Pt. Ravishankar Shukla University Raipur

CURRICULUM & SYLLABUS

(Based on CBCS & LOCF)

M.Tech. in Optoelectronics and Laser Technology

Semester System

Session: 2024-25 & onwards

Approved by:	Board of Studies in Electronics & Physics	Academic Council
Date:		

03/09/2024

M. Tech in Optoelectronics and Laser Technology

The M.Tech. in Optoelectronics and Laser Technology is a two-year, four-semester program tailored to achieve a comprehensive set of course objectives. Firstly, it strives to impart a higher level of knowledge and understanding of optoelectronics and laser technology to its students, ensuring they possess a deep grasp of the subject matter. Additionally, the program focuses on the practical application of these principles, enabling students to harness optoelectronics for newer and innovative applications. Furthermore, it equips students with the analytical skills to dissect mathematical models of physical systems, enhancing system performance, while also recognizing the limitations inherent in these systems. Developing the ability to construct mathematical models for defined physical systems is another core objective, empowering students to tackle complex problems effectively. Moreover, the program prepares students to critically evaluate the soundness of proposed concepts, fostering a spirit of scientific inquiry. In addition to academic pursuits, it hones students' skills to pursue careers in physics, whether in teaching or research, promoting a well-rounded approach to the field. Lastly, the program emphasizes teamwork and lifelong learning, ensuring that students are ready for continuous professional development throughout their careers. In essence, the M.Tech. program in Optoelectronics and Laser Technology offers a holistic education that not only imparts technical expertise but also nurtures a commitment to excellence and adaptability in the ever-evolving world of optoelectronics and laser technology

PROGRAMME OUTCOMES (POs): On successful completion of this course, student should be able to

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and Synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and Modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs): At the end of the program, the student will be able to:

PSO1:	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PSO2:	**Problem analysis:** Identify, formulate, research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PSO3:	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

M. Tech. Optoelectronics and Laser Technology

Specification of Course	**Semester**	**No. of Courses**	**Credits**
Core	I-IV	15	42
Elective	I-II	2	8
Major Project (Core)	III-IV	2	50
Total		19	100
Additional Courses (Qualifying in Nature for students admitted in school of Studies only)			
Skill Enhancement (Value added courses)	II	01	02
Indian Knowledge System (IKS)	I	01	02

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M.Tech. Optoelectronics and Laser Technology

PROGRAMME STRUCTURE

Semester	Course Nature	Course Code	Course Title	Course Type (T/P)	Hrs. / Week	Credits	Marks		
							CIA	ESE	Total
Semester-I	Core	OELT-101	Modern Optics	T	5	4	30	70	100
	Core	OELT-102	Laser Technology	T	5	4	30	70	100
	Core	OELT-103	Optoelectronics	T	5	4	30	70	100
	Core	OELT-104	Optical Communication	T	5	4	30	70	100
	Core	OELT-105	Seminar	P	1	1	-	-	50
	Core	OELT-106	Comprehensive Viva voce	P	-	Grade	-	-	
	Core	OELT-107	Photonics Lab-I	P	10	4	30	70	100
	Elective1 (Select any one)	OELT-108	Quantum Optics	T	5	4	30	70	100
		OELT-109	Advanced Engineering Physics	T	5	4	30	70	100
Semester-II	Core	OELT-201	Physics of Advanced Materials	T	5	4	30	70	100
	Core	OELT-202	Fiber Optics & Laser Instrumentation and Solar Photovoltaic Technologies	T	5	4	30	70	100
	Core	OELT-203	Optical Networks	T	5	4	30	70	100
	Core	OELT-204	Advance Optical Communication	T	5	4	30	70	100
	Core	OELT-205	Seminar	P	1	1	-	-	50
	Core	OELT-206	Comprehensive Viva Voce	P	-	Grade	-	-	
	Core	OELT-207	Photonics Lab-II	P	10	4	30	70	100
	Elective 2(Select any one)	OELT-208	Photonics Materials and Devices	T	5	4	30	70	100
		OELT-209	Nano Photonics	T	5	4	30	70	100
Semester-III	Core	OELT-301	Major Project Phase -I	P	36	25	120	280	400
Semester-IV	Core	OELT-401	Major Project Phase -II	P	36	25	120	280	400
	Core	OELT-402	Viva-Voce	p	-	Grade	-	-	-

Note:

1. In place of Elective Course Student can choose paper(s) from MOOC Courses (Swayam Portal) subject to the following conditions:
   a) The chosen paper will be other than the papers offered in the current course structure.
   b) The paper will be PG level with a minimum of 12 weeks' duration.

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c) The list of courses on SWAYAM keeps changing, the departmental committee will finalize the list of MOOC courses for each semester.
d) The paper(s) may be chosen from Swayam Portal on the recommendation of Head of the Department.

2. The candidates who have joined the M.Tech Programme in Optoelectronics and Laser Technology in School of Studies in Electronics and Photonics, shall undergo Generic Elective Courses (only qualifying in nature) offered by other departments/ SoS in Semester II and Semester III.
3. The candidates who have joined the M.Tech Programme in Optoelectronics and Laser Technology in School of Studies in Electronics and Photonics, shall undergo Skill Enhancement Course/Value Added Course (only qualifying in nature) in Semester II.
4. The candidates who have joined the M.Tech Programme in Optoelectronics and Laser Technology in School of Studies in Electronics and Photonics, shall undergo Indian Knowledge System (only qualifying in nature) in Semester I.
5. 1 Credit = 15 hrs (Theory), 1 Credit = 30 hrs (Practical)

Skill Enhancement/Value Added Courses: (Offered to the PG students of SoS in Electronics and Photonics)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	OELT-501	PYTHON / MATLAB/ SCAPS-1D/ PC-1D	P	2	2	30	70	100

Indian knowledge System (IKS): (Offered to the PG students of SoS in Electronics and Photonics)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
I	OELT-601	IKS: It's relevance to Electronics & Photonics	T	2	2	30	70	100

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Programme Atriculation Matrix:

Following matrix depicts the correlation between all the courses of the programme and programme outcomes ✓×

Course Code	PO's												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
OELT-101	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
OELT-102	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
OELT-103	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
OELT-104	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
OELT-105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-106	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-107	✓	✓	✓	✓	✓	✓	✓	×	×	✓	✓	✓	✓	✓	✓
OELT-108	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
OELT-109	✓	✓	✓	✓	✓	✓	✓	×	×	✓	✓	✓	✓	✓	✓
OELT-201	✓	✓	✓	✓	✓	✓	✓	✓	×	×	✓	✓	✓	✓	✓
OELT-202	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
OELT-203	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-204	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
OELT-205	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-206	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-207	✓	✓	✓	✓	✓	✓	✓	×	×	✓	✓	✓	✓	✓	✓
OELT-208	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-209	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
OELT-301	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-401	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OELT-402	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
No. of courses mapping the PO/PSO	21	21	21	21	21	21	21	12	15	20	21	21	21	21	21

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DETAILED SYLLABUS

Semester -I

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	1st

Course Code	Course Title	Course Type
OELT-101	MODERN OPTICS	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):
This course helps the student to develop a thorough understanding of the underlying physical principles of various modern optical phenomena and their applications and to learn the basic phenomena in Optics.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Explain the propagation of light in conducting and non-conducting media	U
2.	Understand reflection/transmission behaviour of light interacting with a dielectric interface	U
3.	Analyze the polarization state of a beam of light	An
4.	Use the principles of wave motion and superposition to explain the physics of polarization, dispersion, interference and diffraction.	Ap
5.	Describe the operation of optical devices, including, polarisers, retarders, modulators, inteferometers, diffraction gratings.	U
6.	Have an understanding of light coherence, the coherent properties of light from various sources, and the measurement of degrees of coherence	U
7.	Use Fourier transform theory to predict and interpret imaging under various Fourier transform filtering conditions.	Ap

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	2	2	1	1	3	1	2	-	2	3	3	3	2	2	1
2.	2	2	1	2	1	1	3	-	-	-	2	3	2	1	2
3.	3	3	2	1	1	2	3	-	-	2	2	1	2	3	1
4.	3	2	2	3	3	2	2	-	1	2	3	3	3	2	3
5.	2	1	3	1	3	2	2	1	1	3	3	2	3	3	3
6.	2	1	2	2	2	3	2	2	1	3	3	2	3	2	2
7.	3	3	2	3	3	3	-	-	2	3	2	3	3	3	-

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	Classification of optical processes, optical coefficients, complex refractive index and dielectric constant. **Optical materials:** Crystalline insulators and semiconductor, glasses, metal, molecular materials, doped glass and insulator characteristics, Optical Physics in the Solid state, crystal symmetry, electronics bands, vibronic band, the density of state, delocalized states and collective excitation **Light propagation:** Propagation of light in dense optical medium, atomic oscillator, vibration oscillator, free electron oscillation, the Kramers – Kronig relationship, Dispersion, Optical anisotropy, birefringence. Matrix representation of polarization, Jones vector, Jones matrices, Jones calculus, orthogonal polarization. Reflection and refraction at a plane boundary, fresnel's equations.	11
02	**Excitons:** Basic concept, free excitons in external electric and magnetic fields, Free Excitons at light densities, Frenkel excitons. **Luminescence:** Light emission in solids, Inter band luminescence, Direct and indirect gap materials, photoluminescence: Excitation and relaxation degeneracy Photoluminescence spectroscopy.	15

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	Electroluminescence: General Principles of electroluminescence, light emitting diodes, diode laser.	
03	Electromagnetism in dielectrics, Electromagnetism fields and Maxwell equation. Electromagnetism waves, Quantum theory of radiative absorption and emission. Einstein coefficients, Quantum transition rates, selection rules. Basic concept of phonons, Polaritons and polarons. **Laser Plasma Interaction:** Basic concepts and two-fluid description of plasmas, electromagnetic wave propagation in plasmas.	**15**
04	**Nonlinear optics:** Nonlinear optics: Physical origin of optical nonlinearities, Non resonant and resonant nonlinearities, second order nonlinearities, Non liner frequency mixing, Crystal symmetry, Phase matching, Third order nonlinear media. Harmonic generation, mixing and parametric effects. multiphonon processes Two-photon absorption, saturated absorption, Spectroscopy Rayleigh, and Raman scattering. Stimulated Raman effect, Hyper Raman effect, Coherent Antistoke Raman scattering Self-focusing and self-phase modulation. Self-induced transparency. Solitons.	**18**
05	**Optical Design, Fourier Optics & Holography:** Revision of geometrical optics. Fourier transforms. impulse response transfer function. Scalar diffraction, spatial and temporal coherence. **Holography**: Image forming systems, The wavefront reconstruction process: Inline hologram, the off-axis hologram, Fourier hologram, the lens less Fourier hologram. The reconstructed image: Image of a point, image magnification, orthoscopic and pseudoscopic images, effect of source size and spectral bandwidth. Thin hologram, volume hologram, volume transmission hologram and volume refraction holograms. Materials for recording holograms, holograms for displays, colour holography, holographic optical elements. Holographic interferometry: Real time holographic interferometry, double exposure holographic interferometry image hologram, Image forming systems, coherent and incoherent imaging. Spatial filtering. Holography (Fresnel, Fraunhofer, Fourier). Holographic techniques and applications. Fourier transforming property of thin lens.	**16**

