Lovely Professional University, Punjab

Course Code	Course Title	Course Planner
PHY109	ENGINEERING PHYSICS	11468::Dr. Kailash Chandra Juglan

Course Outcomes :Through this course students should be able to

CO1 :: recall the basic principles of physics in engineering courses

CO2 :: extend the knowledge on electromagnetic theory

CO3 :: articulate the concepts of laser and its application

CO4 :: discover the concepts of physics in understanding fiber optics

CO5 :: analyze the importance of quantum physics and its application

CO6 :: evaluate the need of ultrasonic waves and its generation mechanism

	TextBooks (T)		
Sr No	**Title**	**Author**	**Publisher Name**
T-1	ENGINEERING PHYSICS	HITENDRA K MALIK, A K SINGH	MC GRAW HILL

	Reference Books (R)		
Sr No	**Title**	**Author**	**Publisher Name**
R-1	ENGINEERING PHYSICS	B K PANDEY, S CHATURVEDI	CENGAGE LEARNING
R-2	ENGINEERING PHYSICS	D K BHATTACHARYA, POONAM TONDON	OXFORD UNIVERSITY PRESS
R-3	FUNDAMENTALS OF PHYSICS	HALLIDAY. RESNICK, WALKER	WILEY

Other Reading (OR)	
Sr No	**Journals articles as Compulsary reading (specific articles, complete reference)**
OR-1	faculty.essex.edu/~wang/221/Chap16_Sec5.ppt ,
OR-2	http://nptel.ac.in/course.php ,
OR-3	http://ocw.mit.edu/index.htm ,

OR-4	http://phet.colorado.edu/en/simulations/category/physics ,

Relevant Websites (RW)		
Sr No	**(Web address) (only if relevant to the course)**	**Salient Features**
RW-1	http://www.physics-assignment.com/detection-of-ultrasonic-waves	Detection of ultrasonic waves
RW-2	http://hyperphysics.phy-astr.gsu.edu/hbase/Sound/earsens.html#c5	Audible, infra, ultrasound
RW-3	https://www.youtube.com/watch?v=t3ABKsP4-HY	Ultrasonic applications
RW-4	https://www.svce.ac.in/departments/physics/downloads/Notes/Unit-IV/Ultrasonics%20.new.pdf	Production of ultrasonic waves
RW-5	http://ocw.mit.edu/courses/physics/8-511-theory-of-solids-i-fall-2004/	open course on theory of solids
RW-6	http://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/	quantum physics-II
RW-7	http://ocw.mit.edu/courses/physics/8-321-quantum-theory-i-fall-2002/	quantum physics-I
RW-8	http://www.vivaxsolutions.com/physics/total-internal-reflection-examples-in-real-life.aspx	Total internal reflection
RW-9	http://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/index.htm	laser and fiber optics
RW-10	http://danyk.cz/laser_en.html	CD reading and writing
RW-11	http://www.explainthatstuff.com/laserprinters.html	working of laser printer
RW-12	http://www.lasermicromachining.com/laser-micromachining/presentations-papers/	michromachining with lasers
RW-13	http://www.holoworld.com/	Hologram and Holography
RW-14	http://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/index.htm	lasers and fiber optics
RW-15	http://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007/index.htm	open course on electricity and magnetism

Audio Visual Aids (AV)		
Sr No	**(AV aids) (only if relevant to the course)**	**Salient Features**
AV-1	https://www.youtube.com/watch?v=ZejQOX69K5M	Ultrasonic sensor module HC-SR04
AV-2	https://archive.org/details/MIT8.03F04	Lecture series on vibrations and waves
AV-3	https://www.youtube.com/watch?v=bHo6_jltfc8	Hall effect
AV-4	https://www.youtube.com/watch?v=uSqMuDe1i_8	Fermi energy
AV-5	https://www.youtube.com/watch?v=fP59RSgQqg8	LED working
AV-6	https://www.youtube.com/watch?v=fln7bgZB5zU	Direct and indirect band gap
AV-7	https://www.youtube.com/watch?v=_ATDraCQtpQ	video lecture on hall effect
AV-8	https://www.youtube.com/watch?v=Vhypc2cOg44	Metal and Semiconductor band gap and its dependence on temperature

