KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st year 1st Term Examination, 2017

Department of Electronics and Communication Engineering

ECE 1109

(Solid State Electronics)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Briefly explain the conditions of forming stable bond in solid and hence find out the expression of equilibrium spacing between atoms. (12)

   b) Outline the assumptions of classical free electron theory of electrical conductivity in metals. Then prove $\sigma = \frac{ne^2\tau}{m}$, where the symbols have their usual meanings. (12)

   c) Explain the electron scattering mechanism in metals. Explain also why and how the conductivity varies with temperature and composition. (11)

2. a) Explain the current conduction mechanism in a semiconductor material. (08)

   b) Describe the temperature dependence of band gap energy and carrier concentration in case of both intrinsic and extrinsic semiconductor. (08)

   c) Write down the physical significance of continuity equation. Using this equation, show that the diffusion length for holes is $L_p = \sqrt{D_p\tau_p}$, where the symbols have their usual meanings. (10)

   d) For a particular semiconductor material, $N_c = 1.5\times10^{18}$ cm^{-3}, $N_v = 1.3\times10^{19}$ cm^{-3} and $E_g = 1.43$ eV at T=300° K, (i) Determine the intrinsic carrier concentration of the semiconductor at T=300° K. (ii) Find the position of the intrinsic Fermi level with respect to the center of the band gap. (09)

3. a) Draw a schematic diagram showing the energy band of a p-n junction. Show clearly the positions of Fermi levels on two sides of the junction. Explain how the carrier and current flow is affected by a forward-biased voltage. (10)

   b) What does transition region consist of? Show that the width of transition region is $W = \sqrt{\frac{2\varepsilon v_0}{q}\left(\frac{1}{N_a} + \frac{1}{N_d}\right)}$, where the symbols have their usual meanings. (10)

   c) What is minority carrier storage time of a diode? How does it limit the performance of switching diode? Explain. (10)

   d) How can a junction diode be called as a switch? (05)

4. a) What is minority carrier storage time of a diode? How does it limit the performance of a switching diode? Explain. (07)

   b) Briefly describe the process of avalance and zener breakdown. (08)

   c) Explain the process of Hall –effect. Write down few applications of it. (08)

   d) A S_i p-n junction with cross sectional area $A = 10^{-14}$ cm^2 is formed with $N_a = 10^{17}$ cm^{-13} and $N_d = 10^{15}$ cm^{-3} at 300 k. Calculate; (i) Contact potential V_0 (ii) Current with forward bias of 0.5 V. Assume that the current is diffusion dominated. Also assume $\mu_n = 1300$ cm^2/V.S and $\mu_p = 450$ cm^2/V.S in the n side and $\mu_n = 700$ cm^2/V.S and $\mu_p = 200$ cm^2/V.S in the p side. $\tau_n = 0.1$ μs and $\mu_p = 10$ μs. (iii) current at reverse bias of -0.5 V. (12)

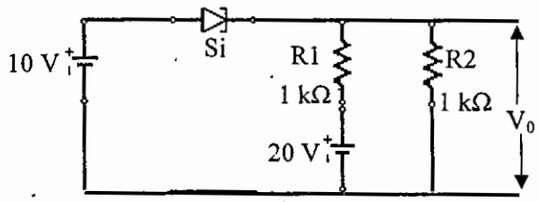
SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Briefly explain the electron versus hole flow mechanism with [illegible] e. (08)

b) Justify the statement – "n-type or p-type semiconductor is electrically neutral." (07)

c) Calculate the current through 1 k Ω resistor(s) and draw the voltage V_0 with proper labeling for the following circuits. (10)



d) Draw and explain the diode equivalent circuits and characteristics curve for ; (10)
(i) Piecewise –linear model (ii) Simplified model (iii) Ideal device