Suggested Study material:

1. Optical Electronics, A. Yariv Saunders
2. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.K
3. Essentials of Optoelectronics, A. Rogers (Chapman Hall)
4. Optical Properties of Solids Mark Fox
5. Jasprit Singh, Semi-conductor Optoelectronics, McGraw Hill, 1995
6. P. Hariharan, Optical holography, (Cambridge University Press, 1984)

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	1st

Course Code	Course Title	Course Type
OELT-102	LASER TECHNOLOGY	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):
This course helps the student to study the principle, construction and working of different lasers and to provide a deeper knowledge about the theory, working and applications of lasers.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Describe Einstein's treatment of absorption and emission of radiation	U
2.	Describe the conditions required for laser action	U
3.	Describe laser media with rate equations and solve them	E
4.	Predict the stability of laser cavity	Ap
5.	Identify the behavior and functionality of different lasers	An
6.	Identify a laser for a particular application	An
7.	Review the safety requirements of lasers	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	3	2	3	3	3	3	-	-	3	3	3	2	1	3
2.	3	3	2	3	2	3	3	-	-	1	2	3	2	2	1
3.	3	3	2	3	2	3	3	-	-	2	2	2	2	1	2
4.	3	3	2	3	3	3	3	1	-	2	3	3	3	2	2
5.	3	2	2	3	3	3	3	1	-	3	3	2	3	3	3
6.	2	1	2	2	2	3	3	2	-	3	3	2	3	2	2
7.	2	1	1	2	3	3	2	3	1	3	2	3	3	3	-

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	**Einstein Coefficients and Light Amplification:** Introduction: The Einstein's coefficients, Quantum Theory for the Evaluation of the Transition Rates and Einstein Coefficients, Interaction with radiation having a broad spectrum, Introduction of a near monochromatic wave with an atom having a broad frequency response, more accurate solution for the two-level system, Line broadening mechanisms, Saturation Behavior of homogeneously and homogeneously broadening transitions.	11
02	**Laser Rate Equations:** Introduction, the three Level System, The Four level System, Variation of Laser Power around Threshold, Optimum Output coupling. Laser spiking. **Semi classical Theory of Laser**: Introduction, Cavity Modes, Polarization of cavity medium: First order & Higher order theory.	16
03	**Optical Resonators:** Introduction, modes of a rectangular cavity and the open planar resonator, The Quality factor, the ultimate line width of the laser, Transverse and longitudinal mode selection switching. Mode locking in Lasers Co focal Resonator system, Planar resonators, General Spherical Resonator. **Optical Pumping:** Laser pumping requirement and techniques, Optical Pumping and Electrical discharge pumping. Introduction of Flash Lamp,	15

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	Optically and diode pumped solid state lasers.	
04	**Properties of Laser Beams and laser Structures:** Coherence properties of Laser Light: Temporal Coherence, Spatial Coherence, Directionality **Semiconductor:** Interaction of photons with electrons and holes in semiconductors. Optical joint density of states, Structure and properties, operating principle, Threshold condition, Power output. **Heterojunction Laser:** Principle and structure, Losses in heterostructure laser, Heterostructure laser materials. **Distributed feedback lasers**: Principle of working, Coupled mode theory. Quantum well laser, Gain in quantum well lasers, Multi quantum well lasers, Strained quantum well laser, Vertical cavity surface emitting lasers. Free Electron Lasers: Basic Concepts.	18
05	**Types and some important applications of laser:** Properties of solid-state laser materials, Ruby, Nd: YAG lasers, Er: lasers, Ti: Saphire laser, Excimer lasers. Gas dynamic CO_2 lasers, High Power Laser. Laser induced fusion: Introduction, The fusion process, laser energy requirements. The laser induced Fusion Reactors. **Lasers in Science:** Harmonic Generation, Stimulated Raman Emission, Self-focusing, Lasers in Chemistry, Rotation of the Earth, Lasers in isotope Separation. Laser in light detection and ranging (LIDAR)	15

Suggested Study material:

1. Lasers Theory and Applications: K. Thyagrajan and A.K. Ghatak, Macmillan Publication
2. Laser Fundmentals - Willaim T Selfvast, Cambridge Univ-Press, 2nd edn (2008). (Text)
3. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.P. 0-521-31408-9
4. Laser Physics, P W Milonni and J H Eberly, John Wiley and Sons, 2010
5. Lasers - Anthony E Siegman, University Science Books, USA, 1986
6. Essentials of Optoelectronic, A Rogers (Chapman Hall), 0-412-40890-2

Suggested Reference book:

1. Fowles G.R., Introduction to Modem Optics, 2nd Edition, Holt, Rienhart and Winston.
2. Lasers and nonlinear optics, BB Laud, Wiley Eastern, 3rd edition (2004).
3. Optical Electronics – A Yariv (4th Ed. Saunders College Pub. (1991).
4. Solid State Laser Engineering - Koechonar (Springer Verlag. 1991).
5. Lasers, principles, types and applications-K R Nambiar, New Age International, Delhi (2004).
6. Free electron Laser T.C.Mashall.
7. Principles of lasers, Svelto and DC Hanna, 4th edition, Plenum Press (1998).

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	1st

Course Code	Course Title	Course Type
OELT-103	OPTOELECTRONICS	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):

This course helps the student to give a deeper understanding of the fundamental theories, fabrication, integration, characterization and applications of novel optoelectronic devices and to introduce the theory, working and applications of various optoelectronic devices.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Recall the properties of Photons and Electrons and recognize their applications in optoelectronic devices.	R
2.	Classify LED and laser diode structures and their applications.	U
3.	Differentiate the types of optical modulators and their applications.	An
4.	Categories different luminescence mechanisms involved in the modern display devices.	An
5.	Compare the modes of operations and characteristics of different optoelectronic detectors.	E

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	POs												PSOs		
	1	2	3	1	2	6	1	2	9	1	2	12	1	2	3
1.	2	1	2	1	3	1	2	1	2	3	3	3	2	1	1
2.	3	1	2	1	3	1	1	-	1	1	2	3	2	3	1
3.	3	2	3	2	3	2	3	-	1	2	2	1	2	1	3
4.	3	1	2	1	2	2	2	1	2	2	3	3	3	2	2
5.	2	1	2	1	2	2	2	2	1	3	3	2	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	**Optical process in Semiconductors** Electron hole pair formation and recombination, absorption in semiconductor, effect of electric field on Absorption, Franz-keldysh and stark effects, Absorption in Quantum wells and Quantum confined stark effect, relation between Absorption and emission spectra, Stokes shift in optical transition, Deep level transitions, Measurement of absorption and luminescence Spectra, Time resolved Photoluminescence.	14
02	**Materials Growth & Fabrication:** Growth of optoelectronics materials by MBE, MOCVD, Plasma CVD, photochemical deposition. Epitaxy, interfaces and junctions (advantages/disadvantages of growth methods on interface quality, interdiffusion and doping. Quantum wells and band gap engineering. **Equipments for Thin Film Deposition**: Working principle of Vacuum Coating Unit, Spin Coating Unit, Dip coating unit, Basics of Ellipsometer and Spray pyrolysis apparatus and their specifications and features.	17
03	**Organic Electronics:** Molecular materials, electronic state in conjugated molecules, Optical spectra of molecules, electronic vibration transitions, the Franck Condon principle hydrocarbons, conjugated polymer, Conductivity and Mobility of nearly-fee Charge Carriers, Charge Carriers in Organic Semiconductors: Polarons, Shallow Traps and Deep Traps, Generation of Charge Carriers and Charge Transport: Experimental Methods. The TOF Method: Gaussian Transport. Space-Charge Limited Currents. Band or Hopping Conductivity, Electric-field Dependence, Charge Transport in Disordered Organic Semiconductors. The Bassler Model.	17

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04	**Organic Optoelectronic Devices:** Organic Light-Emitting Diodes (OLEDs). The Principle of the OLED, Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs **Organic photovoltaic diodes (OPVDs):** Fundamental process, Exciton absorption, citon dissociation, Charge collection characterization of OPVDs, Relevant performance parameters.	15
05	**Introduction to Semiconductor Device Simulation:** Need of Simulation, Process Simulation, Device Simulation device simulation sequence, hierarchy of transport models, DD Model, Relationship between various transport regimes and significant length-scales. Numerical Solution Methods - finite difference scheme, discretization of Poisson's and current continuity equations.	12

Suggested Study material:

1. Organic Molecular Solids Markus Schwoerer (Author), Wolf, Wiley-VCH; 1 edition (March 27, 2007)
2. Semiconductor Devices Modeling and Technology" by Nandita Das Gupta and Amitava Das Gupta, Prentice Hall of India Pvt.Ltd.
3. Fibre Optics and Opto-electronics, R P Khare (Oxford University Press, 2004)
4. Computational Electronics: Dragica Vasileska and Stephen M. Goodnick, CRC Press
5. Semiconductor Optoelectronics Devices: Pallabh Bhattacharya. Pearson Education
6. Optical Electronics, A. Yariv Saunders.
7. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.P. 0-521-31408-9
8. Essentials of Electronic & Optoelectronics properties of semiconductor, Jasprit Singh, Cambridge University Press

Suggested References for this course:

1. Organic Electronics: Materials, Manufacturing and Applications Hagen Klauk, 1 edition
2. Hand book of thin film technology, by L. I. Maissel and R. Glang
3. Thin film phenomena, By K. L. Chopra
4. Introduction to optical electronics - J Palais (Prentice Hall, 1988)
5. Optical fibre communication systems - J Gowar (Prentice Hall 1995)
6. Optical fibre communication - J M Senior (Prentice Hall India (1994)
7. Semiconductor opto electronics - Jasprit Singh (McGraW-Hill, Inc, 1995)
8. Opto electronics-Thyagaraj an and Ghatak, Cambridge Uni, Press (1997)
9. Opto electronics -An introduction - J Wilson and J F B J iS Hawkers.(Prentice-Hall India, 1996)

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Program	Subject		Year	Semester
M.Tech	Optoelectronics and Laser Technology		1st	1st
Course Code	Course Title			Course Type
OELT-104	OPTICAL COMMUNICATION			Core
Credits	Hours Per Week (L-T-P)			
	L	T		P
4	4	0		0
Maximum Marks	CIA	ESE		
100	30	70		
**Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall				

Learning Objective (LO):
This course helps the student to enable the students to understand the principles and design considerations of different optical communication systems and to provide basic understanding and knowledge about various types of optical fiber communication systems and to equip students with understanding of Optical fiber communication systems, their analysis and design. Issues in advanced DWDM system, Impairments in optical system, etc.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Describe the properties and advantages of optical guided communication	R
2.	Identify the various components of optical fiber communication system	U
3.	Describe the operation of optical receivers including the types of preamplifiers	U
4.	Classify various multiplexing schemes and operation principles of wavelength division multiplexing	U
5.	Design and prepare optical power loss/gain budget with various line coding	Ap
6.	Distinguish semiconductor optical amplifier and erbium doped fiber amplifier and calculate its gain and power conversion efficiency	U
7.	Describe various optical network topologies and its performance	U

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CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

COs-POs/PSOs Mapping for the course:

Pos / COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	2	3	2	2	-	1	2	1	3	2	1	1
2.	2	2	2	3	3	2	2	-	2	1	2	3	2	1	1
3.	3	3	3	2	2	3	2	-	1	2	1	1	2	1	1
4.	3	2	3	3	3	2	3	-	1	2	1	3	3	2	2
5.	2	1	3	2	3	3	2	-	2	3	2	2	3	2	2
6.	3	1	2	2	3	3	3	2	2	3	2	2	3	2	1
7.	3	3	3	3	3	3	3	2	2	3	2	3	3	3	-

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	Need for fiber optic Communication, evolution of light wave systems and its components. Optical Fiber – their classification, essentials of electromagnetic theory – total internal reflection, Goos Hanchen shifts Dispersion in Single mode fiber, fiber losses, non-liner optical effects and polarization effect. Analysis of Optical fiber waveguides, electromagnetic mode. Theory for optical propagation attenuation and single distortion in optical waveguide. Characteristic equation of step-index fiber, modes and their cut-off frequencies, single-mode fibers, weakly guiding fibers, linearly polarized modes, power distribution. Graded-index fibers- WKB and other analysis, propagation constant, leaky modes, power profiles, dispersions – material, modal & waveguide, impulse response.	12
02	**Physics and Technology of Optical Fiber:** Passive photonic components: FO cables, Splices, Connectors, Couplers, Optical filter, Isolator, Circulator and Attenuator, switches. **Fabrication of optical fibers:** MOCVD, OVD, VAD, PCVD; measurement of RI, attenuation. Etc. Fiber devices, fiber Bragg gratings, long period	16

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	gratings, fiber amplifiers and lasers. Application of optical fibers in science, industry, medicine and defense.	
03	**Optical fiber systems**: Modulation schemes, Digital and analog fiber communication system-Digital and analog link and power budget of the optical fiber links, system design consideration, fiber choice, wavelength conversion, switching and cross connect. **Optical amplifiers:** Semiconductor Optical amplifier (SOA), characteristics, advantages and drawback of SOA, Raman amplifier, erbium doped fiber amplifier, gain and noise in EDFA, Brillion fiber amplifier, wideband Hybrid amplifier, noise characteristic, amplifier spontaneous emission, noise amplifier, noise figure, Cumulative and effective noise figure, Noise impairments, amplifier applications.	17
04	**Optical Transmitters and Receivers:** Basic concepts, Light emitting diodes, Semiconductor laser, characteristics, Transmitter design, Optical Receivers; Basic concepts, P-n and pin photo detector. Avalanche photo detector MSM photo detector, Receiver design, Receiver noise, Receiver sensitivity, Sensitivity degradation, performance. Electro-optic effect, electro optic retardation. Phase and amplitude modulators, transverse electro optic modulators, Acousto-optic effect, Raman-Nath and Bragg regime, acousto-optic modulators, magneto optic effects.	15
05	**Optical Multiplexing Techniques:** Wavelength division multiplexing (WDM): Multiplexing Technique, Topologies and architectures, Wavelength shifting and reverse, Switching WDM demultiplexer, optical Add/drop multiplexer. Dense wavelength division multiplexing (DWDM): System consideration, Multiplexer and demultiplexers, fiber amplifier for DWDM, SONET/SDH Transmission, Modulation formats, NRZ and RZ signaling, DPSK system modeling and impairments.	15

Suggested Study material:

1. Optical Fibre Communication - G Keiser, McGraw Hill(4th Ed), 2006.
2. OpticalFibre Communications - JM Senior(Prentice Hall India 1994).
3. Fibre Optic Communication - CAgarwal(Wheeler, 1993).
4. OpticalFibre Communication Systems- J Gowar(Prentice Hall, 1995).
5. Fibre Optic Communication -J Palais (Prentice Hall International 1988).
6. Optical networks: A practical perspective Kumar N Sivarajan and Rajeev Ramaswami, MarcourtAsia, ,2010.

Suggested References for this course:

1. Optical Fibre Communication - G Keiser, McGraw Hill (4th Ed), 2006
2. OpticalFibre Communications - JM Senior (Prentice Hall India 1994)

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3. Fibre Optic Communication - CAgarwa1(Wheeler, 1993)
4. OpticalFibre Communication Systems- J Gowar (Prentice Hall, 1995).
5. Fibre Optic Communication -J Palais (Prentice Hall International 1988).
6. Optical networks: A practical perspective Kumar N Sivarajan and Rajeev Ramaswami, MarcourtAsia, 2010

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	1st

Course Code	Course Title	Course Type
OELT-108	QUANTUM OPTICS	Elective

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

****Note : Student should be allowed to use Programmable Scientific Calculator in Examination hall**

Learning Objectives:
This course helps the student to provide knowledge on the evolution of Quantum optics and its impact in technological applications and to introduce the basic concepts and theory of Quantum Optics.

Course Outcomes (COs):

CO No.	Expected Course Outcomes: On successful completion of this course students should be able to	CL
1.	Discuss the basic theory of nonlinear optics including sum and difference frequency generation	U
2.	Analyze the origin of optical bistability and its implications	An
3.	Examine different mathematical transforms used in optical signal processing and compute the transforms of given functions	An
4.	Describe the basic concepts of optical computing and optical neural networks and their practical implementation	U
5.	Analyze the role of various light modulators in signal processing	An
6.	Construct spatial filtering geometries based on the Fourier transform property of lens	Ap

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CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	3	3	3	2	2	1	2	3	3	3	2	1	1
2.	2	2	2	2	2	3	3	-	1	1	2	3	2	3	1
3.	3	3	1	2	2	3	2	-	1	2	2	1	2	1	3
4.	3	2	3	3	3	2	3	3	2	2	3	3	3	2	2
5.	2	2	2	3	3	2	3	1	1	3	3	2	3	2	2
6.	3	2	1	2	2	2	2	2	1	3	3	2	3	2	3

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	**Introduction: What is quantum optics, A brief history of quantum optics** **Classical optics** Maxwell's equations and electromagnetic waves, Electromagnetic fields, Maxwell's equations, Electromagnetic waves, Polarization, Diffraction and interference	10
02	Formalism of quantum mechanics, The Schrodinger equation, Properties of wave functions m, Measurements and expectation values, the uncertainty principle, The Stern–Gerlach experiment, The band theory of solids	13
03	**Radiative transitions in atoms, Einstein** coefficients, Radiative transition rates , Selection rules **Photon statistics :** Introduction, Photon-counting statistics, Coherent light, Classification of light by photon statistics. **Coherent states and squeezed light** , Light waves as classical harmonic oscillators , Light as a quantum harmonic oscillator , Coherent states , Squeezed states , Detection of squeezed light .	15
04	Quantum information processing, Quantum cryptography, Classical cryptography, Basic principles of quantum cryptography Quantum key	10

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	distribution according to the BB84 protocol , System errors and identity verification, Error correction , Identity verification , Practical demonstrations of quantum cryptography ,Quantum cryptography in optical fibres .	
05	**Quantum computing** Introduction, Quantum bits (qubits), The concept of qubit, Quantum logic gates and circuits, Preliminary concepts Single-qubit gates, Two-qubit gates, Practical implementations of qubit operations optical realization of some quantum gates.	12

Suggested Study material:

1. Quantum Optics by M. Fox, Oxford Master series in Atomic, Optical and Laser physics
2. Introductory Quantum Optics by C.C. Gerry and P.L. Knight, Cambridge University Press
3. Quantum Optics by M.O. Scully and M.S. Zubairy, Cambridge University Press
4. Quantum Theory of Light by R. Loudon, Oxford science publication

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	1st

Course Code	Course Title	Course Type
OELT-109	ADVANCED ENGINEERING PHYSICS	Elective

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objectives:
This course helps the student to provide knowledge on the evolution of Quantum optics and its impact in technological applications and to introduce the basic concepts and theory of Quantum Optics.

Course Outcomes (COs):

CO No.	Expected Course Outcomes: On successful completion of this course students should be able to	CL
1.	Identify and correlate structure property relationship in various crystal phases	U
2.	Predict the nature of electronic transitions in periodic crystals	U
3.	Apply Schrödinger equation and Dirac algebra in the presence of various external potentials	Ap
4.	Construct Hamiltonians and solve eigen value problems in the presence of perturbations	Ap
5.	Analyze transition probabilities in perturbative systems using Fermi's Golden rule	An
6.	Apply Maxwell's equations and the concept of harmonic oscillator to quantize electromagnetic radiations	Ap
7.	Interpret rotational, vibrational, electronic and Raman spectroscopic data	Ap

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8.	Analyze UV-Vis, IR and Raman spectra of given samples	**An**

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	2	2	3	2	1	2	2	-	-	2	1	3	2	1	3
2.	2	2	2	1	1	1	1	1	-	1	3	3	2	3	1
3.	3	3	2	3	2	2	2	-	-	2	2	3	2	1	3
4.	3	2	3	3	3	3	3	-	1	3	3	2	3	2	2
5.	2	3	2	3	2	2	2	-	-	2	2	2	3	2	2
6.	3	2	3	2	3	2	2	-	-	2	2	2	3	2	1
7.	3	2	2	2	2	3	1	-	-	1	3	1	1	2	2
8.	2	3	2	2	3	2	1	-	-	2	3	2	3	2	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	Concepts of crystal structure, Symmetry elements, Group theory, Group theory in the classification of crystals, Bravais lattices, Reciprocal lattices, Concept of Brillouin zones, Zone boundary, Crystal directions, Crystal planes, Miller indices, Bonding in crystals, Band theory, Energy bands, Density of states, Fermi surface.	13
02	Familiarization of Matrix algebra, Concept of basis vectors, Dirac algebra, Operators in quantum mechanics, Hermitian and Unitary operators, Dirac delta function, General uncertainty principle, Schrödinger equations, Particle in a box, Quantization of energy levels, Quantum effects intwo dimensional, One dimensional, and Zero dimensional materials, Electrons in periodic potential, Blöch Theorem, Potential barrier, Harmonic oscillator, Krönig-Penney Model.	16
03	Particle in spherically symmetric potential, Hamiltonian of two interacting particles, Rigid rotator, Eigen values and eigen vectors of angular	18

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	momentum, Concept of spin, Perturbation theory, Stark effect and Zeeman effect, Fermi's golden rule, Radiative transition rate, Selection rules.	
04	Maxwell's equations, Electromagnetic spectrum, Quantization of electromagnetic field, Interaction of electromagnetic radiation with matter.	**13**
05	Rotational spectra of diatomic molecules, Intensity of spectral lines, Non-rigid rotator, Vibrational spectra of diatomic and polyatomic molecules, Anharmonic oscillator, Diatomic vibrating-rotator, Quantum and classical theory of Raman spectroscopy, Pure rotational Raman spectra, Vibrational Raman spectra.	**15**

Suggested Study material:

1. Concepts of Modern Physics, Arthur Beiser andShobhit Mahajan, McGraw Hill Education, 9th Edn, 2009
2. Solid State Physics, M A Wahab, Narosa Publications, New Delhi, 3rd Edn, 2015.
3. Introduction to Solid State Physics, Charles Kittel, Wiley, 8th Edn, 2012.
4. Solid State Physics, David Ashcroft and Mermin, CENGAGE Learning, 3rd Edn, 2003.
5. Introduction to Quantum Mechanics, J. Griffiths David,Pearson, 2015.
6. Modern Quantum Mechanics, J. J. Sakurai and Jim Napolitano, Cambridge University Press, 2017.
7. Introductory Quantum Optics, Christopher Gerry and Peter Knight 1st Edn, Cambridge University Press, 2004.
8. Fundamentals of Molecular spectroscopy, C N Banwell, McGraw Hill Education; Fourth edition (2017).