AV-9	https://www.youtube.com/watch?v=G2zgAs5O7I8	The Free Electron Theory of Metals - Electrical Conductivity
AV-10	https://www.youtube.com/watch?v=o1gqmrvPHjM	particle in a box- quantization
AV-11	https://www.youtube.com/watch?v=TQKELOE9eY4	uncertainty principle
AV-12	https://www.youtube.com/watch?v=PeJP0zwp4cU	optical fiber cable
AV-13	https://www.youtube.com/watch?v=6CqT4DuAVxs	manufacturing of optical fibers
AV-14	https://www.youtube.com/watch?v=N_kA8EpCUQo	Construction and types of fibers
AV-15	https://www.youtube.com/watch?v=0MwMkBET_5I	Total internal reflection
AV-16	https://www.youtube.com/watch?v=XI18Is5Lp9I	Working and theory of Nd:YAG laser
AV-17	https://www.youtube.com/watch?v=WJ05XOJiaDY	Pumping and population inversion
AV-18	https://www.youtube.com/watch?v=1LmcUaWuYao	How laser works?
AV-19	https://www.youtube.com/watch?v=R_QOWbkc7UI	Laser Principle
AV-20	https://www.youtube.com/watch?v=unTZjYsKs3g	Main component of Laser
AV-21	https://www.youtube.com/watch?v=lW4Uq_2VPhE	working of laser
AV-22	https://www.youtube.com/watch?v=dyOp7f-2C5E	ampere circuital law
AV-23	https://www.youtube.com/watch?v=9FCYGbOWk4w	introduction to electromagnetism
AV-24	https://www.youtube.com/playlist?list=PLyQSN7X0ro2314mKyUiOILaOC2hk6Pc3j	video lectures on electricity and magnetism by Walter Lewin

Virtual Labs (VL)		
Sr No	**(VL) (only if relevant to the course)**	**Salient Features**
VL-1	http://www.falstad.com/dispersion/group.html	Phase and group velocities applet
VL-2	http://phys23p.sl.psu.edu/phys_anim/EM/indexer_EM.html	Electromagnetic waves

LTP week distribution: (LTP Weeks)	
Weeks before MTE	7
Weeks After MTE	7
Spill Over (Lecture)	7

Detailed Plan For Lectures

Week Number	Lecture Number	Broad Topic(Sub Topic)	Chapters/Sections of Text/reference books	Other Readings, Relevant Websites, Audio Visual Aids, software and Virtual Labs	Lecture Description	Learning Outcomes	Pedagogical Tool Demonstration/ Case Study / Images / animation / ppt etc. Planned	Live Examples

Week 1	Lecture 1	Electromagnetic theory (scalar and vectors fields)	T-1	RW-15 VL-2	Lecture1 will be introduction to the course and Lecture2 will cover basic mathematical quantities like gradient, divergence and curl	L1: Student will understand the importance of the course L2:importance of scalar and vector fields	Discussion using animation	
		Electromagnetic theory (concept of gradient, divergence and curl)	T-1	OR-1 RW-15	Introduction to basic mathematical quantities like gradient, divergence and curl	Student will learn about solenoidal,rotational, irrotational	Discussion using Video	
	Lecture 2	Electromagnetic theory (scalar and vectors fields)	T-1	RW-15 VL-2	Lecture1 will be introduction to the course and Lecture2 will cover basic mathematical quantities like gradient, divergence and curl	L1: Student will understand the importance of the course L2:importance of scalar and vector fields	Discussion using animation	
		Electromagnetic theory (concept of gradient, divergence and curl)	T-1	OR-1 RW-15	Introduction to basic mathematical quantities like gradient, divergence and curl	Student will learn about solenoidal,rotational, irrotational	Discussion using Video	
	Lecture 3	Electromagnetic theory (Gauss theorem and Stokes theorem (qualitative))	T-1	AV-24	Gauss theorem and Stokes theorem (without derivation)	Student will learn about the conversion of volume integral into surface and surface integral into line integral	Qualitative discussion	
Week 2	Lecture 4	Electromagnetic theory (Poisson and Laplace equations, continuity equation)	T-1	AV-23	Poisson and Laplace equations, continuity equation(Qualitative and Quantitative view)	Student will Learn about the electric flux density	Illustrative video	
	Lecture 5	Electromagnetic theory (Ampere Circuital Law, Maxwell displacement current and correction in Ampere Circuital Law)	T-1 R-2	AV-22	Ampere Circuital Law, Maxwell displacement current and correction in Ampere Circuital Law (both qualitative and quantitative View)	Understand the relation between electricity and Magnetism	Derivation and discussion	Allotment of Assignment (Lab at home)
	Lecture 6	Electromagnetic theory (Maxwell electromagnetic equations (differential and integral forms))	T-1 R-2	OR-3 AV-24	Maxwell electromagnetic equations (differential and integral forms), physical significance of Maxwell equations	student Learn the physical significance of Maxwell equations	Discussion with video	Electromagnetic spectrum