6. a) What is meant by regulated power supply? Design a regulated power supply of +5 V dc from 230 V ac mains. Mention the input and output wave-shapes at every stage with proper labeling. (10)

b) The circuit of figure 6(b1) is an inexpensive voltage regulator. All the diodes are identical and have characteristics of figure 6(b2). Find the regulation of V_0 when V_{in} increases from its nominal value of 4V to the value 6V. Given, R=2 KΩ, diode resistance, R_F=500 Ω; cut of voltage V_F=0.5 V. (12)

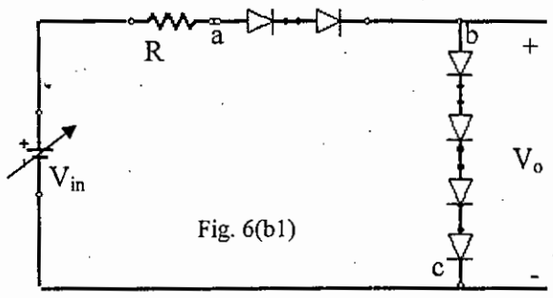


Fig. 6(b1)

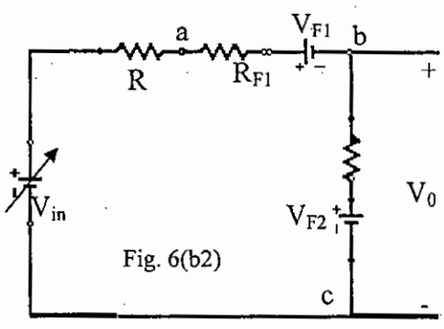


Fig. 6(b2)

c) Why do we use filter circuits in DC power supply? Mention different filters with their circuit diagrams. (10)

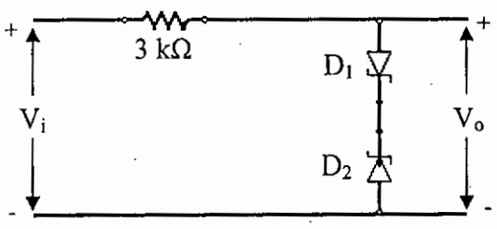
d) A zener diode has the specifications V_z=5.2 V and P_{Dmax}=260 mW. Assume R_z=0. Find the maximum allowable current i_z when the zener diode is acting as a regulator. (03)

7. a) Prove that the expression for collector current of common base connection is (10)
Ic= $\frac{\alpha}{1-\alpha} I_B + \frac{I_{CBO}}{1-\alpha}$, where the symbols have their usual meanings.

b) Determine the following relations for a zener diode with fixed V_i and variable R_L, (10)
where the symbols have their usual meanings.
(i) $R_{Lmin} = \frac{RV_z}{(V_i - V_z)}$, (ii) $R_{Lmax} = \frac{V_z}{I_{Lmin}}$

c) Write short note on ; (i) Tunnel Diode, (ii) Varactor Diode (06)

d) Two zener diodes D_1 and D_2 with breakdown voltages, cut-in voltages as 12 V, 0.5 V, 15 V and 0.7 V respectively are connected back to back as shown in the following figure. Draw to scale the input and output waveforms of their circuit corresponding to a sinusoidal input V_i= 25 sinωt. (09)



8. a) Explain the amplification action of a transistor with proper example. (08)

b) What are the differences between BJT and FET? (09)

c) How can you use JFET as a constant current source? Explain briefly with necessary diagram. (09)

d) Explain the basic operation and characteristics of E-MOSFET with necessary sketch. (09)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2017

Department of Electronics and Communication Engineering

EEE 1109

(Basic Electrical Engineering)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume any missing reasonable data

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is the basic difference between dc and ac? Define: Loop, node, passive and active elements of electric circuit. (10)
   b) Write down the properties of open and short circuits. (05)
   c) What is linear and nonlinear circuit? Determine the current in the 4Ω branch in the circuit shown below. (15)

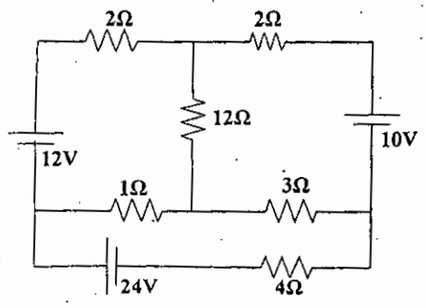


Fig. 1(C)

   d) Explain Ohm's law. What are the limitations of Ohm's law? (05)

