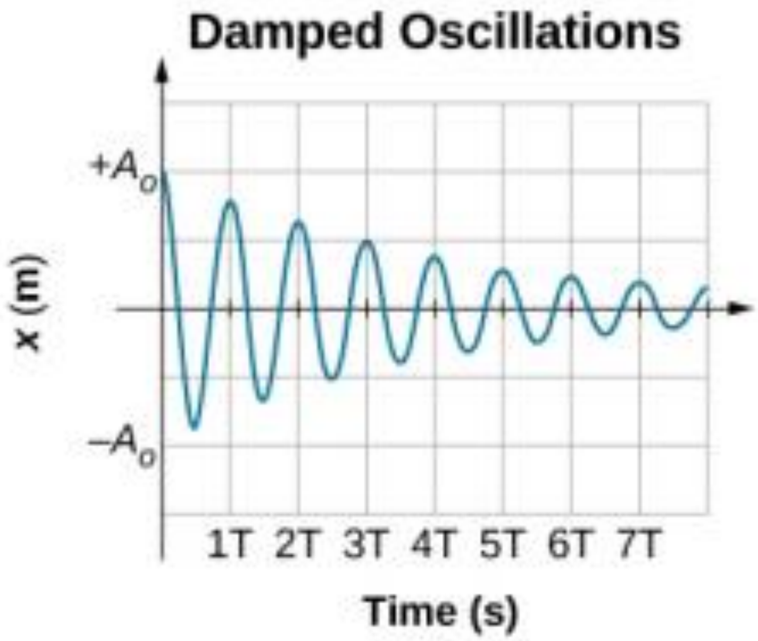
Leaf Springs



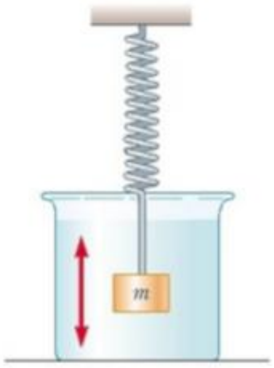
Damped Oscillations

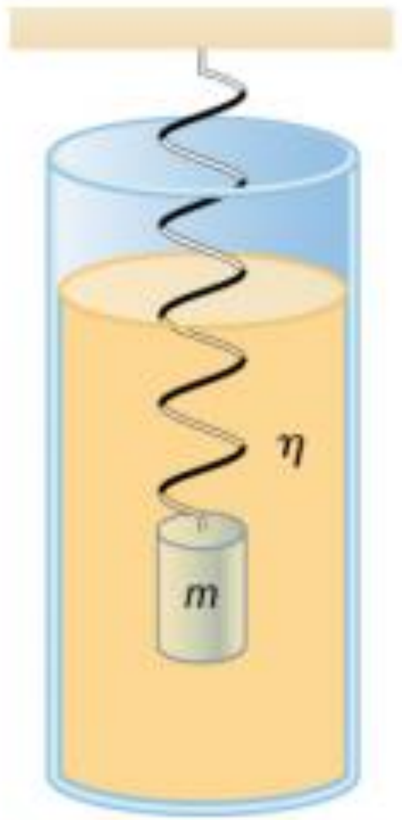