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Program	Subject		Year	Semester
M.Tech	Optoelectronics and Laser Technology		1st	1st
Course Code	Course Title			Course Type
OELT-105	SEMINAR			Core
Credits	Hours Per Week (L-T-P)			
	L	T		P
2	-	-		2
Maximum Marks	CIA		ESE	
50	-		50	
**Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall				

Learning Objectives:
Expertise in understanding research topics in photonics and improving skills such as imparting knowledge and presentation. The seminar should be on a topic of current research. Students have to submit a detailed report and they have to make a presentation of 45 minutes-duration before the seminar committee.

Course Outcomes (COs):

CO No.	Expected Course Outcome: Students will have achieved the ability to:
1.	**Presentation Skills** a. In terms of content, students will be able to show competence in identifying relevant information, defining and explaining topics under discussion. b. They will demonstrate depth of understanding, use primary and secondary sources; they will demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness. c. They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.
2.	**Discussion Skills** Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion to reach a shared understanding, speak with or without notes, show depth of understanding, demonstrate breadth of reading, use primary and secondary sources,

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	show independence and flexibility of thought, help discussions to move forward, show intellectual leadership and effective time management.
3.	**Listening Skills** a. Students will demonstrate that they have paid close attention to what others say and can respond constructively. b. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants.
4.	**Argumentative Skills and Critical Thinking** a. Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information. b. Students will be able to demonstrate use of appropriate methodologies, test the strength of their thesis statement, show insight into a topic, appropriate signposting, and clarity of purpose. c. They will also demonstrate problem-solving skills and apply theoretical knowledge.
5.	**Questioning** Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	1	2	3	3	3	3	3	3	3	2	1	1
2.	2	3	2	2	2	3	3	2	3	2	3	2	2	1	1
3.	3	2	2	2	2	3	2	3	3	2	3	3	2	1	1
4.	3	3	3	2	3	3	3	3	3	2	3	3	3	2	2
5.	3	3	3	3	2	3	3	2	3	3	3	2	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Activities with direct bearing on Employability/ Entrepreneurship/ Skill development:

Improvement of presentation skill in the subject

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Program	Subject			Year	Semester
M.Tech	Optoelectronics and Laser Technology			1st	1st
Course Code	Course Title				Course Type
OELT-106	Comprehensive Viva voce				Core
Credits	Hours Per Week (L-T-P)				
	L		T		P
-	-		-		-
Maximum Marks	CIA			ESE	
Grade	-			-	

Learning Objective (LO):
The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering acquired over 4 years of study in the undergraduate program.

Course Outcomes (COs):

CO No.	Expected Course Outcome:
1.	Viva will be conducted at the end of 1st, 2nd and 4th semester which will be covering the complete syllabus. This will test the student's learning and understanding during the course of their M.Tech Programme. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	3	3	3	3	2	3	2	2	2	2	3	2	1	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Activities with direct bearing on Employability/ Entrepreneurship/ Skill development:
Performance evaluation of the knowledge earned during the course.

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	1st

Course Code	Course Title	Course Type
OELT-107	Photonics Lab- I	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
3	0	0	3

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):
To empower the students with hands-on experience and to provide practical knowledge about Optoelectronic sources, detectors, devices, optical fibers and Laser.

Course Outcomes (COs):

CO No.	Expected Course Outcome: Students will have achieved the ability to:	CL
1.	Understand the behaviour of electronic and photonics components and perform analysis and design of bias circuits for diodes, transistors etc.	U
2.	Set up testing strategies and select proper instruments to evaluate performance characteristics of photonic circuit.	An
3.	Choosing testing and experimental procedures on different types of photonic circuit and analyses their operation different operating conditions.	An
4.	To apply the most commonly used simulation tools in photonics applications.	Ap
5.	To use laboratory test equipment useful in photonics applications.	U
6.	To design and develop full opto-electronic systems by using the photonics-related components and technologies studied along the master.	Ap
7.	To design and develop the required test and measurements procedures to evaluate the working operation of an optoelectronic system.	Ap
8.	To apply the knowledge within the photonic engineering field in a real-life environment both at component and at system level.	Ap

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9.	To work effectively in a multidisciplinary group in the photonic field with the ability to react to technical and operative difficulties in a technological project	**Ap**

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	3	3	3	1	2	3	2	2	2	3	3	2	1	1
2.	3	3	2	1	2	2	2	-	-	2	3	3	2	1	1
3.	3	3	2	2	3	1	3	-	-	3	3	2	2	1	1
4.	3	3	3	3	3	2	3	-	3	2	3	3	3	2	2
5.	3	3	3	3	2	3	3	1	1	2	3	3	3	2	2
6.	3	3	2	2	3	3	3	-	-	3	3	3	2	1	1
7.	3	3	3	2	3	2	3	-	-	3	3	3	2	1	1
8.	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1
9.	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

S.No.	Optics Lab: L-1
1.	Study of setting up an Optic Analog Link.
2.	Study of setting up a fiber Optic Digital Link.
3.	Study of Losses in Optical Fiber.
4.	Measurement of Numerical aperture of an optical fiber.
5.	Measurement of Bit Error Rate of an optical signal through fiber optic link – B.
6.	Study of Eye Pattern of fiber through fiber optic ling – B.
7.	To demonstrate the I-V and P-V characteristics of PV module with varying radiation and temperature level.
8.	To demonstrate the I-V and P-V characteristics of series combination of PV modules.

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9.	To demonstrate the I-V and P-V characteristics of parallel combination of PV modules.
10.	To show the effect of variation in tilt angle on PV module power

S.No.	Laser Lab : L-2
1.	To Observe the diffraction pattern and to calculate the slit width.
2.	To study diffraction from a transmission grating.
3.	To calculate the diameter of a pinhole.
4.	To determine the size of tiny particle using Laser.
5.	To determine the wavelength of a laser light using meter scale ruling.
6.	Holography.
7.	Magneto-optic effect (Faraday Rotation).
8.	To construct a Laser beam expander
9.	To study of Diode Laser characteristics
10.	To measure Electro-Optic coefficient

**The students are required to perform 5 programs using MATLAB platform

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DETAILED SYLLABUS

Semester -II

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	2nd

Course Code	Course Title	Course Type
OELT-201	PHYSICS OF ADVANCED MATERIALS	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO):

This course helps the student to use the fundamental science and engineering principles relevant to materials that include the relationships between nano/microstructure, characterization, properties, processing, performance and design of materials and to use their knowledge of the significance of research, the value of continued learning and environmental/social issues surrounding materials and
use the technical and communication skills developed in the program as a foundation for careers in engineering, research and development, the pursuit of advanced education and other professional careers.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	An
2.	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	Ap
3.	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	E

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	3	1	3	3	3	2	2	-	-	3	3	2	1	1
2.	3	2	1	2	2	3	3	-	-	-	2	3	2	1	1
3.	3	3	2	3	2	2	3	2	2	2	2	3	2	1	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	**Nano Particles and Nano Structured Materials:** **Properties of Individual Nano-Particle:** metal nanoparticles, geometric and electronic structure, magnetic clusters, Semiconductor nanoparticles, optical properties, rare gas and molecular clusters, methods of synthesis of nanoparticles. Carbon nanostructure, C60 carbon nanotube and application. **Bulk nano structured materials:** Solid disordered nanostructures, methods of synthesis, properties, metal nano-cluster composite glasses, porous silicon; Nano structured crystals.	13
02	**Quantum Nanostructures and Nano-Machines/Devices:** Quantum wells, wires and dots, preparation, size & dimensionality effects, excitons, single electron tunneling, applications of quantum nanostructure. Super conductivity. Self-assembly, process of self-assembly, semiconductor islands, monolayers. Catalysis, surface area of nanoparticles, porous, and colloidal materials. **Nanomachines and Devices:** Microelectromechanical system (MEMSs), Nanoelectromechanical system (NEMSs), Photonic nano & micro circuits, nano and micro fluidics. Application of NEMS and MEMS in Rf, Micro fluids, Optics, Bio Science, and Precious Manufacturing.	16
03	**Solid state lasers:** Material requirement for solid state lasers, Activator ions and centers, Material design parameters for semiconductor laser diode, choosing alloy composition and thickness, making ohmic contracts, Other III-V heterojunction laser materials. Introduction to organic laser. Material selection for light emitting diodes. Electrical, Optical and Thermal properties of III-V and II-VI semiconductors required for optoelectronics devices for visible and IR range.	18

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	Electroluminescent materials: Inorganic electroluminescence, AC powder EL, ACTFEL device, EL characteristics, EL excitation mechanism. Electroluminescence in Organic solids, Material useful for organic thin film EL devices, polymeric material for EL. LED Technologies for Light Emission and Displays. QLED.	
04	**Characterization of Materials:** Introduction to emission and absorption spectroscopy: Nature of electromagnetic radiation, electromagnetic spectrum, atomic, molecular, vibrational and Xray energy levels Basics of UV-VIS spectroscopy: Radiation sources, wavelength selection, Cells and sampling devices, Detectors, Basic ideal of IR spectrometry: Correlation of Infrared spectra with Molecular Structure. Fundamental of X-ray diffraction, Powder diffraction method, Quantitative determination of phases; Structure analysis. EDAX, Lithography (top down and bottom up), Contact preparationof thin films for device fabrication. Epitaxial thin film techniques : Liquid phase epitaxy, vapour phase epitaxy, Metal Organic chemical vapour deposition, Atomic layer epitaxy.	13
05	**Experimental Techniques:** High resolution X-ray diffraction, Double Crystal diffraction, Drift mobility and Hall mobility, Hall effect for Carrier density and Hall mobility, Photoluminescence (PL) and Excitation Photoluminescence (PLE) Optical pump probe experiments. **Basic idea of Microscopic Techniques:** Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron microscope (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Thickness measurement – Gravimetric method, Basics of Ellipsometry: Optical parameter measurements (n and k).	15

Suggested Study material:

1. Nanotechnology by Charles P. Poole Jr. and Frank J. Owens (Willey Inter. Science pub 2003).
2. Nanostructures and Nanomaterials – Synthesis properties and Applications by Guozhong Cao (Empirical College Press World Scientific Pub. 2004).
3. Physics of Semiconductor Devices by S. M. Sze(Willey Int., 1981).
4. Instrumental methods of analysis, H. H. Willard, L. L. Merritt, J A Dean, F A Sellte, CBs Publishers New Delhi 1996.

Suggested Refernce Study material:

1. Scanning Electron Microscopy : OOtley
2. Handbook of Electroluminescent Materials Ed. D. R. Vij Inst of Physics, Bristol and Philadelphia.
3. Electronic and Optoelectronic properties of Semiconductor, Jaspreet Singh, Cambridge University Press.
4. H. Baltes, O. Brand, Enabling Technology for MEMS and Nanodevices, Wiley, New York, 2004.