2. a) Draw a circuit with 3 nodes, one of the nodes is reference node with two sources E_1 and E_2 and 5 branches. Write the node equation of this circuit. (10)
   b) Find the loop current for the following circuit using loop current or mesh current method. (12)

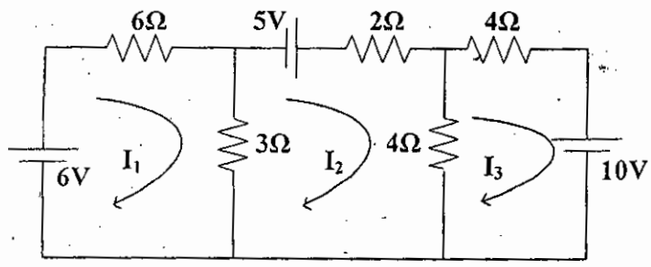


Fig. 2(b)

   c) State superposition theorem. Describe the source conversion process. Find the current through 1.0 Ω resistor using superposition theorem. (13)

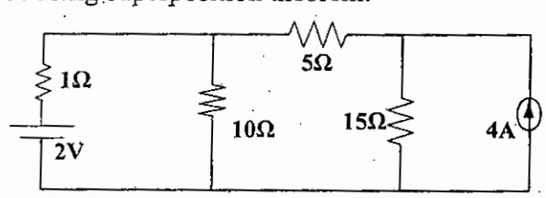


Fig. 2(c)

3. a) Derive the condition for maximum power transfer theorem. Write some applications of maximum power transfer theorem. (10)
   b) Differentiate between electrical circuit and magnetic circuit. (05)

c) What is reluctance and permeability? Classify network with practical examples. (10)

d) State Ampere's circuital law. Find the magnetomotive force around a long straight conductor. (10)

4. a) Describe Y to Δ and Δ to Y conversion process. Find the equivalent resistance between terminals A and B. All resistances are in ohm. (12)

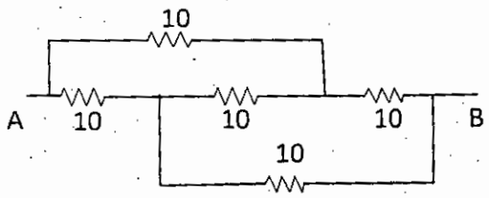


Fig. 4(a)

b) Find the Thevenin's equivalent circuit between the terminals A and B. (13)

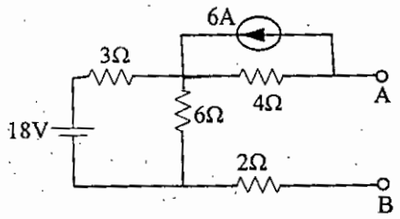


Fig. 4(b)

c) State and explain Biot savart law for a magnetic circuit. (10)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define alternating current. Why alternating current generation is necessary? (05)

b) Find the expression of energy for a purely inductive and capacitive branch for quarter cycle when a sinusoidal voltage is applied. (10)

c) What do you mean by real and reactive power? Show that the average power consumed by inductance or capacitance is zero. (10)

d) A series circuit having pure resistance of 40 Ω, pure inductance of 50.07 mH and a capacitor is connected across a 400 v, 50 Hz AC supply. This combination draws a current of 10A. Calculate – (i) power factor of this circuit, (ii) Capacitor value. (10)

6. a) What is form factor and crest factor? Find the form and crest factor of a sinusoidal ac waveform. (10)

b) A resistance of 10 Ω is in series with a 303 μF capacitor. If the voltage drop across the capacitor is $150sin(220t - 60^0)$ volts. Find the equation with respect to time of the voltage drop and current for the entire circuit. (08)

c) Find all the possible roots of (07)

$$\sqrt[3]{\frac{10\angle 45^0\, 5e^{j60^\circ}(-4.047 - j2.94)}{1 - j1.732}}$$

d) "The frequency range for the pass band is $\Delta f = \frac{R}{2\pi L}$ for a RLC series circuit" – justify this. (10)

