Blow up of Applied Physics for ME Stream (22PHYM12/22) 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	
3		Applications	Mention of applications such as aerodynamics study, chemical kinetic study etc	
		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)
Thermoelectric materials and devices: Thermo emf and thermo current, Seeback effect, Peltier effect, Seeback and Peltier coefficients, figure of merit (Mention Expression), laws of thermoelectricity. Expression for thermo emf in terms of T_1 and T_2, Thermo couples, thermopile, Construction and Working of Thermoelectric generators (TEG) and Thermoelectric coolers (TEC), low, mid and high temperature thermoelectric materials, Applications: Exhaust of Automobiles, Refrigerator, Space Program (RTG), Numerical Problems. **Pre requisites: Basics of Electrical conductivity** **Self-learning: Thermo emf and thermo current**

Sl.No	Topics	Subtopics	Topics to be covered	Duration
1	**Thermoelectric materials and**	Thermo emf and thermo current	Introduction and definition of thermo emf and current	

	devices	Seeback effect, Peltier effect,	Qualitative explanation of both the effects along with relevant diagrams.	1 Hour
		Seeback and Peltier coefficients, Figure of merits	Mention Neutral temperature, thermo electric power, Seeback and Peltier coefficients, Figure of merit along with equations	1 Hour
		laws of thermoelectricity	Statement and brief explanation of Law of homogeneous circuit, law of intermediate metals and law of intermediate thermo couple	1 ½ Hour
		Expression for thermo emf in terms of T_1 and T_2,	To derive the equation $e=\frac{\pi_1}{T_1}(T_1-T_2)$ Using thermodynamics and Peltier effect	
		Thermocouples, thermopile	Construction and working Mention of Advantages and disadvantages	½ Hour
		Thermoelectric generators (TEG), Thermoelectric coolers (TEC)-	Construction and working of both	1 Hour
		thermoelectric materials	Low, medium and high temperature TE materials with examples	½ Hour
		Applications:	Applications: Exhaust of Automobiles, Refrigerator, Space Program (RTG)	1 ½ Hour
		Numerical Problems	Numericals on thermo emf, neutral temperature, thermo power, seeback coefficients, Peltier coefficients, figure of merit	1 Hour

Module-4 (8 Hours)

Cryogenics:
Production of low temperature - Joule Thomson effect (Derivation with 3 cases), Porous plug experiment with theory, Thermodynamical analysis of Joule Thomson effect, Liquefaction of Oxygen by cascade process, Lindey's air liquefier, Liquefaction of Helium and its properties, Platinum Resistance Thermometer, Applications of Cryogenics, in Aerospace, Tribology and Food processing(qualitative), Numerical Problems.

Pre requisites: Basics of Heat and Thermodynamics
Self-learning: Application of Cryogenics in Food Processing

Sl.No	Topics	Subtopics	Topics to be covered	Duration
1	**Cryogenics**	Production of low temperature	Introduction to Production of low temperature phenomena.	½ Hour
		Theory of Joule-Thomson effect,	derive $\Delta T=\frac{(P_1-P_2)}{C_p}\left[\frac{2a}{RT}-b\right]$ and hence discuss 3 cases	1 Hour
		Porous plug experiment with theory, Thermodynamical analysis of Joule Thomson effect	construction and working of Porous plug experiment, Thermodynamical analysis of Joule Thomson effect	1 Hour
		Liquefaction of Oxygen by cascade process	Qualitative explanation of oxygen by cascade process	1 Hour
		Lindey's air liquefier	Construction and working	1 Hour

		Liquefaction of Helium and its properties	Construction and working and properties	1 Hour
		Platinum resistance thermometer	Construction and working	½ Hour
		applications of cryogenics	Qualitative explanation of 3 applications-aerospace, Tribology (Cryogenic Treatment for Metals), Food processing	1 ½ Hour
		Numerical Problems	Joule Thomson Effect	½ Hour

Module-5 (8 Hours)
Material Characterization and Instrumentation Techniques: Introduction to nano materials: Nanomaterial and nanocomposites. Principle, construction and working of X-ray Diffractometer, Crystallite size determination by Scherrer equation, Atomic Force Microscopy (AFM) : Principle, construction, working and applications, X-ray photoelectron spectroscopy(XPS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Numerical Problems. **Pre requisites: Quantum Mechanics** **Self-learning: Crystallites**

Sl.No	Topics	Subtopics	Topics to be covered	Duration
1	**Material Characterization and Instrumentation Techniques**	Introduction to nano materials: Nonmaterial and nanocomposites	Introduction to materials: Nanomaterials and Nano composites.	1 Hour
		Principle, construction and working of X-ray Diffractometer, crystallite size determination by Scherrer equation, Principle	Principle, construction and working of X-ray Diffractometer, crystal size determination by Scherrer equation	2 Hour
		Atomic Force Microscopy (AFM),	Principle, construction, working and applications of Atomic Force Microscopy (AFM)	1 Hour
		X-ray photoelectron spectroscopy(XPS),	Principle, construction, working and applications of X-ray photoelectron *spectroscopy* (XPS)	1 Hour
		Scanning electron microscopy (SEM),	Principle, construction, working and applications of Scanning electron microscopy (SEM),	1 Hour
		Transmission electron microscopy (TEM),	Principle, construction, working and applications of Transmission electron microscopy (TEM),	1 Hour
		Numerical Problems	Numericals on X-Ray diffraction and Scherrer equation	1 Hour