KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2016
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)  What are the main drawbacks of classical free electron theory? Explain the (12)
        assumptions made in quantum theory to overcome the drawbacks.
    b)  Derive the expression for the electrical conductivity of metal from the microscopic (11)
        point of view.
    c)  Explain the electron –scattering mechanism in metals. Explain also why and how the (12)
        conductivity varies with temperature and composition.

2.  a)  Describe the formation of depletion region at a p-n junction. (07)
    b)  Draw a schematic diagram showing the energy band of a p-n junction when it is (09)
        forward biased. Show clearly the positions of the Fermi levels on two sides of the
        junction. Explain how the carrier and current flow is affected by a forward-biased
        voltage.
    c)  Show that contact potential of p-njunction is $V_0 = KT \ln \frac{N_D N_A}{n_i^2}$, where the (10)
        symbols have their usual meanings.
    d)  The resistivity of the two sides of an abrupt germanium diode are $2\Omega.cm$ (p side) (09)
        and $1\Omega.cm$ (n side) at $300^0$ K. Calculate the height $E_0$ of the potential energy barrier.
        Assume that the mobility of electrons and holes in germanium are $\mu_n$=3800
        cm$^2$/v.sec and $\mu_p$=1800 cm$^2$/v.sec respectively.

3.  a)  Derive the continuity equation of charge in semiconductor. Also explain its physical (12)
        significance.
    b)  With the help of suitable diagram, illustrate the current components in a p-n diode. (08)
    c)  Establish the relation $I = I_0 \left( e^{\frac{V}{\eta V_T}} - 1 \right)$ for a p-n junction diode, where the symbols (11)
        have their usual meanings.
    d)  A zener diode is operated in the reverse breakdown region but it does not burn, (04)
        why?

4.  a)  What is minority carrier storage time of a diode? How does it limit the performance (07)
        of a switching diode? Explain in brief.
    b)  How does capacitance formed in a p-n junction? Find an expression for the diffusion (11)
        capacitance of an ideal p-n junction diode in which the dopping concentration of the
        p-side is very high than n-side.
    c)  Briefly describe the phenomena of Hall effect. Write down few applications of it. (09)
    d)  For a particular semiconductor material, $N_c = 1.5 \times 10^{18} cm^{-3}$, $N_v = 1.3 \times 10^{19} cm^{-3}$ and (08)
        $E_a = 1.43 ev$ at T=300$^0$K.
        (i)   Determine the position of the intrinsic Fermi level with respect to the
              center of the bandgap.
        (ii)  Find the intrinsic carrier concentration of the semiconductor at T=300$^0$K.

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

5.  a) Justify the statement-"n-type or p-type semiconductor is electrically neutral." (08)

    b) Conductors have a positive temperature coefficient whereas semiconductor materials have a negative temperature coefficient-why? Explain briefly. (07)

    c) Show that the *PIV* for each diode is double in a full wave rectifier using center tapped transformer than that of a bridge rectifier. (10)

    d) Find out the operating point and calculate the voltage across the load from figure 5(d). (10)
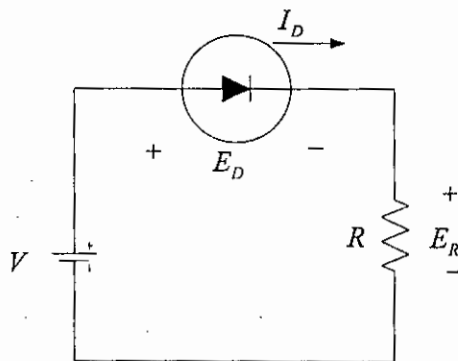


Figure 5(d)

6.  a) Determine $V_0$ and $I_0$ for the configuration of figure 6(a). (06)
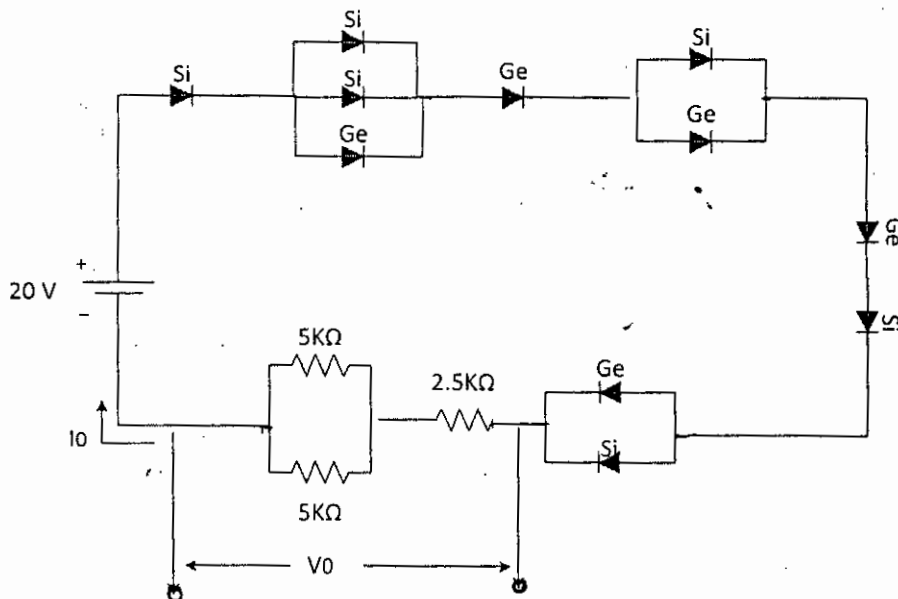