7. a) What is power triangle? From this explain how power factors can be improved. (10)

b) What is quality factor, Q of a series circuit? The per unit bandwidth between the half power points is to be 0.02. Find Q of the coil required. If the coil to be employed has an inductance 10 mH and resonant frequency is 20 KC, find the values of R_s and C. (12)

c) For the circuit as shown in Fig. 7(c). Find – (i) conductance and susceptance of each branch, (ii) the vector diagram. (07)

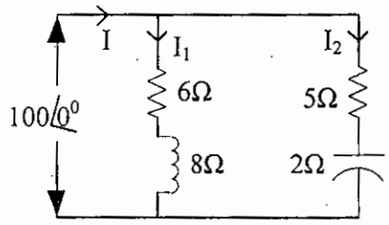


Fig. 7(c)

d) Determine the rms and average values of a semi-circular current wave which has a maximum value of *a*, as shown in Fig. 7(d). (06)

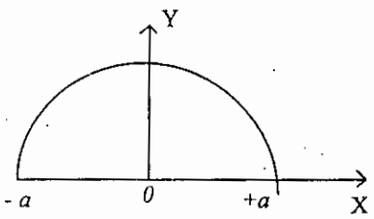


Fig. 7(d)

8. a) Show a comparison of three phase with four phase and single phase in case of requirement of copper to transmit power under fixed conditions. (08)

b) How phase sequence can be determined for a 3-phase supply? Explain your answer with voltmeter method. (07)

c) What are the advantages of using 3-φ system over 1- φ system? Draw the vector diagram of RLC series circuit at resonant condition. What is the value of power factor at this resonant condition? (10)

d) A 3-phase motor takes 10 KVA at 0.6 power factor lagging from a source of 220 volts. It is in parallel with a balanced delta load having 16 Ω resistance and 12 Ω capacitive reactance in series in each phase. Find total VA, power, line current and power factor of the combination. Assume the motor to be Y – connected. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st year 1st Term Examination, 2017

Department of Electronics and Communication Engineering

HUM ~~ECE~~ 1109

(Economics)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Explain with criticism the definition of economics given by Prof. L Robins. (10)
   b) Distinguish positive economics and Normative economics with example. (10)
   c) Explain production possibilities frontier on the basis of choice, scarcity and opportunity cost. (15)

2. a) What is demand schedule? Explain any two causes for downward sloping demand curve. (10)
   b) Nur, a graduating senior has accumulated an impressive file of test during his college career. But now, he needs to sell his test collection to obtain money for his impending marriage. Three wealthy friends express interest in buying some of the tests. Nur determines that their individual demand equations are as follows: (15)

   Q1=50.00-2.00 P Q2=22.50-1.75 P Q3= 27.50-1.25 P

   Where the quantity subscripts denote each of the three friends and price is measured in dollars per test.

   Ques : What is the market demand equation for Nur's test and how many more test can he sell for each one dollar decrease in price? If he has a file of 60 tests, what price would be charge to sell his entire collection?

   c) How do technology and government policy affect the supply of any goods or services? (10)

3. a) Define price elasticity of demand. Explain various types price elasticity of demand with example. (20)
   b) What factors (determinants) govern the size of the coefficient of price elasticity of demand? (10)
   c) Is the price elasticity of demand for 'Dell' computers greater than the price elasticity for computers in general? Why? (05)

4. a) Explain the following concepts: (i) Fixed Cost, (ii) Variable Cost, (iii) Total Cost, (iv) Marginal Cost and (v) Average Cost. (10)
   b) What are the characteristics of indifference curve? (10)
   c) Discuss the law of diminishing marginal utility with limitations. (15)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Distinguish between autonomous and induced investment. (05)
   b) What are the determinants of investment? Explain. (25)
   c) What is economic profit? (05)