Week 2	Lecture 6	Electromagnetic theory (physical significance of Maxwell equations)	T-1 R-2	OR-3 AV-24	Allotment of Lab@home, Maxwell electromagnetic equations (differential and integral forms), physical significance of Maxwell equations	Student learn the physical significance of Maxwell equations	Discussion with derivation	
Week 3	Lecture 7	Electromagnetic theory (Maxwell electromagnetic equations (differential and integral forms))	T-1 R-2	OR-3 AV-24	Maxwell electromagnetic equations (differential and integral forms), physical significance of Maxwell equations	student Learn the physical significance of Maxwell equations	Discussion with video	Electromagnetic spectrum
		Electromagnetic theory (physical significance of Maxwell equations)	T-1 R-2	OR-3 AV-24	Allotment of Lab@home, Maxwell electromagnetic equations (differential and integral forms), physical significance of Maxwell equations	Student learn the physical significance of Maxwell equations	Discussion with derivation	
	Lecture 8	Lasers and applications (fundamentals of laser-energy levels in atoms)	T-1	AV-17 AV-19	fundamentals of laser-energy levels in atoms, Radiation matter interaction, Absorption of light, spontaneous emission of light, stimulated emission of light	student will learn fundamental concepts of laser	Discussion	Incandescent light bulbs and laser
		Lasers and applications (Radiation matter interaction, Absorption of light, spontaneous emission of light, stimulated emission of light)	T-1	AV-17 AV-19	fundamentals of laser-energy levels in atoms, Radiation matter interaction, Absorption of light, spontaneous emission of light, stimulated emission of light	student will learn fundamental concepts of laser	Discussion with animation	Incandescent light bulbs and laser
	Lecture 9	Lasers and applications (metastable state, population inversion)	T-1	RW-14 AV-20 AV-21	metastable state, population inversion, lasing action, properties of laser	comparison of laser with ordinary sources of light	Discussion with animation	Laser
		Lasers and applications (lasing action, properties of laser)	T-1	RW-14 AV-20 AV-21	metastable state, population inversion, lasing action, properties of laser	Student will understand by comparing laser with ordinary sources of light	Discussion along with animation and video	Laser

Week 4	Lecture 10	Lasers and applications (population of energy levels, Einstein A and B coefficients)	T-1	RW-14	population of energy levels, Einstein A and B coefficients	Understand the basic principle and theory of lasers	Discussion	
	Lecture 11	Lasers and applications (resonant cavity, excitation mechanisms)	T-1 R-1	RW-9	Optical cavity and different pumping technique	knowledge of active medium pumping sources	Explanation using video	optical pumping
	Lecture 12	Lasers and applications(Nd - YAG, He-Ne Laser, Semiconductor Laser)	T-1 R-2	AV-16 AV-18	Ruby ,Nd - YAG, He-Ne Laser, Semiconductor Laser (construction and working Mechanism)	Student understand the working,principle and construction of Ruby,He Ne Laser,Nd-YAG laser and semiconductor	Discussion along with video	
		Lasers and applications (applications of laser in engineering, holography.)	T-1 R-2	RW-10 RW-11 RW-12 RW-13 AV-18	Ruby ,Nd - YAG, He-Ne Laser, Semiconductor Laser (construction and working Mechanism) Holography : Recording and Reconstruction of Hologram (Qualitative view)	different types of lasers .Conceptual learning of formation of 3D images	Video lecture	
Week 5	Lecture 13	Lasers and applications(Nd - YAG, He-Ne Laser, Semiconductor Laser)	T-1 R-2	AV-16 AV-18	Ruby ,Nd - YAG, He-Ne Laser, Semiconductor Laser (construction and working Mechanism)	Student understand the working,principle and construction of Ruby,He Ne Laser,Nd-YAG laser and semiconductor	Discussion along with video	
		Lasers and applications (applications of laser in engineering, holography.)	T-1 R-2	RW-10 RW-11 RW-12 RW-13 AV-18	Ruby ,Nd - YAG, He-Ne Laser, Semiconductor Laser (construction and working Mechanism) Holography : Recording and Reconstruction of Hologram (Qualitative view)	different types of lasers .Conceptual learning of formation of 3D images	Video lecture	
	Lecture 14				Online Assignment			
	Lecture 15	Fiber optics(fiber optics introduction)	T-1 R-1	RW-8 AV-12 AV-15	optical fiber as a dielectric wave guide	Student will Learn the propagation of light from optical fiber.	Explanation using video	
		Fiber optics(optical fiber as a dielectric wave guide)	T-1 R-1	RW-8 AV-12 AV-15	optical fiber as a dielectric wave guide	fundamentals of fiber	Demonstration	