Figure 6(a)

    b) Show that in half-wave rectification, a maximum of 40.6% of ac power is converted into dc power. (11)

    c) Write down the advantages and disadvantages of center-tapped full wave rectifier. How can you eliminate those disadvantages? (08)

d) (i) Sketch the output $V_0$ and determine the dc level of the output for the network of   (10)
figure 6(d).
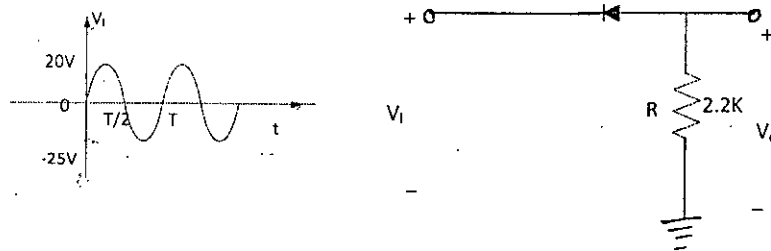(ii) Repeat part (i) if the ideal diode is replaced by a silicon diode.



Figure 6(d)

7. a) What is meant by regulated power supply? Design a regulated power supply for   (10)
your mobile phone (+5v dc) from 220 v ac mains, Mention the input and output
wave shapes at every stages with proper labeling.

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.

$$\text{(i) } R_{L\min} = \frac{RV_z}{(V_i - V_z)}, \qquad \text{(ii) } R_{L\max} = \frac{V_z}{I_{L\min}}$$

c) Prove that, the expression for collector current of common base connection is   (10)

$$I_c = \frac{\alpha}{1-\alpha}I_B + \frac{I_{CBO}}{1-\alpha}, \quad \text{where the symbols have their usual meanings.}$$

d) What do you mean by dark current and dark resistance?   (05)

8. a) Write short note on (i) Tunnel diode, (ii) Varactor diode.   (08)
b) For n-channel JFET, why the depletion region is wider near the top of the p-type   (08)
materials. Explain briefly.
c) How can you use JFET as a constant current source? Briefly describe with necessary   (08)
diagram.
d) What is the primary difference between D-MOSFET and E-MOSFET? Explain the   (11)
basic operation and characteristics of D-MOSFET with necessary sketch.

# KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
## B.Sc. Engineering 1st Year 1st Term Examination, 2016
### 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) B-H curve may be supplied (if necessary).

## SECTION A

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

1. a) Define (i) active element, (ii) passive element, (iii) unilateral circuit, (iv) bilateral circuit, (v) mesh with proper example. (10)

   b) Find the equivalent resistance and total current of the following network shown in figure 1(b). (10)
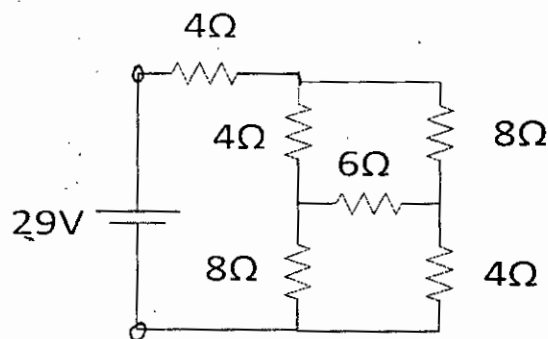


Figure 1(b)

   c) State and explain the basic laws of electrical engineering. (06)

   d) Classify energy sources. Also show their characteristics curves in both ideal and practical cases. (09)