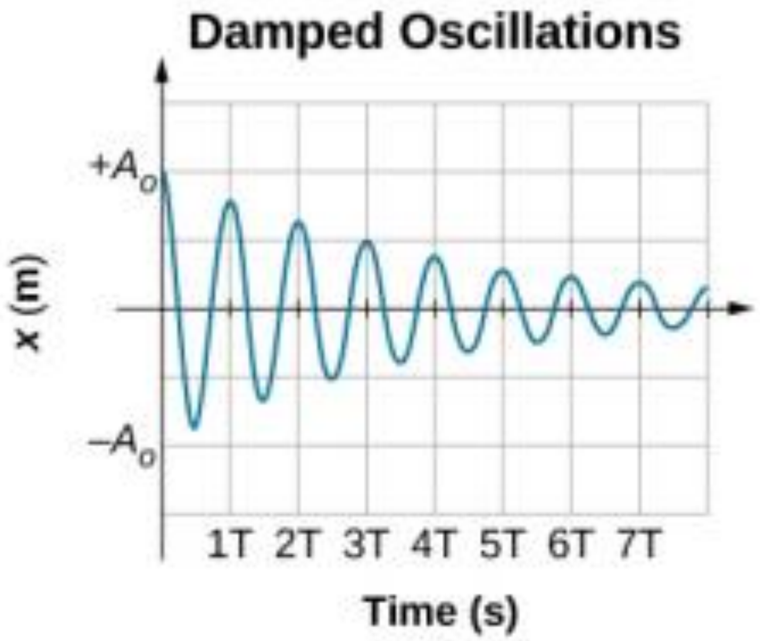




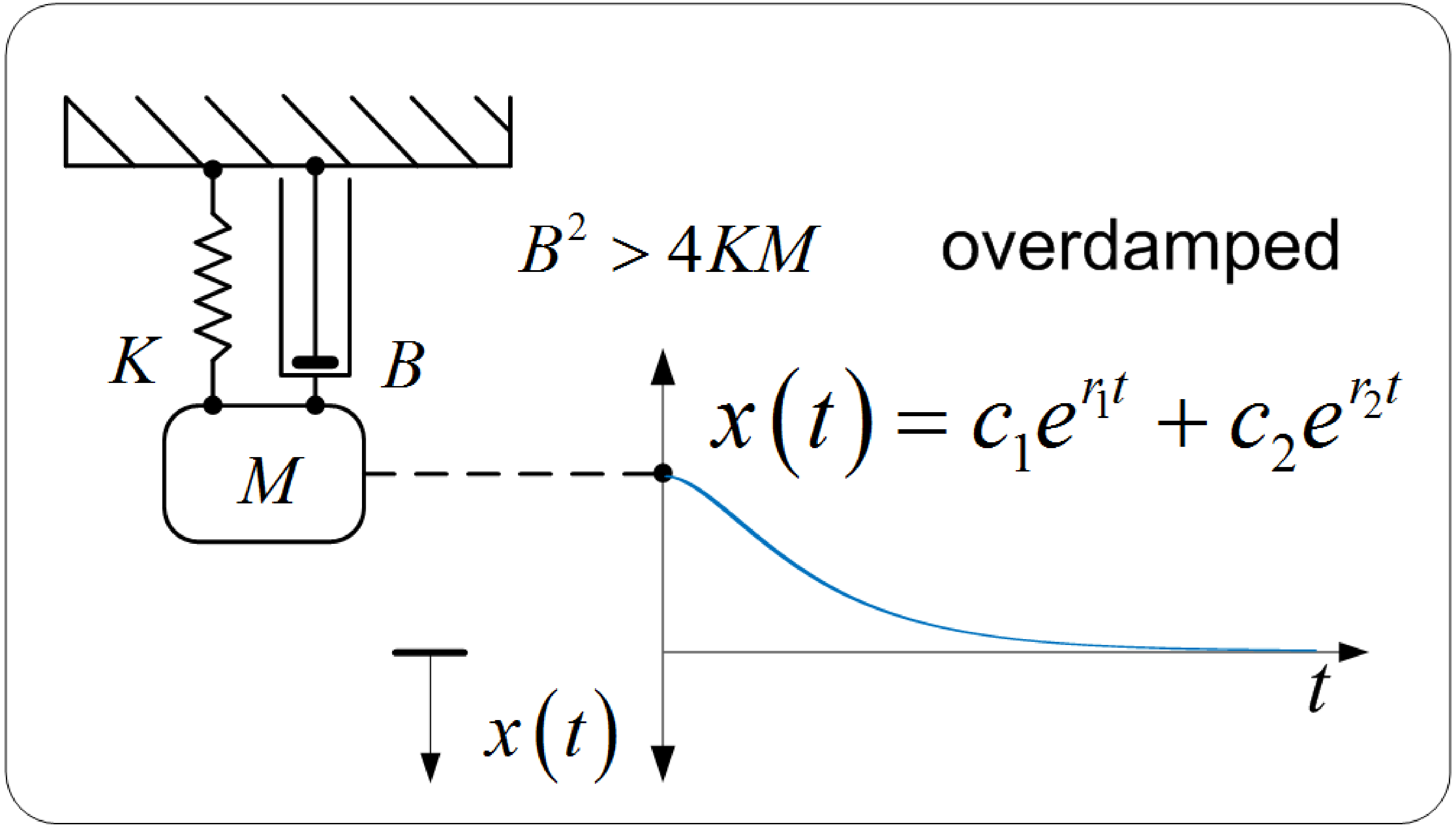
Damped Oscillations



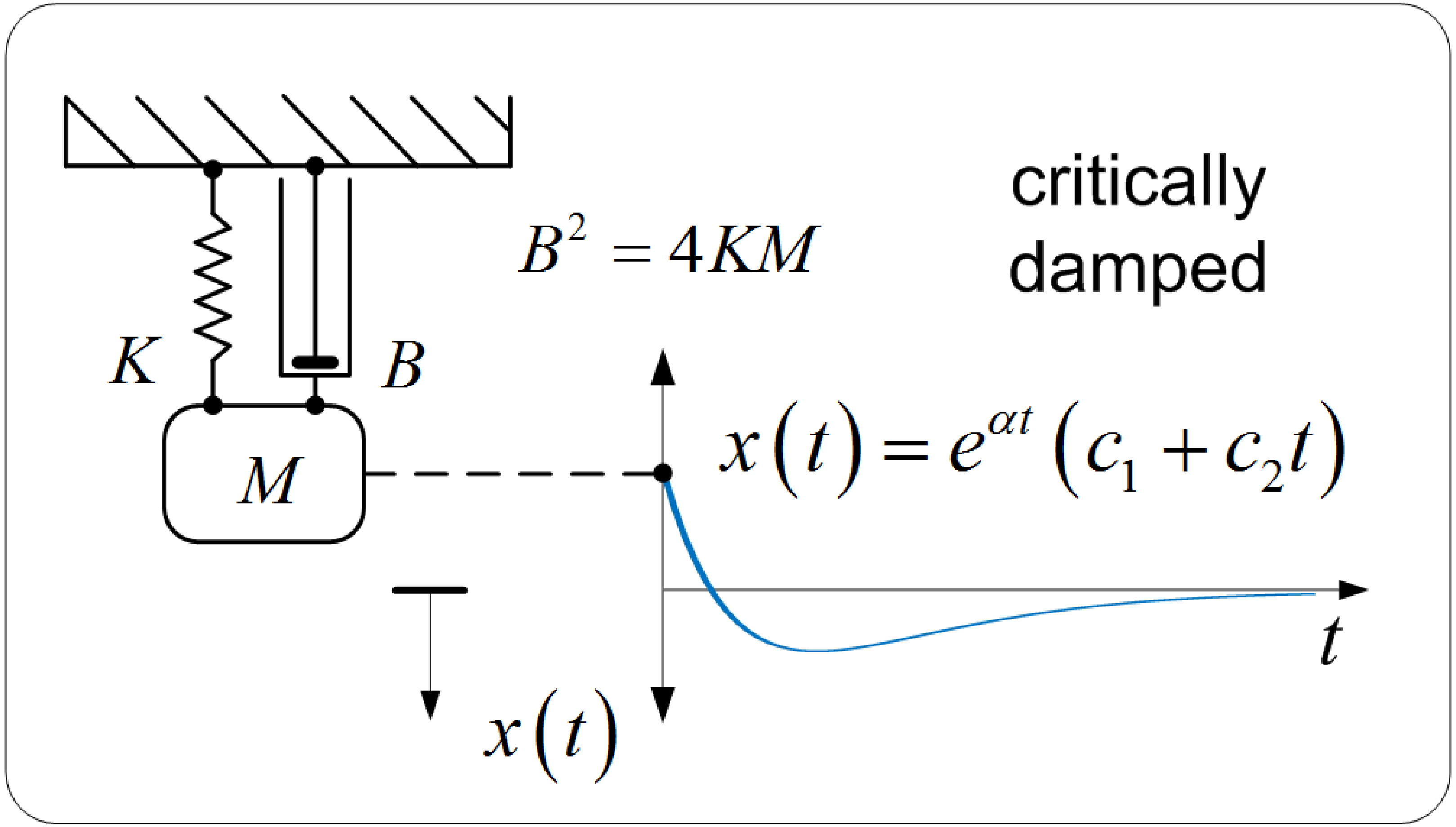




