Blow up of Applied Physics for CV Stream (22PHYC12/22) Syllabus

Module-1 (8 Hours)

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.

Pre-requisites: Basics of Oscillations

Self-learning: Simple Harmonic motion, Differential equation for SHM

Sl. No.	Topics	Subtopics	Topics to be covered	Duration
1	**Oscillations**	Simple Harmonic motion(SHM), differential equation for SHM	Only definition, examples, mention of differential equation, mention of natural frequency and time period expression	1 ½ Hour
		Sprigs: Stiffness Factor and its Physical Significance, series and parallel combination of springs (Derivation)	Hookes' law, Stiffness Factor and its Physical Significance, series and parallel combination of springs(Derivation)	
		Types of spring and their applications	(Only Compression springs and their use in shock absorber and suspensions, leaf spring and its use in railway/truck suspension)	
		Damped oscillations and types of damping	Definition, Various forces acting on the system, Set up of the Differential equation, Assuming the expression for displacement explanation for variation of amplitude, Mention of three different cases and Graphical Explanation	2 Hours
		Engineering applications of damped oscillations	Qualitative discussion of applications such as automatic door closures, automobile suspension system,	
		Theory of forced oscillations	Definition of forced oscillation, Various forces acting on the system, Set up of the Differential equation, Assuming the expression for Amplitude and Phase, Explanation of variation of amplitude with frequency (Three Cases)	1 Hour
		Resonance, Sharpness of resonance.	Qualitative explanation of resonance and sharpness of resonance (without derivation)	½ Hour
2	**Shock Waves**	Mach number and Mach Angle, Mach Regimes, definition and characteristics of Shock waves	Definition of Mach number, Mach Angle, Mach Regimes, characteristics of Shock waves	1 ½ Hour
		Construction and working of Reddy shock tube	Construction and working of Reddy shock tube	
		Applications	Mention of applications such as aerodynamics study, chemical kinetic study etc	
3		Numerical problems	Numerical problems on SHM, Sprigs: Stiffness Factor, series and parallel combination of springs, damped oscillations, forced oscillations, Resonance and Mach number	1 ½ Hour

Module-2 (8 Hours)
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. **Pre requisites: Elastcity,Stress & Strain** **Self-learning: Stress-Strain Curve**

Sl.No	Topics	Subtopics	Topics to be covered	Duration
1	**Elasticity**	Stress-Strain Curve	Review of Hookes law, qualitative explanation of stress-strain curve	½ Hour
		Stress hardening and softening	Explain them along with examples	½ Hour
		Poisson's ratio	Define elongation and compression strain, mention the relation between them. Define Poisson's ratio	1 Hour
		Elastic Moduli, relation between them, mention relation between K, Y and σ,	Define 3 moduli and derive the relations $Y=2n(1+\sigma)$ and mention the relation between 3 moduli, mention relation between K, Y and σ, limiting values of Poisson's ratio	1 Hour
		Beams, bending moment (only expression)- cantilever and I section girder and their Engineering Applications,	Definition of beam, types of beams, qualitative discussion of bending and bending moment. Mention the expression for bending moment (No derivation). Concept of cantilever and I girders. Their applications (qualitative)	2 Hour
		Elastic materials, Failures of engineering materials	Mention different elastic materials, Fundamentals of fracture, qualitative discussion of ductile and brittle fracture, stress concentration and concentration factor	1 Hour
		Fatigue failure	Definition, a brief discussion on factors affecting fatigue such as surface effect, design effect and environmental effects	1 Hour
		Numerical Problems	Numericals on Elastics moduli and relations, Poisson's ratio, Bending moment.	1 Hour

Module-3 (8 Hours)
Acoustics, Radiometry and Photometry: **Acoustics:** Introduction to Acoustics, Types of Acoustics, Reverberation and reverberation time, Absorption power and Absorption coefficient, Requisites for acoustics in auditorium, Sabine's formula (derivation), Measurement of absorption coefficient, Factors affecting the acoustics and remedial measures, Sound Insulation and its measurements. Noise and its Measurements, Impact of Noise in Multi-storied buildings **Radiometry and Photometry:** Radiation Quantities, Spectral Quantities, Relation between luminance and Radiant quantities, Reflectance and Transmittance, Photometry (cosine law and inverse square law). **Pre requisites: Basics of Sound, Waves & light properties.** **Self-learning: Introduction to acoustics.**

Sl. No.	Topic	Sub Topic	Topics to be covered	Duration
1	**Acoustics**	Introduction to acoustics Types of acoustics	Explain the importance of acoustics in auditorium, review some general terms such as pitch, intensity, audible scale, dB Define acoustics, mention types of acoustics, their definition and any one relevant point	1 Hour
		reverberation and reverberation time, absorption power and absorption coefficient	Explain reflection and refraction of sound, reverberant sound, define reverberation time, discuss its importance(noise & dead effect), its optimum value for good auditorium & examples of some good auditoriums Qualitative explanation of absorption of sound, open window concept, definition of absorption coefficient & absorptive power, absorptive power of a hall, mention the expression $A=\sum a_i \, d \, S_i$ Numerical Problems	1 Hour
		Requisites for acoustics in auditorium	Mention the conditions such as absence of echo, minimum noise, absence of echelon effect, minimum extraneous effects, optimum reverberation time etc	1 Hour
		Sabine formula	Explain transport of sound energy in a hall and mention the expression $\frac{E}{4\pi}\left(\frac{dS\cos\theta}{r^2}\right)$ Derive Sabine formula using this expression $T=\frac{0.162}{\sum aS}$ Numerical Problems	
2	**Acoustics**	Measurement of absorption coefficient Factors affecting acoustics and remedial measures	Explain the measurement of *a* using Sabine formula, list the value of *a* for some absorbing materials Explain in brief about factors such as loudness, echo, echelon, structure borne sound, focusing due to walls and ceiling, reverberation time, multiple noise sources, lack of diffusing materials and corresponding remedies	1 Hour
		Sound insulation	Requirement of sound insulation, mention its measurement index, mention the methods of insulation	1 Hour