2. a) Deduce the condition for maximum power transfer. Hence, show that power transfer efficiency is 50% under maximum power transfer condition. Why maximum power transfer condition is important for communication engineering? (15)

   b) Find the voltage across the $2\Omega$ resistor in figure 2(b) by using superposition theorem. (10)
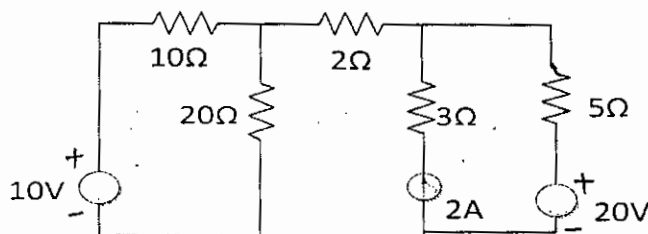


Figure 2(b)

   c) State Millman theorem. Find the current and voltage through $R_L$ of the network shown in figure 2 (c) using Millman theorem. (10)
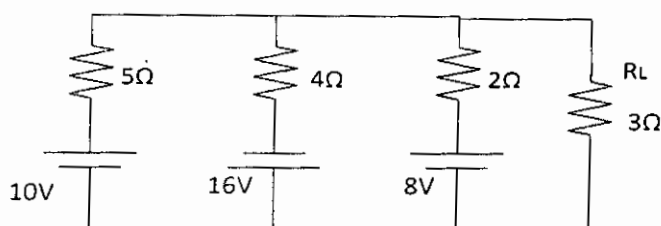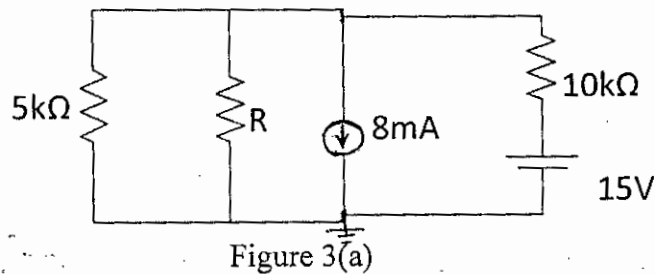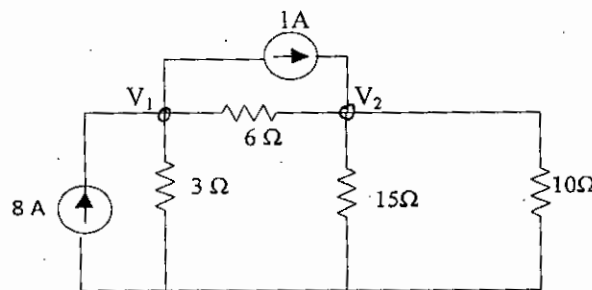


Figure 2(c)

3. a) State Norton's theorem. For the circuit as shown in figure 3(a), find: (15)
   (i) Thevenin equivalent circuit for the network external to the resistor R.
   (ii) Norton equivalent circuit.



Figure 3(a)

b) Determine the current across the 6Ω resistance shown in figure 3(b) using nodal analysis. (10). Also determine nodal voltage $V_1$ and $V_2$.



Figure 3(b)

c) What are the basic differences between electric circuit and magnetic circuit? Show that the (10) magnetic flux density at any specified distance from a long straight current carrying conductor is $B = \mu I_1 / 2\pi s$, where the symbols have their usual meanings.

4. a) Determine the secondary current $I_2$ for the transformer of figure 4(a), if the flux in the core is (10) $1.5 \times 10^{-5}$ wb.



Figure 4(a)
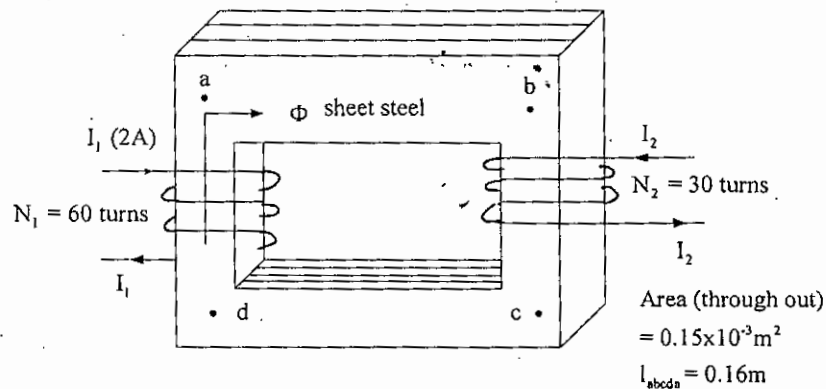
b) Define reluctance, permeance, mmf. Explain hysteresis loss and eddy current loss. How to (07) minimize these losses?

c) Derive the expression of energy stored in a toroid and show that $W = \frac{1}{2} B^2 / \mu_0$, where the (08) symbols have their usual meanings.

d) Define independent source and dependent source. Differentiate between primary cell and (10) secondary cell.