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	2nd

Course Code	Course Title	Course Type
OELT-202	FIBER OPTICS, LASER INSTRUMENTATION AND SOLAR PHOTOVOLTAIC TECHNOLOGIES	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO):
This course helps the student to introduce students the fundamental theories and technological aspects of power generation using solar photovoltaic technology and to learn theory, working and applications of solar cells.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Explain the theory of propagation of light in an optical fiber	U
2.	Analyze the formation of modes in a planar optical wave guide	An
3.	Examine single mode and multimode optical fibers and classify optical fibers based on their refractive index profiles.	An
4.	Compare the loss mechanisms in optical fibers and to compute various losses	An
5.	Distinguish between different techniques to provide optical connections in fibers	An
6.	Summarize the functioning of optical fiber sensors that use amplitude, phase, frequency and polarization type modulation schemes	E
7.	Analyze the different nonlinear processes associated with light-matter interaction.	An
8.	Identify lasers with appropriate wavelength for various applications	U

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9.	To understand the role of solar energy in the context of regional and global energy system, its economic, social and environmental connotations, and the impact of technology on a local and global context.	**U**
10.	To understand the physical principles of the photovoltaic (PV) solar cell and what are its sources of losses.	**U**
11.	To understand and apply the basic concepts of solar radiation necessary for dimensioning (sizing) PV systems installations.	**Ap**
12.	To know the electrical (current-voltage and power-voltage) characteristics of solar cell, panel or generator and how the environment parameters influence it	**An**

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	2	3	1	2	3	3	2	-	2	2	3	3	2	1	1
2.	2	2	3	3	3	3	2	-	1	2	2	3	2	1	1
3.	2	3	2	2	2	3	2	-	1	2	2	1	2	1	1
4.	3	2	2	3	3	2	1	1	2	3	3	3	3	2	2
5.	3	2	3	3	3	2	1	-	1	2	3	2	3	2	2
6.	2	2	1	2	2	2	2	-	2	2	3	3	2	1	1
7.	2	3	3	2	2	3	2	-	1	2	2	3	2	1	1
8.	2	2	2	3	2	2	2	-	1	2	2	1	2	1	1
9.	3	3	3	2	3	3	3	3	3	2	3	3	3	2	2
10.	3	2	3	3	2	3	2	-	3	2	2	3	2	1	1
11.	2	3	2	2	2	2	2	3	3	2	2	1	2	1	1
12.	3	2	2	3	3	3	2	-	2	2	3	3	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

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Unit	Topics	No. of Lectures
01	**Optical Fiber and Their Properties** Principle of light propagation through a fiber – Different types of fiber and their properties – Fiber materials and their characteristics – Transmission characteristic of fibers – absorption losses – scattering losses – Dispersion – measurement of optical fibers – optical sources –Optical detectors. Dispersion shifted Fiber Technologies.	13
02	**Fiber Optic Sensors in Measurements** Fiber optic instrumentation system – Fiber optic sensors, Different types of modulators, Application in instrumentation, Interferometric method of length Measurement, Measurement of pressure, temperature, current, voltage, liquid level and strain. Magnetic and electric field sensors based on the characteristics like intensity, phase, polarization, frequency and wavelength of light wave , Plasmonic nano-sensors. Laser Plasma Interaction: Basic concepts and two-fluid description of plasmas, electromagnetic wave propagation in plasmas.	16
03	**Lasers In Measurements and Testing** Laser for measurement of distance, velocity, acceleration, current, voltage, and atmospheric effect, Laser application in Spatial Frequency filtering. surface topology & optical component testing, beam modulation telemetry, laser Doppler velocimetry, surface velocity measurement using speckle patterns, measurements of rate and rotation using laser gyroscope. Holography: Basic principle, methods; Holographic interferometry and applications; Holography for non–destructive testing – Holographic components. The wavefront reconstruction process: Inline hologram, the off axis hologram, Fourier hologram, the lens less Fourier hologram, image hologram.	18
04	**Lasers in Industry** – Laser material processing: Laser matter interactions, mode of coupling energy from beam to the material. CW and pulsed heating and the resulting effect. Thermal processing of materials with lasers, Application in material processing, Laser Welding, Hole Drilling, Laser cutting, Laser Tracking, heat treatment, glazing, alloying, cladding, hardening of surfaces, semiconductor annealing and trimming. BioMedical Application of Lasers: Medical applications of lasers; laser and tissue interaction- Laser instrument of surgery. Laser light scattering, application in biomedicine. Light transport in tissue. Photochemical, photothermal, photomechanical effects and their therapeutic applications.	13
05	**Solar Photovoltaic Technologies** Generation of Photo voltage, Light Generated current,, I-V equation, Solar	15

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	Cell Characteristics, parameters of solar cells, Relation of Voc and Eg Design of solar cells: Upper limit of cell parameters, Losses in Solar Cell, Design for High Isc, Voc and FF Analytical Techniques: Solar Simulator-IV measurement, Quantum efficiency measurement, Minority carrier lifetime & diffusion length measurement.	

Suggested Study material:

1. Optical fiber communication-G Keiser ,McGraw Hill Education; Fifth edition (2017)
2. Introduction to fiber optics , Ajoy Ghatak and K. Thyagarajan, Cambridge Univ Press (2017)
3. Optical Fiber Communications: Principles and Practice, John M Senior, Pearson Education India, 3rd edition (2010)
4. Fundamentals Of Fibre Optics In Telecommunication And Sensor Systems, B P Pal, new age publishers (1992)
5. Solar Photovoltaics: Fundamentals, Technologies and Applications, C. S. Solanki, 2nd Edition Prentice Hall of India, 2011.
6. Understanding fiber optics, J Hecht, Laser Light Press, 5 edition (2016)
7. John F Ready, Industrial application of lasers. Academic press 1978
8. John Crisp, Introduction to Fibre Optics , an imprint of Elsevier Science 1996
9. Understanding Fiber Optics, 4th or 5th edition; Jeff Hech; Prentice Hall Publishers
10. Optical Fiber Communication Principles and Systems, A. Selvarajan, S. Kar and T. Srinivas TMH

Suggested Reference Study material:

1. Fiber Optic Communication System, G. P. Agarwal, Willey Eastern
2. Laser Material processing by W.M. Steen
3. Industrial Laser and their applications, John and Harry, McGraw Hill
4. M.L. Wolbarshi, Ed. Laser Applications in Medicine & Biology, Vol.1, 2 & 3 (Plenum, New York, 1971,74,77)
5. Solar cells: Operating principles, technology and system applications, by Martin A. Green, Prentice- Hall Inc, Englewood Cliffs NJ, U

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Program	Subject		Year	Semester
M.Tech	Optoelectronics and Laser Technology		1st	2nd
Course Code	Course Title			Course Type
OELT-203	OPTICAL NETWORKS			Core
Credits	Hours Per Week (L-T-P)			
	L	T		P
4	4	0		0
Maximum Marks	CIA	ESE		
100	30	70		

Learning Objective (LO):
This course helps the student to with the optical network evolution, from the point-to-point link to the intelligent transport. Introduce the main elements and components of the all-optical networking solution. Explore the capabilities and limitations of the optical network and expose students to recent research articles on various optical networking issues

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Identify the three generations of optical networking evolution	U
2.	Name the all-important technological issues that affect how optical networks are implemented Comprehend the potentialities and limitations of optical networks	An
3.	Underline how these networks fit in the more classical communication networks based on electronic time division	An
4.	Compare the performance of optical networks via computer discrete-event simulation	U
5.	Review current optical networking trends like optical packet, burst or label switching from research articles	An

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	2	2	2	1	1	1	2	2	2	2	1	1
2.	2	1	1	3	3	3	2	1	1	3	2	3	2	1	1
3.	2	2	2	2	2	3	1	1	1	2	3	3	2	1	1
4.	2	2	2	3	3	2	2	2	2	2	3	2	3	2	2
5.	2	1	3	2	3	3	1	1	2	2	3	1	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	WDM Technology and Issue in WDM Optical networks: Introduction– Optical networks–WDM-WDM optical network evolution- Enabling Technology for WDM optical networks – WDM optical network architecture – Issue in Wavelength routed networks – Next generation optical Internet networks, The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.	13
02	Wave length Routing Algorithms: Introduction – Classification of RWA algorithms – Fairness and Admission control – Distributed control protocols – Permutation routing and Wavelength requirements Wavelength Rerouting algorithms: Introduction–benefits of wavelength routing – Issue in Wavelength routing – Light path Migration – Rerouting schemes – Algorithm AG –Algorithm MWPG – Rerouting in WDM networks with Sparse Wavelength conversion –Rerouting in Multifiber networks – Rerouting in Multifiber Unidirectional ring Networks .	16
03	Wavelength Convertible networks : Introduction - need for Wavelength converters –Wavelength convertible switch architecture – routing in convertible networks – Performance evaluation of convertible networks – Networks with Sparse Wavelength conversion – Converter placement problem – Converter allocation problem.	18
04	Virtual topology Design: Introduction – Virtual Topology design problem – Virtual topology sub problems – Virtual topology design Heuristics – Regular virtual topology design –predetermined virtual topology and light	13

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	path routes – Design of multi fiber networks. Virtual Topology Reconfiguration: Introduction – Need for virtual topology reconfiguration –Reconfiguration due to Traffic changes – reconfiguration for fault restoration.	
05	Network Survivability and provisioning: Failures and Recovery – Restoration schemes –Multiplexing techniques – Distributed control protocols. Optical Multicast routing – Next generation optical internet network.	**15**

Suggested Study material:

1. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks : Concepts, Design and Algorithms ", Prentice Hall India 2002.
2. Rajiv Ramasami and Kumar N. Sivarajan, "Optical networks: A Practical Perspective", A Harcourt publishers international company 2000.