6. a) What is inflation? What are the causes of inflation? Discuss. (25)
   b) Distinguish between demand pull and cost push inflation. (10)

7. a) Discuss the methods of estimating national income. (15)
   b) Explain the following terms: (i) Personal income (ii) Disposable income (iii) Transfer payment. (10)
   c) What are the problems in calculating National income? Explain. (10)

8. a) How can you evaluate a project under NPV and IRR? (10)
   b) Distinguish between NPV and IRR method. (10)
   c) Cost of a project 1, 00,000 Tk. Life time of this project is 2 years. If expected rate of return 60,000 Tk. per year. And market interest 9%. Evaluate the project under present value method. (15)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2017

Department of Electronics and Communication Engineering

Math 1109

(Mathematics-I)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is meant by the continuity of a function? A function $f(x)$ is defined as follows: (15)

$$f(x) = 3 + 2x, \quad \text{for} -\frac{3}{2} < x \le 0$$

$$= 3 - 2x, \quad \text{for } 0 < x < \frac{3}{2}.$$

Discuss the continuity of $f(x)$ and the existence of $f'(x)$ at $x = 0$.

b) State L' Hospital's theorem. Determine: (10)

$$Lt_{x\to 0}\left(\frac{\sin x}{x}\right)^{1/x}.$$

c) State Rolle's theorem. Is Rolle's theorem applicable to the function $f(x) = 3 + (2x-1)^{2/3}$ in [0, 1]? Justify your answer. (10)

2. a) State Leibnitz's theorem. If $y = \ln(x + \sqrt{1+x^2})$ find the relation among y_{n+2}, y_{n+1} and y_n. (13)

b) Determine the maximum or minimum value for $f(x) = x^3 - 6x^2 + 9x + 1$ in the interval $0 \le x \le 1$. (10)

c) Define homogeneous function. If $u = \tan^{-1}\left(\frac{x^3 + y^3}{x - y}\right)$ then show that (12)

$$x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin 2u.$$

3. a) Expand $\ln x$ in the powers of $(x-2)$. (10)

b) Find all the asymtotes of the curve $y^2x^2 - 3yx^2 - 5xy^2 + 2x^2 + 6y^2 - x - 3y + 2 = 0$ (12)

c) Find the equation of the tangent and normal to the curve $xy^2 = 4(4-x)$ at the point where it is cut by the line $y = x$. (13)

4. a) Find the radius of curvature of the parabola $y^2 = 4x$ at the vertex. (10)

b) If $u = \frac{x}{r^3}$ and $r^2 = x^2 + y^2 + z^2$, then prove that $u_{xx} + u_{yy} + u_{zz} = 0$ (15)

c) State mean value theorem. Differentiate $x^{\sin^{-1}x}$ with respect to $\ln x$. (10)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. Integrate ANY THREE of the followings: (35)

(a) $\int e^x \frac{2-\sin 2x}{1-\cos 2x}dx$, (b) $\int (x+2)\sqrt{x^2+x+1}dx$, (c) $\int \frac{5\cos x+6}{2\cos x+\sin x+3}dx$,

(d) $\int \frac{dx}{(x^2-1)\sqrt{x^2-1}}$

6. Evaluate ANY THREE of the following definite integrals: (35)

(a) $\int_0^{\pi/2} \sin^6\theta\cos^3\theta d\theta$, (b) $\int_0^{\pi} \frac{dx}{1-2a\cos x+a^2}, (0<a<1)$

(c) $\int_0^1 \frac{\ln(1+x)}{1+x^2}dx$, (d) $\int_0^1 x^3(1-x^2)dx$

7. a) State Walli's formula. Use this formula to evaluate $\int_0^{\pi/2} \sin^9 x dx$. (10)

b) Define Gamma function and Beta function. Prove that $\Gamma(\frac{1}{2}) = \sqrt{\pi}$. (13)

c) Obtain the reduction formula for $\int \tan^n x dx$ and hence find $\int \tan^6 x dx$. (12)