# SECTION B

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

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

   b) If R=10Ω, L=0.056 henry, c=50 μf, find impedance of this RLC circuit when f=50 cycles. If $v = 200\sin \omega t$ volts, find the expression of current. (10)

   c) Show the expression of energy delivered and received for purely inductive and capacitive branch respectively for a quarter cycle. (10)

   d) Show that the crest factor of a sine wave is $\sqrt{2}$ and the form factor is 1.11. (10)

6. a) A series circuit consist of two pure elements has the following current and voltage , (10)
   $v = 100\sin(2000t + 50^0)$ volt   $i = 20\cos(2000t + 20^0)$ amp. Find the elements in the circuit.

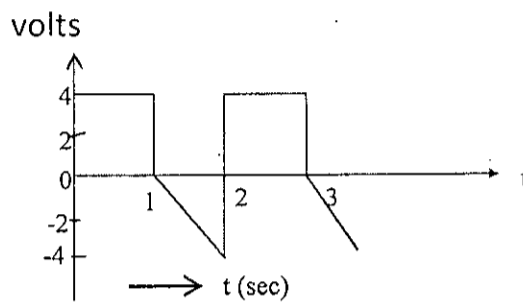   b) Define RMS value. Find the form factor for the following voltage wave as shown in figure 6(b). (13)



Figure 6(b)

   c) Define balanced and unbalanced $3 - \Phi$ system. Prove that $3 - \Phi$ system is more economical than $1 - \Phi$ and $4 - \Phi$ system respectively. (12)

7. a) Define resonance. Prove that "In RLC series circuit the maximum voltage across the capacitor occurs below the resonant frequency and the maximum voltage across the inductor occurs above the resonant frequency". (12)

   b) For the following equation, evaluate $\alpha$ and $\beta$. (06)

$$\alpha + j\beta = 2\log_e \left( \sqrt{1 + \frac{z_1}{4z_2}} + \sqrt{\frac{z_1}{4z_2}} \right),$$

where $z_1 = 25.14\angle -90^0 \, \Omega$   and $4z_2 = 795\angle +90^0 \, \Omega$

   c) Define magnetic coupling. Derive the expression of the coefficient of magnetic coupling. (06)

   d) For the given circuit as shown in figure 7(d), find: (i) conductance and susceptance of each branch (ii) the vector diagram. (11)
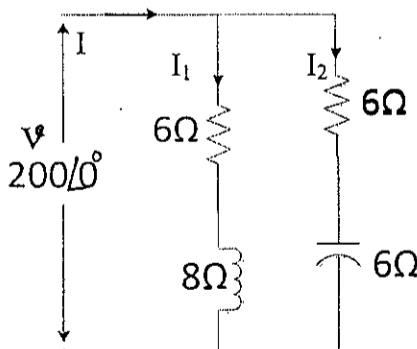


Figure 7 (d)

8. a) Define phase sequence. Explain the two lamp method of determining phase sequence of a $3 - \Phi$ system (12)

   b) A $3 - \Phi$ motor takes 10kva 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 volt-amperes, power, line current and power factor of the combination. Assume the motor to be 'Y' connected. (14)

   c) Show the power variations of purely inductive and capacitive branch for a single phase system. (09)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st year 1st Term Examination, 2016
Department of Electronics and Communication Engineering
Hum 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)  Define Robbins definition of economics. Why is it necessary for an engineer to study   (10)
        Economics? Explain.
    b)  What is scarcity and choice? Explain the basic problems of an economic system.          (20)
    c)  What do you understand by production possibilities frontier? Explain with figure.        (05)

2.  a)  What is meant by shift in demand curve? Explain the factors behind the down word         (20)
        slope demand curve.
    b)  Why the supply curve slopes upward to the right?                                         (10)
    c)  If there are 100 identical producers in the market, each with a supply of commodity      (05)
        X is given by $Q_{sx}$= -40+20$P_x$ and 1000 identical individuals, each with a demand for
        commodity x is given by $Q_{dx}$= 8-Px. Now determine the equilibrium quantity and
        equilibrium price.

3.  a)  What does the price elasticity of demand measure in general?                             (10)
    b)  Explain the idea of price elasticity of demand, income elasticity of demand and cross    (18)
        price elasticity of demand.
    c)  The market demand for playing card is given by the equation, $Q= 6000 - 1000 P$,         (07)
        For a price increase from $2 to $3, per deck, then what is the price elasticity of
        demand?

