Course Code	Course Title	L	T	P	C
1152EC147	FIBER LASERS AND APPLICATIONS	3	0	0	3

a) Course Category

Programme Elective

b) Preamble

To impart knowledge on laser operation, different types of fiber lasers-Continues Wave (CW) and Pulsed lasers- Q-switching - Mode-locking techniques and applications of fiber lasers.

c) Prerequisite

Nil

d) Related Courses

Opto Electronic Devices

e) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Understand the theoretical background of laser operation and types	K2
CO2	Understand the fabrication of different lasers using the electromagnetic field equations.	K2
CO3	Understand the various types of laser demonstration with differentdesign parameters	K2
CO4	Analyze the laser characteristics by the modelling of laser cavity. Understand the split step Fourier method.	K2
CO5	Understand the various applications of fiber lasers in different fields.	K2

f) Course Content

UNIT I Introduction to lasers **9**

Introduction to general lasers and their types, Schrodinger wave equation, Atomic systems, emission and absorption processes, Population inversion, gain, optical cavities, three- and four- level lasers, CW and pulsed lasers, Q-switching and mode-locking techniques.

UNIT II Laser systems **9**

Atomic, ionic, molecular, excimer and liquid laser systems- Review of Electromagnetic properties - Basic principle of laser action, Fabrication of lasers - Modulation of lasers - Quantum Well and Quantum Dot Lasers - Passive mode locking Lasers.

UNIT III Fiber lasers **9**

Basic concepts - cavity design – continuous wave (CW) lasers – ytterbium doped fiber lasers – erbium doped fiber lasers - passive mode-locking - saturable absorber - nonlinear fiber loop mirror- graphene based saturable absorber - nonlinear polarization rotation - role of fiber nonlinearity and dispersion - saturable absorber mode-locking

UNIT IV Numerical modeling of fiber lasers **9**

Modeling of passively mode-locked fiber lasers – lumped and distributed modeling - scalar and vector modeling - nonlinear dynamics inside the laser cavity - multiwavelength fiber laser modeling – numerical methods – split step fourier method – variational analysis – finite difference and finite element beam propagation methods – Rungekutta method.

UNIT V Applications **9**

Laser applications in medicine and surgery, Materials processing, Optical Communication Lasers, Metrology and LIDAR.

Total 45 Hrs

g) Learning Resources

Reference Books

1. Andrew.M.Weiner, “Ultrafast Optics” Wiley Series in Pure and Applied Optics, 2008.
2. Govind P.Agarwal,” Applications of Nonlinear Fiber Optics” Second Edition, 2007.
3. Le Nguyen Binh, Nam Quoc Ngo,"Ultra-Fast Fiber Lasers" Principles and Applications with MATLAB Models”, CRC Press, 2011.
4. Jean-Claude Diels, Wolfgang Rudolph," Ultra short Laser Pulse Phenomena, Fundamentals, Techniques, and Applications on a Femtosecond Time Scale" Academic Press ,Second Edition, 2006.