		Noise and its Measurements, Impact of Noise in Multi-storied buildings	Explain the concept of noise in terms of sound level. Mention the names of noise level measuring instruments (dosimeter, sound level meter etc) Mention few impacts such as lack of privacy, health issues, annoyance, insufficient sleep, etc.,	
3	**Radiometry and Photometry**	Radiation quantities, Spectral Quantities, Relation between luminance and radiant quantities,	Definition of radiometry, review of EM spectrum, qualitative explanation of radiometric quantities such as Radiant energy, radiant power, radiant intensity, radiance, radiant exitance etc along with respective equations (if any) and SI units. Definition of spectral quantities such as Spectral radiant power, spectral radiant intensity, spectral radiance, spectral irradiance and spectral radiant exitance	1 Hour
		Reflectance and transmittance	Definition and a qualitative explanation	½ Hour
		Photometry	Definition of photometry, photometric quantities such as luminous energy, luminous power or luminous flux, luminous intensity, luminance, luminous exitance or emittance along with equations (if any) and SI units, Relation between photometric and radiant quantities, relation between watt and lumen	1 Hour
		Cosine law and inverse square law	Definition and equation for both the laws and few relevant points	½ Hour

Module – 4 (8 Hours)
Photonics **LASER** Properties of a LASER Beam, Interaction of Radiation with Matter, LASER action, Population Inversion, Metastable State,Requisites of a LASER System, Semiconductor LASER, LASER Range Finder, LIDAR, Road Profiling, Bridge Deflection, Speed Checker, Numerical Problems. **Optical Fiber** 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 **Pre-requisite: Properties of light** **Self-learning: Total Internal Reflection**

Sl.No	Topics	Subtopics	Topics to be covered	Duration
1	**LASER**	Basic properties of a LASER beam, Interaction of Radiation with Matter,	Basic properties of a LASER beam, Interaction of Radiation with Matter : Induced Absorption, Spontaneous Emission and Stimulated Emission	1 Hour
		Laser Action, Population Inversion, Metastable State, Requisites of a laser system,	Laser Action Explanation, Population Inversion explanation, Metastable State: Description using 3 level system, Requisites of a laser system : Energy Source, Active Medium, Laser Cavity	1 Hour
		Semiconductor LASER, LASER Range Finder, LIDAR, Road Profiling, Bridge Deflection, Speed Checker.	Construction and working Semiconductor LASER, LASER Range Finder (Defence application), LIDAR(Measurement of pollutants in atmosphere), Brief explanation of Road Profiling, Bridge Deflection and Speed Checker.	2 Hour
2	**Optical Fibers**	Principle and Construction of Optical Fibers, Acceptance angle and NA, Expression for NA	**Principle : Total Internal Reflection,** Structure: Core, Clad, Sheath and corresponding RIs, Propagation of Light Through the Optical fiber (Ray Diagram), Acceptance angle and Numerical Aperture (NA) Explanation ,derivation of Expression for NA	1 Hour
		Modes of Propagation, Attenuation and Fiber Losses,	Modes of Propagation (Three types) , Attenuation, Attenuation Coefficient, Types of Fiber Losses: Absorption, Scattering and Geometrical Losses	1 Hour
		Fiber Optic Displacement Sensor, Fiber Optic Temperature Sensor	Principle, construction and working of Fiber Optic Displacement Sensor, Fiber Optic Temperature Sensor	1 Hour
		Numerical Problems	Number of photons / sec in a LASER beam of certain power output. Numerical Aperture, Acceptance angle and Attenuation Co-efficient	1 Hour

Module-5 (8 Hours)
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, fire-proofing materials, fire safety regulations and firefighting equipment - Prevention and safety measures. Numerical Problems **Pre-requisite: Oscillations Self-learning: Richter scale**

Sl.No.	Topics	Subtopics	Topics to be covered	Duration
1	**Natural Hazards.**	Introduction,	General introduction to disasters/hazards-natural hazards and man-made hazards with examples	½ Hour
		Earthquake, (general characteristics, Physics of the earthquake, Richter scale of measurement, and earthquake-resistant measures)	Definition, causes of earthquake, Sketch illustrating hypocenter, epicenter, and earthquake depth Characteristics, magnitude and energy equations, Types of earthquakes, Richter scale of measurement	2 ½ Hour
		Tsunami (causes for tsunami, characteristics, adverse effects, risk reduction measures, engineering structures to withstand tsunami),	Definition, Cause for tsunami, characteristics, adverse effects, risk reduction measures, engineering structures to withstand earthquakes and tsunami	1 ½ Hour
		Landslides (causes such as excess rainfall, geological structure, human excavation, etc, types of landslides, adverse effects, engineering solution for landslides)	causes such as excess rainfall, geological structure, human excavation, etc, types of landslides, adverse effects, engineering solutions for landslides	1 ½ Hour
		Forest Fires and detection using remote sensing. Fire hazards and fire protection, fire-proofing materials, fire safety regulations and firefighting equipment - Prevention and safety measures	Forest Fires and detection using remote sensing. Fire hazards and fire protection, fire-proofing materials, fire safety regulations and firefighting equipment - Prevention and safety measures	1 ½ Hours
		Numerical Problems	On energy and magnitude of earthquakes	½ Hour