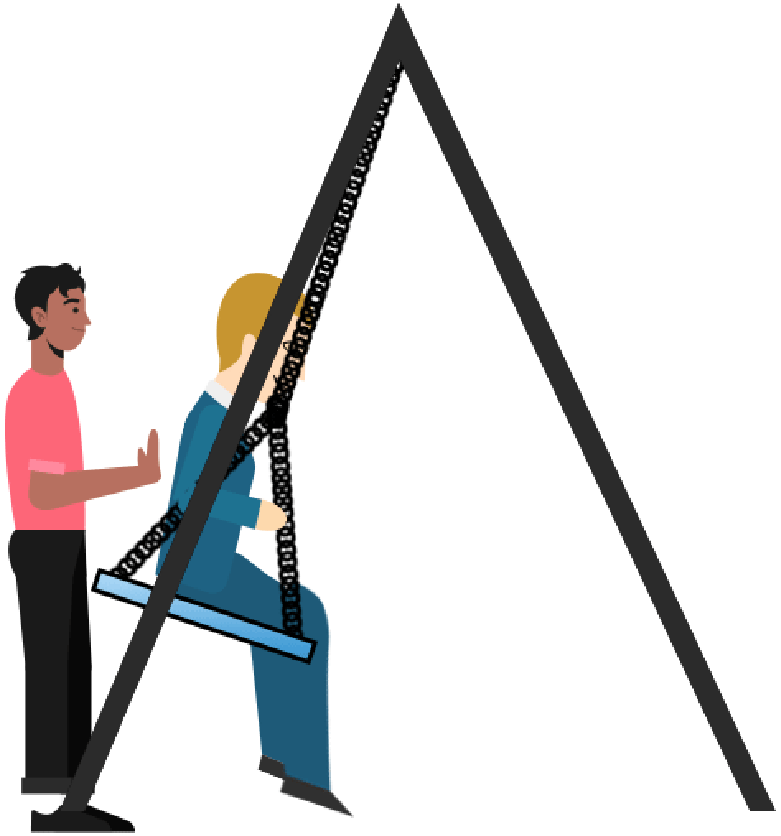
Over Damping



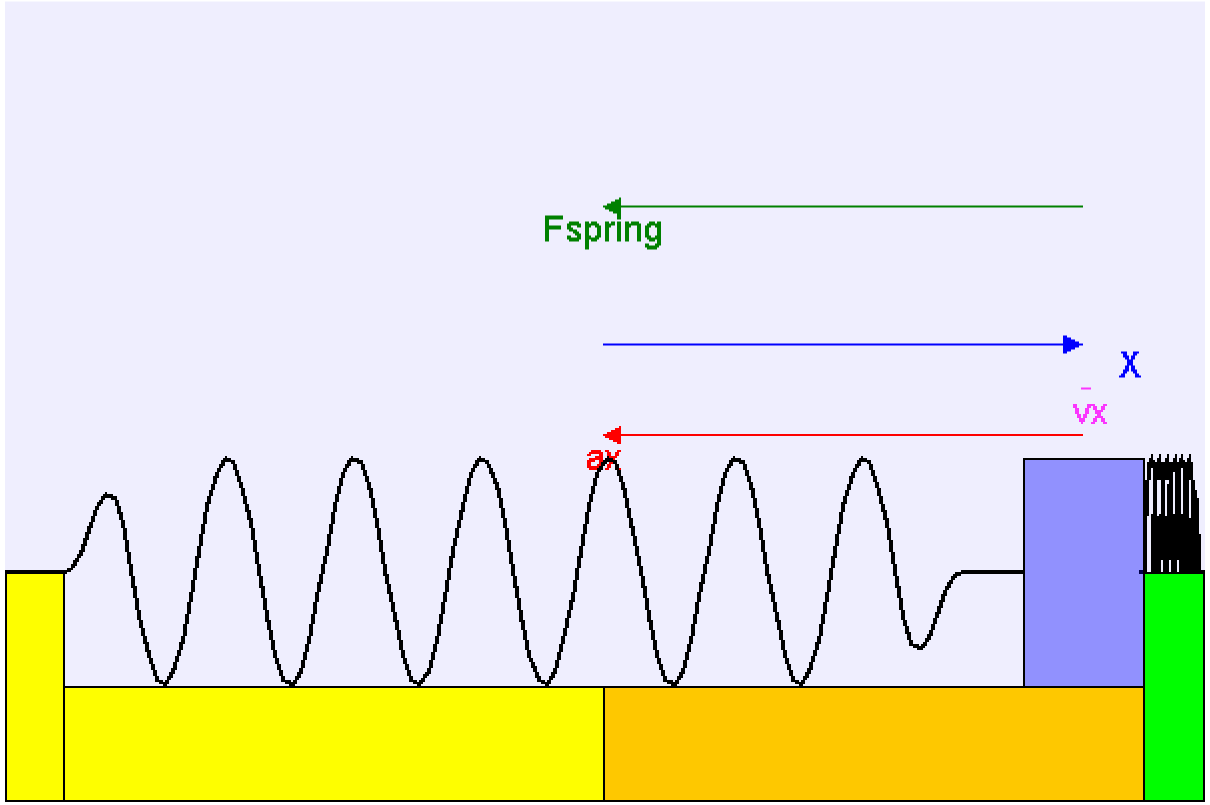
Critical damping

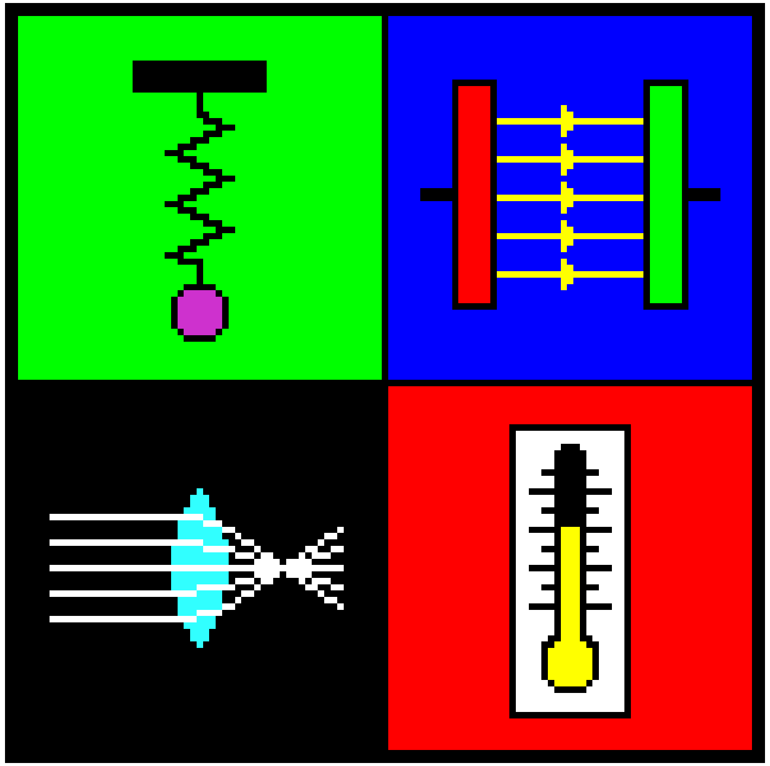