8. a) Find the area above the x-axis, included between the parabola $y^2 = ax$ and the circle $x^2 + y^2 = 2ax$. (13)

b) Find the arc length of the curve $y = x^{3/2}$ from (1, 1) to $(2, 2\sqrt{2})$. (10)

c) Evaluate $\int_0^{\pi/2} \frac{d\theta}{\sqrt{\sin\theta}} \times \int_0^{\pi/2} \sqrt{\sin\theta}d\theta$ (12)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2017

Department of Electronics and Communication Engineering

Ph 1109

(Physics)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is radio activity? Write down the properties of alpha, beta and gamma rays. (12)
   b) Derive an expression for age of earth using radio-active dating and hence calculate the age of earth. (13)
   c) Half-life of Radium is 26.8 minutes. Calculate the amount of Ra^{214} which activity is 1 curie. (10)

2. a) Draw binding energy curve and explain it with the help of fission and fusion. (10)
   b) What is simple harmonic motion (SHM)? Show graphical representation of the SHM. (07)
   c) Derive differential equation of SHM. (08)
   d) A particle is moving simple harmonically in a straight line. If the distance of the particle from the equilibrium position are x_1 and x_2 correspondingly to the velocities are u_1 and u_2, show that the period is given by $T = 2\pi\left[\frac{x_2^2 - x_1^2}{u_1^2 - u_2^2}\right]^{1/2}$. Find also its maximum velocity and amplitude. (10)

3. a) What are damped vibrations and forced vibrations? Derive an expression for power dissipation in damped harmonic oscillation. (15)
   b) What is resonance? Derive an expression for maximum displacement of a driven oscillator. (10)
   c) An under damped harmonic oscillator has its amplitude reduced to $1/10^{th}$ of its initial value after 100 oscillations. Its period is 1.25 sec. (*i*) calculate the damping constant and relaxation time, (*ii*) if the observed value of the first amplitude of the oscillator be 2.2 cm, what would be its value in the absence of damping? (10)

4. a) What are stationary waves? Write down their properties. (09)
   b) Draw the Lissajous' figure using the following equations: (06)
   $$x = a\sin\omega t$$
   $$y = 2a\sin 2\omega t$$
   c) Briefly explain the Doppler principle. (05)
   d) Write down the requisites for good acoustics. (08)
   e) Calculate the increase in the acoustic intensity level when the sound is doubled. (07)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What are the two consequences of Michelson-Moreley experiment? Show that the speed of light is invariant under velocity addition. (10)
   b) Derive an expression for Einstein mass energy relation and hence show that the classical kinetic energy is only an approximation. (15)
   c) A man has a mass of 100 Kg on the ground. When he is in a rocket ship in flight, his mass is 101 Kg as determined by an observer on the ground. What is the speed of the rocket ship? (10)

6. a) What is photoelectric effect? What are the limitations of classical electromagnetic wave to explain it? (10)

b) Show that the Compton red shift is $\lambda_c(1-\cos\theta)$, where the symbols have their usual meanings. (15)

c) A beam of X-ray is scattered by free electron. At 45^0 from the beam direction the scattered X-rays have a wavelength 0.22A. What is the wavelength of the X-rays in the direct beam? (10)

7. a) What are coherent sources of light? Show that the distance between two successive bright and dark fringes formed in Young's experiment is $\beta = \frac{\lambda D}{d}$, where the symbols have their usual meanings. (10)

b) What is interference of light? How can you determine the wavelength of light using a Fresnel's biprism? (15)

c) Two coherent sources are 0.22 mm apart and the fringes are observed on a screen 70 cm away. It is found that with a certain monochromatic source of light, the fourth bright fringe is situated at a distance of 10 mm from the central fringe. Calculate the wavelength of light. (10)

8. a) Discuss how can you prove light wave is a transverse wave. (10)

b) Discuss the constructional details of a Nicole prism. How can you use it as a polarizer and an analyzer? (15)

c) Find the specific rotation of a given sample of sugar solution if the plane of polarization is turned through 26.4^0. The length of the tube containing 20% sugar solution is 20 cm. (10)