Lesson Plan for EE, ME & ECE 1st Semester

Name of Faculty : **Dr. Trilok Ranjan Mudgal, Associate Professor**
Discipline : Electrical Engg, Mechanical Engg. and Electronics and Comm. Engg
Semester : 1st
Subject : Physics: Oscillations, waves and optics, **CODE- BSC101(IV) (T)**
Lesson Plan Duration : 15 weeks (from December, 2020 to March, 2021)
Work Load (Lecture/Practical) per week (in hours): **Lectures 03 hours**, **Tutorial 01 hour**, **Practicals -03 hours**

Week	Theory		Practicals BSC 101-IV (P)	
	Lecture Day	Topic (Including Assignment/Test)	Lab. Day	Topic
1st	**Module 1: S.H.M., damped and forced simple harmonic oscillators (7 Lectures)**			
	1.	Mechanical and electrical simple harmonic oscillators	1	De Sauty Bridge
	2.	Complex no. notation and phasor representation of SHM	1	De Sauty Bridge
	3.	Problem and solutions	1	De Sauty Bridge
	4.	Heavy, critical and light damping, energy daecay	1	De Sauty Bridge
2nd	5.	Q-factor, forced mechanical and electrical oscillators	2	Flashing & Quenching
	6.	Problem and solutions	2	Flashing & Quenching
	7.	Electrical and mechanical impedance	2	Flashing & Quenching
	8.	Steady state motion of forced damped harmonic oscillator	2	Flashing & Quenching
3rd	9.	Power absorbed by oscillator	3	Freq. of A.C.Mains
	10.	Problem and solutions	3	Freq. of A.C.Mains
	Module 2: Non-dispersive and longitudinal waves in one dimension and introduction to dispersion (7 Lectures)			
	11.	Transverse on a string, wave equation of a string	3	Freq. of A.C.Mains
	12.	Harmonic waves, reflection and transmission of waves at a boundary	3	Freq. of A.C.Mains
4th	13.	Problem and solutions	4	V-I Characteristics
	14.	Impedance matching, standing waves and their eigen frequencies	4	V-I Characteristics
	15.	Longitudinal waves and wave equation for them	4	V-I Characteristics
	16.	Acoustics waves and speed of sound, standing sound waves	4	V-I Characteristics
5th	17.	Problem and solutions	5	Four Probe
	18.	Waves with dispersion, water waves	5	Four Probe
	19.	Superposition of waves and Fourier method	5	Four Probe
	20.	Wave groups and group velocity	5	Four Probe
6th	21.	Problem and solutions	6	**Viva-Voce-1**
	Module 3: The propagation of light and geometric optics (10 Lectures)			
	22.	Fermat's principle of stationary time	6	**Viva-Voce-1**
	23.	Applications e.g., mirage effect, laws of reflection, refraction	6	**Viva-Voce-1**
	24.	Light as EM wave and Fresnel equations	6	**Viva-Voce-1**
7th	**Minor Test-I**			
8th	25.	Reflectance and transmittance	7	Gee Apparatus
	26.	Brewster' angle, TIR	7	Gee Apparatus
	27.	Problem and solutions	7	Gee Apparatus
	28.	Evanescent wave,	7	Gee Apparatus
9th	29.	Mirrors and lenses and optical instruments based on them	8	Hall Effect
	30.	Mirrors and lenses and optical instruments based on them	8	Hall Effect
	31.	Problem and solutions	8	Hall Effect
	32.	Transfer formula and	8	Hall Effect
10th	33.	The matrix	9	B-H Curve
		Module 4: Wave optics (6 Lectures)		
	34.	Problem and solutions	9	B-H Curve
	35.	Huygens' principle, Superposition of waves and interference of light	9	B-H Curve
	36.	Division of wave front and amplitude, Young' double slit experiment	9	B-H Curve
11th	37.	Newton's rings, Michelson's interferometer	10	Newton's Ring
	38.	Mach-Zehnder interferometer, Fraunhoffer diffraction	10	Newton's Ring
	39.	Single slit and circular aperture	10	Newton's Ring
	40.	Rayleigh criteria for limit of resolution, application to vision	10	Newton's Ring
12th	**Minor Test-II**			
13th	41.	Diffraction grating and its resolving power	11	Planck's Constant
	42.	Problems and solutions	11	Planck's Constant
	43.	Einstein's theory of matter radiation interaction, A & B coefficients	11	Planck's Constant
	44.	Amplification by population inversion	11	Planck's Constant
14th	45.	Gas LASERs (He-Ne and CO_2)	12	**Viva-Voce-2**
	46.	Solid state LASERs (Ruby, Neodymium)	12	**Viva-Voce-2**
	47.	Dye LASERs,	12	**Viva-Voce-2**
	48.	Laser Characteristics: monochromaticity, coherence	12	**Viva-Voce-2**
15th	49.	Directionality and brightness, LASER speckles	13	Final Submission of Record
	50.	Applications of LASERs in science, engineering and medicine	13	Final Submission of Record
	51.	Problems and Solutions	13	Final Submission of Record
	52.	Final submission of assignments	13	Final Submission of Record

PHYSICS (SYLLABUS)

Oscillations, waves and optics[L : 3; T:1; P : 0 (4 credits)]

Module 1: Simple harmonic motion, damped and forced simple harmonic oscillator (7 lectures)

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

Module 2: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion (7 lectures)

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Module 3: The propagation of light and geometric optics (10 lectures)

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method

Module 4: Wave optics (6 lectures)

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer.

Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Module 5: Lasers (8)

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers(ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Course Outcomes

- Analyse oscillations and waves mathematically.
- Solve simple problems of geometric optics.
- Predict diffraction and interference patterns.
- Operate small telescopes and record images.
- Different type of laser and lasing action with application of laser in various fields

❖ **Laboratory - Oscillations, waves and optics [L : 0; T:0 ; P : 3 (1.5 credits)]**

Choice of experiments

- To find the capacity of unknown capacitor by De Sauty Bridge.
- Finding frequency of A.C. mains by using sonometer.
- To find the capacity of unknown capacitor by Flashing and Quenching of Neon Bulb.
- To study the variation of magnetic field by Gee apparatus.
- To study the V-I characteristics of p-n junction diode.
- To find the value of Hall Co-efficient of a semi-conductor.
- To find the band gap of intrinsic semi-conductor using four probe method.
- To calculate the hysteresis loss by tracing a B-H curve.
- To Determine the Variation of Magnetic Field Along the Axis of a Circular Coil Carrying Current and Calculate the Radius of the coil.
- To find the value of Plank's constant by using a photoelectric cell.
- To study Newton's ring by using sodium light.