Forced Oscillations

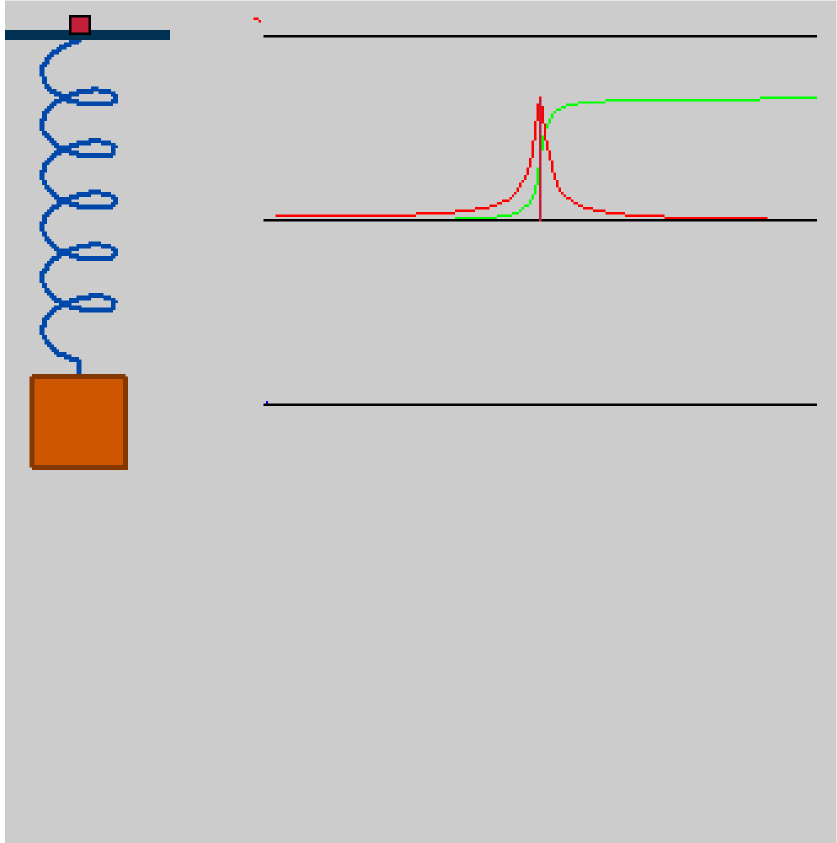


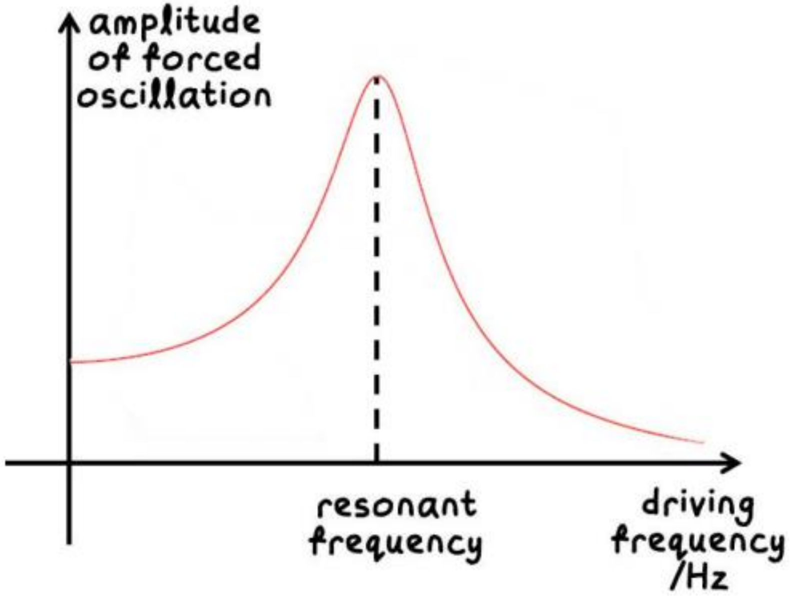

A
B
FORCED OSCILLATIONS AND RESONANCE


