M.Sc. 4th Semester Examination, 2021

PHYSICS

(Laser Physics and Nonlinear Optics-III)

Paper: 405ME

Course ID: 42455

Time: 2 Hours **Full Marks: 40**

The figures in the right hand side margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any five* of the following questions: 2x5=10

(a) The ratio of recoil velocities of Na and Cs atom due to laser cooling is 10:1, what is the ratio of their deceleration?

(b) What is quasi-phase-matching?

(c) Draw a schematic diagram and explain the input–output characteristics of a system showing optical bistability.

(d) Discuss molecular beam epitaxy?

(e) What is phase conjugate mirror?

(f) Why cube corner reflector is used for interferometric distance measurement technique?

(g) Which type of methods of laser-based distance measurement are useful for long and short ranges?

2. Answer *any four* of the following questions: 5x4=20

(a) Describe with neat diagram the measurement technique of fluid flow rate using laser light. Calculate the modulation frequency of the scattered light detected by a detector when laser light of 632·8nm incident on water (n = 1·33) at an angle of 60° flowing at a rate of 2m/s. [3+2]

(b) Discuss different types of pulse dispersion in optical fibre?

(c) Using coupled amplitude equations derive the expression of conversion efficiency for sum frequency generation process in a negative uniaxial crystal when the conversion efficiency is limited to 10%.

(d) Discuss the Raman scattered LIDAR in remote monitoring of the atmosphere.

(e) What is multiplexing? Explain different multiplexing in fibre optics.

(f) Discuss the laser cutting techniques for non-metal. Why oxygen assisted gas jet is used in laser cutting for reactive metals.

3. Answer *any one* of the following questions: 10x1=10

(a) Derive an expression for the phase-conjugate reflectivity obtained by degenerate four-wave mixing utilizing the nonlinear response of a collection of "two-level" atoms.

(b) Consider refractive bistability in a nonlinear Fabry–Perot interferometer. Assume that the nonlinear material also displays (linear) absorption. How are the intensity requirements for switching modified by the inclusion of loss, and how large can the absorption be and still allow the existence of bistability?