**Bachelor of Printing Engineering Supplementary Examination, 2017**
**(2nd Year-1st Semester)**
**Printing Materials Science-I**

**Time: Three hours** **Full Marks: 100**

**Answer any five questions.**

1. (a) What is black body? State and explain Stefan's law. 5
   (b) Define fractional refractive index and numerical aperture of an optical fiber. Establish the relation between them. 6
   (c) Find the terminal velocity of an oil drop of density 0.95 g/cm$^3$ and radius $10^{-4}$ cm falling through air of density 0.0013 g/cm$^3$, if the viscosity of air is 181 x $10^{-6}$ c.g.s. unit and g=980 cm/s$^2$. 5
   (d) Distinguish between thermal conductivity and thermometric conductivity of a substance. What is the relation between them? 4

2. (a) What do you mean by thermal conductivity and diffusivity of a substance? Describe a method of determining the thermal conductivity of a bad conductor. 7
   (b) One thousand drops of water each of diameter 0.2 mm combine to form a single drop. Calculate the loss of energy in forming the large drop. Assume the surface tension of water to be 72 dyne/cm. 6
   (c) State Kirchoff's law of heat radiation. Prove that $E_\lambda = \frac{e_\lambda}{a_\lambda}$, the notations having their usual meaning. 7

3. (a) State stoke's law. Define terminal velocity. Obtain an expression for the terminal velocity of a small spherical body falling through a liquid. 7
   (b) Find the terminal velocity of an oil drop of density 0.95 g/cm$^3$ and radius $10^{-4}$ cm falling through air of density 0.0013 g/cm$^3$, if the viscosity of air is 181 x $10^{-6}$ c.g.s. unit and g=980 cm/s$^2$. 5
   (c) Explain how mercury column in a capillary tube is depressed when the tube is dipped vertically in mercury. 5
   (d) A piece of camphor placed on water moves to and fro. Why? 3

4. (a) How is the surface tension of a liquid explained on the basis of intermolecular force? Obtain a relationship between surface tension and surface energy of a liquid. 7
   (b) What is Reynold's number? State its utility. 3
   (c) Discuss about the different uses of optical fiber. 5
   (d) A garden hose having an internal diameter of 2cm is connected to a lawn sprinkler that consists merely of an enclosure with 24 holes, each 0.125cm in diameter. If the water in the hose has a speed of 1 m/s at what speed does it leave the sprinkler holes? 5

5. (a) Find an expression for the excess pressure within a spherical soap bubble. 5
   (b) Describe a simple experiment to show that a good emitter of radiation is also a good absorber of radiation. 5
   (c) Write down the application of laser. 5
   (d) A capillary tube 0.5mm bore stands vertically in a wide vessel containing a liquid of surface tension 30 dyne/cm. The liquid wets the tube and has a specific gravity of 0.8. Calculate the rise of the liquid in the tube. 5

6. (a) What are the different pumping schemes available? Explain. 6
   (b) What are the factors on which the light gathering capacity of optical fiber depends? 4
   (c) Distinguish between spontaneous emission and stimulated emission. 5
   (d) In an optical fiber, the core material has refractive index 1.6 and clad material has refractive index 1.3. Calculate the value of the critical angle and acceptance angle. 5

7. (a)Write down advantages of ruby laser. 3
   (b) Derive the equation of loss of energy when liquid drop of radius R breaks into n no. of small drops. 7
   (c) A glass clad fiber is made with core glass of refractive index 1.5 and the cladding is doped to give a fractional index difference 0.0004. Calculate i. the cladding index, ii. the critical internal reflection angle, iii. The external critical acceptance angle and iv. the numerical aperture. 10

8. Write short notes on: 5 x 4

   (a) Wien's black body
   (b) He-Ne laser
   (c) Fe'ry's black body
   (d) Emissive power
   (e) Ruby laser