Week 6	Lecture 16	Fiber optics(total internal reflection, acceptance angle, numerical aperture)	R-1 R-2	AV-14	total internal reflection, acceptance angle, numerical aperture	fiber optics fundamentals	Discussion And demonstration using video	
		Fiber optics(relative refractive index, V-number)	R-1 R-2	AV-14	total internal reflection, acceptance angle, numerical aperture	Student Learn the fundamental parameters of optical fiber.	Discussion with animation	
	Lecture 17	Fiber optics(step index and graded index fibers)	T-1 R-1	RW-14 AV-13	step index and graded index fibers	types of fibers	Video describing the phenomenon	
	Lecture 18	Fiber optics(losses associated with optical fibers)	T-1 R-1	RW-14 AV-12	losses associated with optical fibers	reason for data loss	Explanation using video	
Week 7	Lecture 19	Fiber optics(application of optical fibers)	T-1 R-1	OR-2	application of optical fibers	application of optical fibers	Discussion	endoscopy
		SPILL OVER						
Week 7	Lecture 20				Spill Over			
	Lecture 21				Spill Over			
		MID-TERM						
Week 8	Lecture 22	Quantum mechanics(need of quantum mechanics)	T-1	RW-7	Importance of quantum mechanics will be explained here	Student will learn about quantum nature of matter	Illustrative videos and simulations	
		Quantum mechanics (photoelectric effect)	T-1	RW-6	Importance of quantum mechanics will be explained here	Student will learn about quantum nature of matter	Illustrative videos and simulations	
	Lecture 23	Quantum mechanics(concept of de Broglie matter waves)	T-1	RW-7	Dual nature of matter will be explained here, relation between wavelength and momentum/energy need to be discussed.	How wavelength and momentum/energy are related?	Simulations and videos	
		Quantum mechanics (wavelength of matter waves in different forms)	T-1	RW-7	Dual nature of matter will be explained here, relation between wavelength and momentum/energy need to be discussed.	How wavelength and momentum/energy are related?	Simulations and videos	
	Lecture 24	Quantum mechanics (Heisenberg uncertainty principle)	T-1	AV-11	Heisenberg uncertainty principle, concept of phase velocity and group velocity	How to use uncertainty principle to calculate uncertainty in physical quantities?	Videos and discussion	

Week 8	Lecture 24	Quantum mechanics(concept of phase velocity and group velocity (qualitative))	T-1	VL-1	Heisenberg uncertainty principle, concept of phase velocity and group velocity	How to use uncertainty principle to calculate uncertainty in physical quantities?	Videos and animations	
Week 9	Lecture 25	Quantum mechanics(wave function and its significance)	T-1 R-1	RW-6 RW-7	Introduction to wave functions and concept of waves of probability, basic principle in quantum physics-Schrodinger equation	Probabilistic behavior of quantum physics.	Videos and animation	
		Quantum mechanics (Schrodinger time dependent and independent equation)	T-1 R-1	RW-7	Introduction to wave functions and concept of waves of probability, basic principle in quantum physics-Schrodinger equation	Probabilistic behavior of quantum physics.	Videos and discussion	
	Lecture 26	Quantum mechanics(wave function and its significance)	T-1 R-1	RW-6 RW-7	Introduction to wave functions and concept of waves of probability, basic principle in quantum physics-Schrodinger equation	Probabilistic behavior of quantum physics.	Videos and animation	
		Quantum mechanics (Schrodinger time dependent and independent equation)	T-1 R-1	RW-7	Introduction to wave functions and concept of waves of probability, basic principle in quantum physics-Schrodinger equation	Probabilistic behavior of quantum physics.	Videos and discussion	
	Lecture 27	Quantum mechanics(particle in a box)	T-1	AV-10	Particle in a box problem, for example electron confined in a potential	Energy of the particles is discrete and quantized.	Animation	
Week 10	Lecture 28				Online Assignment			
	Lecture 29	Waves(interference phenomenon)	T-1 R-3	AV-2	Wave interference and concept of resonance	Student will learn about concept of resonance	Video and animation	
		Waves(concept of resonance)	T-1 R-3	AV-2	Wave interference and concept of resonance	Student will learn about concept of resonance	Video and animation	
	Lecture 30	Waves(production of ultrasonic waves by magnetostriction method)	T-1 R-1	RW-4	Categorization of sound waves, production of high frequency sound by magnetostriction and piezoelectric method.	Students will learn about different range of frequency of sound and how to produce high frequency sound?	Illustrative video	