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	2nd

Course Code	Course Title	Course Type
OELT-204	ADVANCED OPTICAL COMMUNICATION	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
4	4	0	0

Maximum Marks	CIA	ESE
100	30	70

Learning Objective (LO):
This course helps the student to To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures and to understand the different kind of losses, signal distortion, SM fibers and to learn the various optical sources, materials and fiber splicing and to learn the fiber optical receivers and noise performance in photo detector and to learn link budget, WDM, solitons and SONET/SDH network.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.	U
2.	Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers	Ap
3.	Describe the principles of optical sources and power launching-coupling methods.	E
4.	Compare the characteristics of fiber optic receivers	An
5.	Design a fiber optic link based on budgets	An,Ap
6.	To assess the different techniques to improve the capacity of the system	E

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	2	2	2	1	-	2	3	3	3	2	1	1
2.	1	3	2	2	3	3	1	-	2	2	2	3	2	1	1
3.	3	3	2	2	2	3	1	1	2	3	2	1	2	1	1
4.	2	2	2	3	2	2	1	-	2	2	3	3	3	2	2
5.	2	2	3	2	3	3	3	2	3	2	3	2	3	2	2
6.	2	2	3	3	3	3	2	1	3	3	3	3	2	1	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	Introduction to optical components – optical amplifiers – types – issue in optical amplifiers –photonic switching – Cross connect – Wavelength conversion – Multiplexer – Demultiplexer, Filters– tunable filters, Photonic Crystal Fibers : Introduction, Guiding mechanism, modified total internal reflection and photonic bandgap guidance, properties and applications, introduction to OICs and its applications.	13
02	**First Generation Optical Networks SONET/SDH** – multiplexing process in SDH- requirements & description of SDH frames, concept of containers and pointers, element of a SONET/SDH infrastructure - SONET/SDH physical layer, Computer interconnects – ESCON, Fiber channel, HIPPI, Metropolitan area networks –FDDI, ATM, Layered Architecture - SONET/SDH layers – Second generation optical network layers.	16
03	**DWDM:** Networks, Devices, and Technology: Fundamentals of DWDM Technology, Architecture and components, Working of DWDM, Topologies and Protection Schemes for DWDM, IP over DWDM Networks, Ethernet switching over DWDM, OTN (Optical Transport Networking), Capacity expansion and Flexibility in DWDM, Future of DWDM, Survivability in DWDM Networks.	18
04	**OTDM Technology** Important issues of OTDM – optical solitons. Optical pulse compression – fiber grating compressor soliton effect compressor. Modulation instability, fundamental and higher-order solitons, soliton lasers, soliton-based communication systems, fiber loss, frequency chirp, soliton interaction,	16

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	design aspects, higher-order nonlinear effects. Broadcast OTDM networks, bit interleaving and packet interleaving, optical AND gates, nonlinear optical loop mirrors, terahertz optical asymmetric demultiplexer, switch based networks. Applications of solitons.	
05	**FTH and PON Technology** Proposed architecture and issues of Fiber to the home (FTH) – Passive Optical Network (PON), Near space communication – open air optical communication. Inter satellite link hops (ISL). Introduction to all optical networks (AON), Military, Civil, consumer and industrial applications.	15

Suggested Study material:

1. Rajiv Ramaswami and Kumar N. Sivrajan, " Optical networks – A practical perspective", A Harcourt Publishers International Company 2000
2. R. G. Junsperger, " Integrated Optics – Theory and Technology, Springer Series in Optical Sciences", 3rd Edition 1991
3. Gerd Keiser, " Optical Fiber Communications" ,McGraw Hill International Edition 191
4. G. P. Aggarwal," Non Linear Optics", Academic Press.
5. Stamations V. Kartalopoulos, "Understanding SONET/ SDH and ATM Communication network for Next Millennium", PHI 2000.
6. C. Sivaram and mohan Gurusamy, " WDM Optical Networks : Concepts, Design and Algorithms" PHI India 2002.

Suggested Reference Study material:

1. DWDM: Networks, Devices, and Technology 1st Edition, by "Stamatios, V. Kartalopoulos"
2. Broadband Networking ATM, Adh and SONET, " Mike Sexton, Andy Reid" F. Poli, A. Cucinotta and S. Selleri : Photonic crystal fiber properties and application, Springer, 2007

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Program	Subject		Year	Semester
M.Tech	Optoelectronics and Laser Technology		1st	2nd
Course Code	Course Title			Course Type
OELT-208	PHOTONICS MATERIALS AND DEVICES			Core
Credits	Hours Per Week (L-T-P)			
	L	T		P
4	4	0		0
Maximum Marks	CIA		ESE	
100	30		70	

Learning Objective (LO):
In this course, students will acquire a theoretical knowledge base in photonics-related areas of physics, learning the fundamental principles of photonics and light-matter interactions. They will also develop the ability to formulate problems related to photonic structures and processes, analyze them, and understand processes that manipulate the fundamental properties of light. The course, recognizing photonics as the technology of this century, aims to cultivate interest and awareness in students. Additionally, students will delve into the fundamentals of lasers and their applications, optical fiber technology, holography, and nano photonics, analyzing the transmission properties of optical guides. Furthermore, they will describe the mechanisms contributing to signal degradation in optical transmission links and assess the performance characteristics of active components like fiber amplifiers, laser diodes, light-emitting diodes, and photodetectors. The course will also cover the evaluation of spectral characteristics of passive components such as gratings and couplers using coupled-mode theory, along with the design of optical guides and passive guided-wave components with prescribed transmission characteristics.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Acquire a theoretical knowledge base in photonics related areas of physics (Optics, Electrodynamics, Physics of Semiconductors, Quantum Mechanics)	U
2.	Develop understanding of application of fundamental laws of physics in such engineering areas as telecommunications, optoelectronics, nano and microfabrication, growth techniques	U

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3.	Learn fundamentals of computerized modeling of diverse optical and photonics systems and gain working experience with standard computational tools used in industry.	**An**
4.	Acquire essential laboratory skills in designing experiments, assembling standard optical tools for optical experimentation, carrying out measurements with customary optical instruments and analyzing acquired data	**E**
5.	Become familiar with economics and management of photonics related engineering projects	**Ap**
6.	Learn to communicate scientific and engineering ideas both orally and in written form and acquire experience working in industrial or research lab settings as a part of a team.	**E**
7.	Be able to analyze the properties of materials and associated technologies and make judicious choice of the appropriate material/technology for a given application	**An**
8.	To have a grasp of the state-of-the-art materials and technologies relevant for current and emerging topics in optics and photonics.	**An**
9.	Explain working principles of basic photonic devices, Make simple calculations to quantify performances of various photonic devices,	**E**
10.	Choose appropriate photonic devices for achieving certain system requirements, technological limits of several photonic devices such as solar cells, displays, LED bulbs, and describe potential solutions to those problems.	**Ap**

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	3	2	2	2	2	1	1	2	2	3	3	2	1	1
2.	3	2	3	3	2	3	2	-	2	2	2	3	2	1	1
3.	3	2	2	2	2	3	1	2	2	2	3	3	2	1	1
4.	2	3	3	2	3	3	1	-	2	3	3	2	3	2	2
5.	2	2	2	2	3	3	2	2	3	2	3	3	3	2	2
6.	3	2	3	2	3	3	1	3	3	3	2	3	2	1	1
7.	3	3	2	3	3	2	2	1	2	2	3	2	2	1	1
8.	2	2	2	2	3	2	3	-	3	3	3	3	2	1	1
9.	2	2	1	3	2	3	1	1	2	2	2	2	3	2	2
10.	2	2	3	2	2	2	3	1	3	2	2	2	2	1	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

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Unit	Topics	No. of Lectures
01	Materials for nonlinear optics, preparation and characterization, evaluations of second order and third order nonlinear coefficients, 3 wave and 4 wave mixing in uniaxial and biaxial crystals.	13
02	Frequency up and Frequency down conversions, Photorefractive materials, phase conjugation and its applications.	16
03	AO Phenomenon, Raman-Nath and Bragg modulators, deflectors, spectrum analyser devices based on EO and MO effects.	18
04	EL and POS devices, fluoride glass based fibres and their applications, optical fibre based signal processing.	13
05	Optical Integrated Circuits, architecture fabrication and applications, CD read/write mechanism, memory storage, information storage and retrivel using holography.	15

Suggested Study material:

1. Optoelectronic devices and systems, SC Gupta, Prentice Hall India (2005) (Text)
2. Handbook of Nonlinear optical crystals - Dmtriev (Springer Verlag), 2003
3. Optical Electronics - Thyagaraj an and Ghatak W (Cambridge University Press), 1997

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Program	Subject		Year	Semester
M.Tech	Optoelectronics and Laser Technology		1st	2nd
Course Code	Course Title			Course Type
OELT-209	NANO PHOTONICS			Core
Credits	Hours Per Week (L-T-P)			
	L	T		P
4	4	0		0
Maximum Marks	CIA	ESE		
100	30	70		

Learning Objective (LO):
This advanced topical course shall introduce the basic principles, applications and latest advances in the area of nano-photonics. Student shall have a clear view about this excited new area and ready to contribute to the advances of photonic technology for a broad area of applications, from telecommunication/data communications to solid state display, energy and sensing technologies. Students shall have an opportunity to get the latest update on this new field from the seminars offered by the experts in this area and to introduce the students to fields of confinement of matter and light matter interaction at the nanoscale and its applications and to learn fundamentals of nanotechnology and its applications in Photonics.

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Learn about the background on Nanophotonic	U
2.	Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment	U
3.	Apply their learned knowledge to develop Nanomaterial's.	An

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	PO'S												PSO'S		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	1	3	3	2	1	-	-	2	3	3	2	1	1
2.	2	2	1	2	2	1	1	2	-	2	2	3	2	1	1
3.	3	3	2	2	2	2	3	2	1	3	2	1	2	1	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Unit	Topics	No. of Lectures
01	**Foundations for Nanophotonics** Confinement of Photons and Electrons, Propagation Through a Classically Forbidden Zone: Tunneling, Localization Under a' Periodic Potential: Bandgap, Cooperative Effects for Photons and Electrons, Nanoscale Optical Interactions, Axial and Lateral Nanoscopic Localization, Nanoscale Confinement of Electronic Interactions, Quantum Confinement Effects, Nanoscopic Interaction Dynamics, Nanoscale Electronic Energy Transfer. Near-Field Interaction and Microscopy: Near-Field Optics, Modeling of Near-Field Nano scopic Interactions, Near-Field Microscopy, Aperture less Near-Field Spectroscopy and Microscopy, Nanoscale Enhancement of Optical Interactions, Time- and Space-Resolved Studies of Nanoscale Dynamics.	13
02	**Quantum-Confined Materials:** Quantum Wells, Quantum Wires, Quantum Dots Quantum Rings, Manifestations of Quantum Confinement, Optical Properties, Quantum-Confined Stark Effect, Dielectric Confinement Effect, Single-Molecule Spectroscopy, Quantum-Confined Structures as Lasing Media, Metallic Nanoparticles and Nanorods, Metallic Nano shells Applications of Metallic Nano structures. **Growth and Characterization of Nano materials:** Growth Methods for Nanomaterials, Epitaxial Growth, Laser-Assisted Vapor Deposition (LAND) Nano chemistry, Characterization of Nano materials, X-Ray Characterization, Transmission Electron Microscopy (TEM) Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM).	16
03	**Nanostructured Molecular Architectures:** Non covalent Interactions, Nanostructured Polymeric Media, Molecular Machines, Dendrimers, Supramolecular Structures, Monolayer and Multilayer Molecular Assemblies. Photonic Crystals: Basics Concepts, Theoretical Modelling of Photonic	18

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	Crystals, Features of Photonic Crystals, Methods of Fabrication, Photonic Crystal Optical Circuitry Nonlinear Photonic Crystals, Photonic Crystal Fibers (PCF), Photonic Crystals and Optical Communications, Photonic Crystal Sensors.	
04	Nanocomposites, Nanocomposites as Photonic Media, Nanocomposite Waveguides, Random Lasers: Laser Paints, Local Field Enhancement, Multiphasic Nanocomposites, Nanocomposites for Optoelectronics. Industrial nano photonics: Nano lithography, Nanosphere Lithography, Dip-Pen Nanolithography, Nanoimprint Lithography, Nanoparticle Coatings, Sunscreen Nanoparticles, Self-Cleaning Glass Fluorescent Quantum Dots, Nano barcodes.	**13**
05	Bio Nano photonics and nanomedicine: Bioderived Materials, Bioinspired Materials Bio templates, Bacteria as Bio synthesizers, Near-Field Bioimaging, Nanoparticles for Optical Diagnostics and Targeted Therapy, Semiconductor Quantum Dots for Bio imaging Bio sensing, Nano clinics for Optical Diagnostics and Targeted Therapy, Nano clinic Gene Delivery Nano clinics for Photodynamic Therapy.	**15**

Suggested Study material:

1. Nanophotonics: P N Prasad, Wiley Inter science(2003)(Text) Biophotonics: P N Prasad, Wiley Publications (2004)
2. L. Novotny and B. Hecht, Principles of Nano-optics, Second Edition, Cambridge University Press, 2012

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Program	Subject		Year	Semester
M.Tech	Optoelectronics and Laser Technology		1st	2nd
Course Code	Course Title			Course Type
OELT-205	SEMINAR			Core
Credits	Hours Per Week (L-T-P)			
	L	T	P	
2	-	-	2	
Maximum Marks	CIA		ESE	
50	-		50	

Learning Objective (LO):
Expertise in understanding research topics in photonics and improving skills such as imparting knowledge and presentation. The seminar should be on a topic of current research. Students have to submit a detailed report and they have to make a presentation of 45 minutes-duration before the seminar committee.

