

M. Sc. 4th Semester Examination, 2022

PHYSICS

(Laser Physics and Non-linear 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.
The questions are of equal value.*

1. Answer *any five* questions: 2x5=10
- (a) Define the optical phase conjugation.
 - (b) Discuss the temperature tuning phase matching process.
 - (c) How much lowest temperature can be achieved by laser cooling process in an atom and why further lower temperature cannot be obtained? Justify your answer.
 - (d) Discuss the differences between the WDM and TDM in fibre optics waveguide.
 - (e) What is the importance of saturable absorption?
 - (f) What is optical molasses?
 - (g) Describe laser annealing.
2. Answer *any four* question: 5x4=20
- (a) What is numerical aperture of a fiber? Derive an expression of V-parameter. What is the significance of V-parameter? 1+2+3=5
 - (b) Discuss liquid phase epitaxy and molecular beam epitaxy. 5

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- (c) What is Kerr effect? Derive an expression to explain the self-focusing for a Gaussian input beam. 1+4=5
- (d) What are the positive and negative uniaxial crystals? Discuss the Type I and Type II phase matching condition for the positive and negative uniaxial crystals. 1+4=5
- (e) Describe laser cutting process for metal and nonmetal materials and hence compare the laser cutting process with other existing cutting technology. 5
- (f) Discuss different types of LIDAR for the remote sensing and environmental monitoring. 5

3. Answer *any one* question: 1x10=10

- (a) Define quasi phase matching. Calculate the efficiencies of a first- and third-order quasi phase matching process when duty cycle of the nonlinear material is $\frac{1}{2}$. 2+8=10
- (b) Discuss the refractive bistability? Show that for a strongly absorbing nonlinear optical material the effective interaction length is much shorter than the physical length of the nonlinear medium. 5+5=10
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