Week 10	Lecture 30	Waves(audible, ultrasonic and infrasonic waves)	T-1 R-1	RW-2	Categorization of sound waves, production of high frequency sound by magnetostriction and piezoelectric method.	Students will learn about different range of frequency of sound and how to produce high frequency sound?	Explanation using videos	
		Waves(production of ultrasonic waves by piezoelectric method)	T-1 R-1	RW-4	Categorization of sound waves, production of high frequency sound by magnetostriction and piezoelectric method.	Students will learn about different range of frequency of sound and how to produce high frequency sound?	Explanation using videos	
Week 11	Lecture 31	Waves(ultrasonic transducers and their uses)	T-1 R-1	AV-1	Ultrasonic transducers and applications	Student will gain the knowledge transducers proximity calculations.	Explanation using videos	
		Waves(applications of ultrasonic waves)	T-1 R-1	RW-3	Ultrasonic transducers and applications	Student will gain the knowledge transducers proximity calculations.	Videos and discussion	
	Lecture 32	Waves(detection of ultrasonic waves (Kundt's tube method, sensitive flame method and piezoelectric detectors))	T-1 R-3	RW-1	Detection of ultrasonic waves	Students will learn different methods to detect ultrasonic waves	videos and discussion	
		Waves(absorption and dispersion of ultrasonic waves)	T-1 R-3		Detection of ultrasonic waves	Students will learn different methods to detect ultrasonic waves	videos and animation	
	Lecture 33	Waves(detection of ultrasonic waves (Kundt's tube method, sensitive flame method and piezoelectric detectors))	T-1 R-3	RW-1	Detection of ultrasonic waves	Students will learn different methods to detect ultrasonic waves	videos and discussion	
		Waves(absorption and dispersion of ultrasonic waves)	T-1 R-3		Detection of ultrasonic waves	Students will learn different methods to detect ultrasonic waves	videos and animation	
Week 12	Lecture 34				Online Assignment			
	Lecture 35	Solid state physics(free electron theory (Introduction))	T-1 R-1	RW-5 AV-9	free electron theory (Introduction), diffusion and drift current (qualitative)	Students will understand conduction theory for metals	Illustrative video	
		Solid state physics(diffusion and drift current (qualitative).)	T-1 R-1	RW-5 AV-9	free electron theory (Introduction), diffusion and drift current (qualitative)	Students will understand conduction theory for metals	Discussion	

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Week 12	Lecture 36	Solid state physics(fermi energy, fermi-dirac distribution function)	T-1 R-1	OR-4 AV-4	fermi energy, fermi-dirac distribution	how to arrange fermions	Explanation using video	
Week 13	Lecture 37	Solid state physics (semiconductors and insulators, fermi level for intrinsic and extrinsic semiconductors)	T-1 R-1	AV-8	semiconductors and insulators, fermi level for intrinsic and extrinsic semiconductors	Students will understand fermi level and its significance	Discussion with video	
	Lecture 38	Solid state physics(band theory of solids -formation of allowed and forbidden energy bands)	T-1 R-1 R-2	RW-5	band theory of solids - formation of allowed and forbidden energy bands	Student will understand the formation of bands in solids	Explanation along with video	
		Solid state physics(concept of effective mass - electrons and holes)	T-1 R-1 R-2	AV-3 AV-5 AV-6 AV-7	concept of effective mass - electrons and holes, direct and indirect band gap semiconductors	Student will understand the concept of positive and negative mass of electron	Discussion and video	
		Solid state physics(direct and indirect band gap semiconductors)	T-1 R-1 R-2	AV-5 AV-6	concept of effective mass - electrons and holes, direct and indirect band gap semiconductors	Student will understand the concept direct and indirect band gap	Discussion with animation	LEDs and solar cells
	Lecture 39	Solid state physics(concept of effective mass - electrons and holes)	T-1 R-1 R-2	AV-3 AV-5 AV-6 AV-7	concept of effective mass - electrons and holes, direct and indirect band gap semiconductors	Student will understand the concept of positive and negative mass of electron	Discussion and video	
		Solid state physics(direct and indirect band gap semiconductors)	T-1 R-1 R-2	AV-5 AV-6	concept of effective mass - electrons and holes, direct and indirect band gap semiconductors	Student will understand the concept direct and indirect band gap	Discussion with animation	LEDs and solar cells
Week 14	Lecture 40	Solid state physics(Hall effect (with derivation))	T-1 R-1	AV-3	Hall effect (with derivation)	working principle of Hall sensors	Discussion with derivation	
		SPILL OVER						
Week 14	Lecture 41				Spill Over			
	Lecture 42				Spill Over			
Week 15	Lecture 43				Spill Over			
	Lecture 44				Spill Over			
	Lecture 45				Spill Over			