Course Outcomes (COs):

CO No.	Expected Course Outcome: Students will have achieved the ability to:
1.	**Presentation Skills** a. In terms of content, students will be able to show competence in identifying relevant information, defining and explaining topics under discussion. b. They will demonstrate depth of understanding, use primary and secondary sources; they will demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness. c. They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.
2.	**Discussion Skills** Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion to reach a shared understanding, speak with or without notes, show depth

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	of understanding, demonstrate breadth of reading, use primary and secondary sources, show independence and flexibility of thought, help discussions to move forward, show intellectual leadership and effective time management.
3.	**Listening Skills** a. Students will demonstrate that they have paid close attention to what others say and can respond constructively. b. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants.
4.	**Argumentative Skills and Critical Thinking** a. Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information. b. Students will be able to demonstrate use of appropriate methodologies, test the strength of their thesis statement, show insight into a topic, appropriate signposting, and clarity of purpose. c. They will also demonstrate problem-solving skills and apply theoretical knowledge.
5.	**Questioning** Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

Activities with direct bearing on Employability/ Entrepreneurship/ Skill development:

Improvement of presentation skill in the subject

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	1	2	3	3	3	3	3	3	3	2	1	1
2.	2	3	2	2	2	3	3	2	3	2	3	2	2	1	1
3.	3	2	2	2	2	3	2	3	3	2	3	3	2	1	1
4.	3	3	3	2	3	3	3	3	3	2	3	3	3	2	2
5.	3	3	3	3	2	3	3	2	3	3	3	2	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

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Program	Subject			Year	Semester
M.Tech	Optoelectronics and Laser Technology			1st	2nd
Course Code	Course Title				Course Type
OELT-206	Comprehensive Viva voce				Core
Credits	Hours Per Week (L-T-P)				
	L		T		P
-	-		-		-
Maximum Marks	CIA			ESE	
Grade	-			-	

Learning Objective (LO):
The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering acquired over 4 years of study in the undergraduate program.

Course Outcomes (COs):

CO No.	Expected Course Outcome:
1.	Viva will be conducted at the end of 1st, 2nd and 4th semester which will be covering the complete syllabus. This will test the student's learning and understanding during the course of their M.Tech Programme. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

COs-POs/PSOs Mapping for the course:

POs / COs	Pos											PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	3	3	3	3	2	3	2	2	2	2	3	2	1	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

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Comprehensive Viva-Voce
A comprehensive viva -voce will be held immediately after the end of Semester. The Comprehensive Viva- Voce is intended to assess the student's understanding of various subjects he has studied during the M.Tech. course of study. The Viva-Voce would be conducted by a Board of Examiners consisting of the Head, Course Coordinator and all concerned Faculty Members of the both Electronics and Physics department. The Comprehensive Viva- Voce is evaluated on the basis of Grade. A candidate has to secure a minimum Grade to be declared successful. If he fails to obtain the minimum Grade, he has to reappear for the viva-voce during the next examination. The Grades are mentioned in the regulation

Activities with direct bearing on Employability/ Entrepreneurship/ Skill development:

Performance evaluation of the knowledge earned during the course.

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	2nd

Course Code	Course Title	Course Type
OELT-207	Photonics Lab- II	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
3	0	0	3

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):

To empower the students with hands-on experience and to provide practical knowledge about Optoelectronic sources, detectors, devices, optical fibers and Laser.

Course Outcomes (COs):

CO No.	Expected Course Outcome: Students will have achieved the ability to:	CL
1.	Understand the behaviour of electronic and photonics components and perform analysis and design of bias circuits for diodes, transistors etc.	U
2.	Set up testing strategies and select proper instruments to evaluate performance characteristics of photonic circuit.	An
3.	Choosing testing and experimental procedures on different types of photonic circuit and analyses their operation different operating conditions.	An
4.	To apply the most commonly used simulation tools in photonics applications.	Ap
5.	To use laboratory test equipment useful in photonics applications.	U
6.	To design and develop full opto-electronic systems by using the photonics-related components and technologies studied along the master.	Ap
7.	To design and develop the required test and measurements procedures to evaluate the working operation of an optoelectronic system.	Ap
8.	To apply the knowledge within the photonic engineering field in a real-life environment both at component and at system level.	Ap
9.	To work effectively in a multidisciplinary group in the photonic field with the ability to react to technical and operative difficulties in a technological project	Ap

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CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

COs-POs/PSOs Mapping for the course:

POs / COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	3	3	3	1	2	3	2	2	2	3	3	2	1	1
2.	3	3	2	1	2	2	2	-	-	2	3	3	2	1	1
3.	3	3	2	2	3	1	3	-	-	3	3	2	2	1	1
4.	3	3	3	3	3	2	3	-	3	2	3	3	3	2	2
5.	3	3	3	3	2	3	3	1	1	2	3	3	3	2	2
6.	3	3	2	2	3	3	3	-	-	3	3	3	2	1	1
7.	3	3	3	2	3	2	3	-	-	3	3	3	2	1	1
8.	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1
9.	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

S.No.	Practical
1.	To Calculate the wavelength of Laser using Michelson Interferometer.
2.	To study shape of Laser Beam Cross section and Evaluate spot size.
3.	To find the Divergence angle of Laser beam.
4.	To study polarization using Malus's Law.
5.	To find the refractive index of glass (transparent materials) by measuring Brewster angle.
6.	To determine the bending losses that occur in a multimode fiber when it is bent along various radii.
7.	To determine the absorption coefficient of transparent materials (glass slide).
8.	To study the variation of splice losses due to transverse offset, angular tilt and longitudinal separation.
9.	To Observe the refraction of light in liquid and to calculate its refractive index

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10.	To study the wavelength dependence of attenuation in the given optical fiber.
11.	To determine insertion loss of each channel of WDM mux, loss uniformity and optical cross talk in channels.
12.	To setup optical Add/Drop multiplexer (OADM) using fiber Bragg grating.
13.	To setup the WDM link with the given component and determine the total loss for each wavelength
14.	To find the refractive index of transparent Bar using diode Laser.
15.	. To observe the absorption of Laser light when various colors are introduced in its path.
16.	Preparation of thin films with the help of Dip Coating Unit and resistance/ impedance measurement using Source measuring unit.
17.	Preparation of thin films with the help of SILAR Controller and resistance/ impedance measurement using Source measuring unit.
18.	Preparation of thin films with the help of Spin Coating Unit and optical constant measurement using ellipsometer.

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	2nd	3rd

Course Code	Course Title	Course Type
OELT-301	Major Project Phase - I	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
25	0	0	25

Maximum Marks	CIA	ESE
400	120	280

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):

Each student has to submit a first level of report of the M.Tech project that they are undergoing at the end of the 3rd semester.

Course Outcomes (COs):

CO No.	Expected Course Outcome: The Master of Technology in optoelectronics & laser Technology is comprised of rigorous coursework followed by a full year of research project in two phases. In addition to communication, team work and research skills, each student will attain at least the following learning outcomes from this degree course:	CL
1.	Demonstrate a depth of knowledge of Photonics	An,Ap,C
2.	Complete an independent research project, resulting in at least a thesis publication, and research outputs in terms of publications in high impact factor journals, conference proceedings, and patents.	An
3.	Demonstrate knowledge of contemporary issues in their chosen field of research.	Ap
4.	Demonstrate an ability to present and defend their research work to a panel of experts.	Ap

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	2	2	2	1	2	2	2	2	3	2	1	1
2.	2	3	3	2	2	3	2	2	3	3	3	3	2	1	1
3.	2	2	2	3	2	2	1	3	3	3	3	2	2	1	1
4.	3	3	3	3	3	2	1	3	3	3	3	3	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Project Work Scheme
Project evaluation shall be done at the end of III and IV semesters and the students will have to submit a dissertation on his / her project work as per the Regulation for M.Tech. The problem may be selected form an appropriate Industry or Institution. The candidate is expected to work under the guidance of a project guide for at least for a period as decided. In case the project work is taken up in an external Industry/Institution, the project shall have two guides: one in the participating organization (Industry/Institution) who is the external guide and the other shall be one of the faculty members form Department who is the internal guide. The dissertation should be submitted within tow calendar years form the starting date of the third semester, Six copies of the dissertation have to be submitted to the M.Tech. Course Coordinator. These copies shall be distributed to the External examiner, Internal Examiner, Project guide (Faculty), Department Library and University Library and the Candidate.
Evaluation of Project Work The project evaluation committee shall be responsible for the project work evaluation The project evaluation committee as per M.Tech. Regulation. The project guide (faculty from department) shall be the internal examiner. The external examiner shall be a technical expert in the concerned subject form any organization other than that of the project guide and is selected form the panel of experts submitted by the Course Coordinator. The dissertation shall be evaluated by the external examiner. Three bound copies along with a soft copy of the dissertation shall be submitted to the Head of the Department/Coordinator within the last date prescribed by the Department / School for the purpose. The project work shall be evaluated through presentations and viva voce. The grade/marks shall be given to the students according to the level and quality of work and presentation/documentation

Activities with direct bearing on Employability/ Entrepreneurship/ Skill development:

It helps to development of skill of presentation and project planning

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Program	Subject		Year	Semester
M.Tech	Optoelectronics and Laser Technology		2nd	4th
Course Code	Course Title			Course Type
OELT-401	Major Project Phase – II			Core
Credits	Hours Per Week (L-T-P)			
	L	T		P
25	0	0		25
Maximum Marks	CIA		ESE	
400	120		280	
**Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall				

Learning Objective (LO):
Each student has to submit a first level of report of the M.Tech project that they are undergoing at the end of the 3rd semester.