Fspring
x
vx
ax



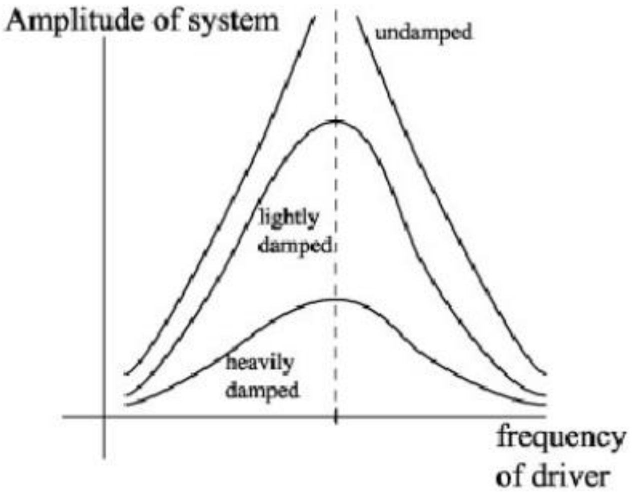
Resonance





$$A = \frac{F_0}{m\gamma\omega_0} = \frac{F_0}{b\omega_0}$$

Sharpness of Resonance



$$Sharpness of resonance = \frac{\Delta A}{\Delta \omega}$$

$$Sharpness of resonance = \frac{F_0}{m\gamma\omega_0\omega} = \frac{F_0}{b\omega_0\omega}$$