List of suggested topics for term paper[at least 15] (Student to spend about 15 hrs on any one specified term paper)

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Sr. No.	Topic
1	Working and components of CFL and its installation in home, compared the power consumption of it with LED bulb.
2	Working principle of TV remote control and AC remote control.
3	Principle of cooling mechanism in AC, function of various parts of AC and compared its power consumption with electric fan
4	Magnetic switch and its working and compared it with mechanical switches
5	working principle of electrical chimney in home.
6	Working and components of incandescent bulb and its installation in home, compared the power consumption of it with CFL bulb.
7	Mobile battery charger circuit and working principle.
8	Principle of Cloths drying in washing machine.
9	Tube light working and white color emission and compared it with white LED.
10	Working principle of computer mouse (Wireless and optical).
11	Types and working principle of inverters.
12	Working of air purifier.
13	Working mechanism and functions of various parts of Water purifier.
14	Concept of antilock breaking system(ABS).
15	Capacitive touch screen.
16	Resistive touch screen.
17	Li fi technology and compared it with wi fi.
18	Working principle, components and material used in Induction cooker and compared its efficiency with ordinary LPG stove.
19	Vacuum cleaner.
20	LED display panel.

Plan for Tutorial: (Please do not use these time slots for syllabus coverage)

Tutorial No.	Lecture Topic	Type of pedagogical tool(s) planned (case analysis,problem solving test,role play,business game etc)
Tutorial1	Scalar and Vectors fields, Concept of gradient, divergence and curl	Problem Solving
Tutorial2	Gauss theorem and Stokes theorem (qualitative), Poisson and Laplace equations, continuity equation, Ampere Circuital Law	Problem Solving
Tutorial3	Maxwell displacement current and correction in Ampere Circuital Law, Maxwell electromagnetic equations (differential and integral forms), physical significance of Maxwell equations	Problem Solving

Tutorial4	fundamentals of laser- energy levels in atoms, Radiation matter interaction, Absorption of light, spontaneous emission of light, stimulated emission of light, population of energy levels	Problem Solving
Tutorial5	Einstein A and B coefficients, metastable state, population inversion, lasing action, properties of laser, resonant cavity, excitation mechanisms, Nd - YAG, He-Ne Laser, Semiconductor Laser, applications of laser in engineering, holography	Problem Solving
Tutorial6	fiber optics introduction, optical fiber as a dielectric wave guide, total internal reflection, acceptance angle, numerical aperture	Problem Solving
Tutorial7	relative refractive index, V- number, step index and graded index fibers, losses associated with optical fibers, application of optical fibers	Problem Solving
After Mid-Term		
Tutorial8	need of quantum mechanics, photoelectric effect,concept of de Broglie matter waves, wavelength of matter waves in different forms,Heisenberg uncertainty principle	Problem Solving
Tutorial9	concept of phase velocity and group velocity (qualitative),wave function and its significance, Schrodinger time dependent and independent equation, particle in a box	Problem Solving
Tutorial10	In this tutorial lab at home submission is scheduled. Evaluate this academic tasks as per rubrics given in the course files.	Problem Solving
Tutorial11	ultrasonic transducers and their uses, applications of ultrasonic waves, detection of ultrasonic waves (Kundt's tube method, sensitive flame method and piezoelectric detectors), absorption and dispersion of ultrasonic waves	Problem Solving
Tutorial12	free electron theory (Introduction), diffusion and drift current (qualitative)., fermi energy, fermi-dirac distribution function	Problem Solving
Tutorial13	band theory of solids - formation of allowed and forbidden energy bands, concept of effective mass - electrons and holes, Hall effect (with derivation)	Problem Solving
Tutorial14	semiconductors and insulators, fermi level for intrinsic and extrinsic semiconductors, direct and indirect band gap semiconductors	Problem Solving