Course Outcomes (COs):

CO No.	Expected Course Outcome: The Master of Technology in optoelectronics & laser Technology is comprised of rigorous coursework followed by a full year of research project in two phases. In addition to communication, team work and research skills, each student will attain at least the following learning outcomes from this degree course:	CL
1.	Demonstrate a depth of knowledge of Photonics	An,Ap, C
2.	Complete an independent research project, resulting in at least a thesis publication, and research outputs in terms of publications in high impact factor journals, conference proceedings, and patents.	An
3.	Demonstrate knowledge of contemporary issues in their chosen field of research.	Ap
4.	Demonstrate an ability to present and defend their research work to a panel of experts.	Ap

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

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COs-POs/PSOs Mapping for the course:

POs / COs	POs											PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	2	2	2	1	2	2	2	2	3	2	1	1
2.	2	3	3	2	2	3	2	2	3	3	3	3	2	1	1
3.	2	2	2	3	2	2	1	3	3	3	3	2	2	1	1
4.	3	3	3	3	3	2	1	3	3	3	3	3	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

Project Work Scheme
Project evaluation shall be done at the end of III and IV semesters and the students will have to submit a dissertation on his / her project work as per the Regulation for M.Tech. The problem may be selected form an appropriate Industry or Institution. The candidate is expected to work under the guidance of a project guide for at least for a period as decided. In case the project work is taken up in an external Industry/Institution, the project shall have two guides: one in the participating organization (Industry/Institution) who is the external guide and the other shall be one of the faculty members form Department who is the internal guide. The dissertation should be submitted within tow calendar years form the starting date of the third semester, Six copies of the dissertation have to be submitted to the M.Tech. Course Coordinator. These copies shall be distributed to the External examiner, Internal Examiner, Project guide (Faculty), Department Library and University Library and the Candidate.
Evaluation of Project Work The project evaluation committee shall be responsible for the project work evaluation The project evaluation committee as per M.Tech. Regulation. The project guide (faculty from department) shall be the internal examiner. The external examiner shall be a technical expert in the concerned subject form any organization other than that of the project guide and is selected form the panel of experts submitted by the Course Coordinator. The dissertation shall be evaluated by the external examiner. Three bound copies along with a soft copy of the dissertation shall be submitted to the Head of the Department/Coordinator within the last date prescribed by the Department / School for the purpose. The project work shall be evaluated through presentations and viva voce. The grade/marks shall be given to the students according to the level and quality of work and presentation/documentation

Activities with direct bearing on Employability/ Entrepreneurship/ Skill development:

It helps to development of skill of presentation and project planning

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	2nd	4th

Course Code	Course Title	Course Type
OELT-402	Comprehensive Viva-voce	Core

Credits	Hours Per Week (L-T-P)		
	L	T	P
-	-	-	-

Maximum Marks	CIA	ESE
Grade	-	-

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objectives (LO):
The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering acquired over 4 years of study in the undergraduate program.

Course Outcomes (COs):

CO No.	Expected Course Outcome:
1.	Viva will be conducted at the end of 1st, 2nd and 4th semester which will be covering the complete syllabus. This will test the student's learning and understanding during the course of their M.Tech Programme. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

COs-POs/PSOs Mapping for the course:

POs / COs	POs												PSOs		
	1	2	3	1	2	6	1	2	9	1	2	12	1	2	3
1.	2	2	1	1	3	1	2	-	2	3	3	3	2	1	1

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

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Comprehensive Viva-Voce
A comprehensive viva -voce will be held immediately after the end of Semester. The Comprehensive Viva- Voce is intended to assess the student's understanding of various subjects he has studied during the M.Tech. course of study. The Viva-Voce would be conducted by a Board of Examiners consisting of the Head, Course Coordinator and all concerned Faculty Members of the both Electronics and Physics department. The Comprehensive Viva- Voce is evaluated on the basis of Grade. A candidate has to secure a minimum Grade to be declared successful. If he fails to obtain the minimum Grade, he has to reappear for the viva-voce during the next examination. The Grades are as follows.

RANGE	QUALITATIVE_ASSESSMENT/GRADE	
91% - 100%	O	Outstanding
81% - 90%	A	Very Good
71% - 80%	B	Good
61% - 70%	C	Fair
50% - 60%	D	Pass
Below 50%	F	Failure

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	2nd

Course Code	Course Title
OELT-501	Skill Enhancement : PYTHON / MATLAB/ SCAPS-1D/ PC-1D

Credits	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	2

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):
This course helps the student to Learn about

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
1.	Apply a variety of common numeric techniques to solve and visualize engineering-related computational problems.	Ap,An
2.	Introduce the MATLAB software environment	An,U
3.	Learn programs to understand the python programming	U,An
4.	Introduce the PC-1D software environment.	An,U
5.	Introduce the SCAPS-1D software environment.	An,U

COs-POs/PSOs Mapping for the course:

POs / COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	3	2	2	2	2	2	1	2	2	2	2	3	2	1	1

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2.	2	3	3	2	2	3	2	2	3	3	3	3	2	1	1
3.	2	2	2	3	2	2	1	3	3	3	3	2	2	1	1
4.	3	3	3	3	3	2	1	3	3	3	3	3	3	2	2

"3"-Strong; "2"-Moderate; "1"-Low; "-"-No Correlation;

S.No.	Practical
1.	To perform the application of MATLAB for mathematical operations like +,- , *, / etc.
2.	To obtain Fourier transform for a given signal.
3.	To plot graph of a sine wave signal and its power spectrum.
4.	To plot graph of a cosine wave signal and its power spectrum.
5.	To plot graph of square wave signal and its power spectrum.
6.	. Write a program for generation and plotting of elementary signals in discrete time
7.	Write a program for generation and plotting of discrete time exponential sequence.
8.	Write a program to find the multiplication of two discrete time signals.
9.	Write a program to find the even and odd component of the sequence y(n) = u(n)-u(n-10)
10.	Write a program to find and plot the Convolution of two sequences.
11.	Write a program to find Fourier transform and Inverse Fourier transform of a given sequence.
12.	Write a program to find and plot Fourier transform of u(t+0.5) – u(t-0.5)
13.	Write a program to find and plot Fourier series representation of a full wave rectified wave.
14.	SIMULATION AND MODELLING OF SILICON BASED SOLAR CELL USING PC-1D.
15.	Analysis of Silicon Solar Cell Device Parameters using PC-1D.
16.	SIMULATION AND MODELLING OF SILICON BASED SOLAR CELL USING SCAPS-1D
17.	Analysis of Silicon Solar Cell Device Parameters using SCAPS-1D

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Program	Subject	Year	Semester
M.Tech	Optoelectronics and Laser Technology	1st	1st

Course Code	Course Title
OELT-601	Indian Knowledge System: It's Relevance to Electronics & Photonics

Credits	Hours Per Week (L-T-P)		
	L	T	P
2	2	0	0

Maximum Marks	CIA	ESE
100	30	70

****Note: Student should be allowed to use Programmable Scientific Calculator in Examination Hall**

Learning Objective (LO):
This course helps the student to Learn about Indian Knowledge System and Learn the basics of Ancient Indian Science, Mathematics and Technology and Study about the Ancient Indian Astronomy Learn and understand the importance of Yoga for health and wellness of ones mind and body

Course Outcomes (COs):

CO No.	Expected Course Outcome: On successful completion of this course students should be able to	CL
6.	Gain knowledge about Vedic Philosophy, Vedic Vidyapeeth and Non-Vedic Philosophical Systems.	R,U
7.	Learn the IKS foundation concept for Science & Technology	R,U
8.	Learn about ancient Indian Mathematics, Great Mathematicians and their contributions, Arithmetic Operations, Geometry	U
9.	Learn about contribution of Astronomy in Indian Knowledge System	U
10.	Learn Importance of Yoga & Psychology for human beings	U

CL: Cognitive Levels (R-Remember; U- Understand; Ap- Apply; An- Analyze; E- Evaluate; C-Create)

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COs-POs/PSOs Mapping for the course:

COs \ POs	POs											PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	2	2	2	3	2	1	2	3	-	3	3	3	2	1	1
2.	3	1	2	2	1	1	1	2	-	1	2	3	2	3	1
3.	3	2	3	2	1	2	3	1	1	2	2	1	2	1	3
4.	3	1	2	3	2	2	2	1	-	2	3	3	3	2	2
5.	2	1	2	2	2	2	2	2	1	3	3	2	3	2	2

"3":- Strong, "2":- Moderate, "1":-Low, "-":- No Correlation

Unit	Topics	No. of Lectures
01	**Introduction to Indian Knowledge System (IKS)** Introduction to Vedic Philosophy, Vedic Vidyapeeth, 64 Kalas, Shilpa Shastra, Four Vedas, Vedanga, Indian Philosophical Systems, Vedic Philosophy (Samkhya and Yoga, Nyaya and Vaisesika, Purva-Mimaṃsa and Vedanta), Non-Vedic Philosophical Systems (Carvaka, Buddhist, Jain), Puranas (Maha-puranas, Upa-Puranas and Sthala-Puranas), Itihasa (Ramayana, Mahabharata), Niti Sastras, Subhasitas	12
02	**Foundation concept for Science & Technology** Linguistics & Phonetics in Sanskrit Grammar, Role of Sanskrit in Natural Language Processing, Number System and Units of Measurement, concept of zero and its importance, Large numbers & their representation, Place Value of Numerals, Decimal System, Measurements for time, distance and weight, Unique approaches to represent numbers (Bhuta Saṃkhya System, Kaṭapayadi System), Pingala and the Binary system, Knowledge Pyramid, Prameya – A Vaisesikan approach to physical reality, constituents of the physical reality, Pramaṇa, Saṃsaya	12
03	**Indian Mathematics in IKS** Indian Mathematics, Great Mathematicians and their contributions, Arithmetic Operations, Geometry (Sulba Sutras, Aryabhatiya-bhasya), value of π, Trigonometry, Algebra, Chandah Sastra of Pingala	12

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04	**Indian Astronomy in IKS** Indian Astronomy, celestial coordinate system, Elements of the Indian Calendar Aryabhatiya and the Siddhantic Tradition Panchanga – The Indian Calendar System Astronomical Instruments (Yantras) Jantar Mantar or Raja Jai Singh Sawal	12
05	**Yoga & Social Sciences in IKS** Health, Wellness & Psychology, Ayurveda Sleep and Food, Role of water in wellbeing, Indian approach to Psychology, the Triguṇa System Body-Mind-Intellect-Consciousnes, Yoga , health and hygiene, Introduction to 7 main Chakras and energy centers in human body.	12

Suggested Study material:

1. Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru.
2. Kapur K and Singh A. K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of
   Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995.
3. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008.
4. SK Das, The education system of Ancient hindus, Gyan publication house, India

Suggested Reference Book:

1. BL Gupta,Value and distribution system in india, Gyan publication house, India
2. Gambirananda, Swami, Tr. *Upanishads with the Commentary of Sankarachrya.* Kolkata: Advaita Ashrama publication Department, 2002.
3. Ranganathananda, Swami. *The Massage of the Upanishads.* Bombay: Bharathya Vidya Bhaven, 1985.
4. Om Prakash, Religion and Society in Ancient India, Bhariya Vidhya Prakashan, 1985
5. DK Chakkrabarty, Makkhan Lal, History of Ancient India (Set of 5 Volumes), Aryan book
   Internation publication, 2014
6. Dr. Girish Nath Jha, Dr. Umesh Kumar Singh and Diwakar Mishra, Science and Technology in
   Ancient Indian Texts, DK Print World limited,
7. Swami BB Vishnu, Vedic Science and History - Ancient Indian's Contribution to the Modern
   World, gosai publication, 2015
8. Chatterjee, S.C. The Nyaya Theory of Knowledge. Calcutta: University of Calcutta Press, 1950.
   Dasgupta, Surendra. A History of Indian Philosophy. Delhi: Motilal Banarsidass, 1991.Vols. III & IV.

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