4.  a)  Distinguish between perfect competition and monopoly.                                    (07)
    b)  Define short run. Explain short run equilibrium of a firm in perfect competition.        (18)
    c)  When does a firm shut down? Explain with a suitable figure.                              (10)

## SECTION B

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

5. a) What are real and Nominal GDP? Which is the better measure of economic (10) wellbeing? Why?

   b) Suppose in the year 2011 the economy produces 1000 units of pen that sell for $2 (15) each. In year 2012 the economy produces 1200 units of pen that sell $3 each. And in 2013 the economy produces 1500 units of pen that sell at $3 each. Calculate Nominal GDP. Real GDP, GDP deflator. Use 2011 as the base year.

   c) By what percentage does each of these threl statistics risc from one year to the next? (10)

6. a) What is the role of financial system in our economy? Name and describe two markets (10) that are the part of financial system in our economy.

   b) Define national savings, private savings and public savings. How are these variables (15) related? Explain with examples.

   c) What is investment? How is it related to national savings? (10)

7. a) What do you mean by the word "productivity"? List and describe four determinates (15) of productivity.

   b) What is stock and bond? How are they different and how are they similar? (15)

   c) What is budget deficit? (05)

8. a) What is inflation, Demand pull inflation and the cost push inflation? (15)

   b) Professional artworks, Inc is a firm that speculates in modern paintings. The manager (20) is thinking of buying an original picesso for $ 400000 with the intention of selling, if at the end of one year. The manager expects that that the painting will be worth $480000 in one year. Suppose the guaranteed interest rate granted by banks is 12% and the risk premium is 25%. Should the firm purchase the piece of art? Explain why? Why next?

# KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1$^{st}$ Year 1$^{st}$ Term Examination, 2016

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) Using $(\delta - \varepsilon)$ definition show that $\lim\limits_{x \to 2} \dfrac{x^2 - 4}{x - 2} = 4$. (10)

   b) Examine continuity for the function $f(x)$ at $x=2$ where $f(x) = \begin{cases} \dfrac{|x-2|}{x^2 - 4} & when \quad x \neq 2 \\ \dfrac{1}{4} & " \quad x = 2 \end{cases}$. (12)

   c) Discuss the differentiability at $x = \dfrac{\pi}{2}$ for the function (13)

$$f(x) = \begin{cases} 1 & when \quad x < 0 \\ 1 + \sin x & " \quad 0 \leq x < \pi/2 \\ 2 + (x - \pi/2)^2 & " \quad \pi/2 \leq x \end{cases}.$$

2. a) If $y = \cos^2 x \sin^3 x$ then find $y_n$. (13)

   b) If $u = \log(x^2 + y^2 + z^2)$ then prove that $x\dfrac{\delta^2 u}{\delta y \delta z} = y\dfrac{\delta^2 u}{\delta x \delta z} = z\dfrac{\delta^2 u}{\delta x \delta y}$. (11)

   c) Expand $\cos x$ in powers of $(x - \dfrac{\pi}{4})$. (11)

3. a) Find $\dfrac{dy}{dx}$:  (i) $y = x^x + (\sin x)^{\ln x}$  (ii) $y = \sin^2 t, \quad x = \tan t$ (12)

   b) Verify whether Roller's theorem is applicable for the function $f(x) = \ln\dfrac{x^2 + 3}{4x}$ in the interval $(1, 3)$. (12)

   c) Justify the validity of the Lagrange's mean value theorem for $f(x) = 3 + 2x - x^2$ at $(0, 1)$. (11)

4. a) Find the maximum and minimum of $1 + 2\sin x + 3\cos^2 x$ for $0 \leq x \leq \dfrac{\pi}{2}$. (13)

   b) Find the radius of curvature at the point $(r, \theta)$ on the condition $r = a(1 - \cos\theta)$. (12)

   c) Evaluate $\lim\limits_{x \to \frac{\pi}{2}} (\tan x)^{\tan 2x}$. (10)

5. Integrate any three of the followings. (35)

   (a) $\int \dfrac{dx}{(x^2-1)\sqrt{x^2+1}}$

   (b) $\int \dfrac{xdx}{(x-1)(x^2+4)}$

   (c) $\int \dfrac{dx}{2+\cos x - 2\sin x}$

   (d) $\int \dfrac{dx}{x^4\sqrt{x^2-1}}$

6. Integrate any three of the followings. (35)

   (a) $\int_0^{\pi/2} \dfrac{5\cos x + 6}{2\cos x + \sin x + 3}dx$

   (b) $\int_0^1 \dfrac{dx}{(1+x)(\sqrt{1+2x-x^2})}$

   (c) $\int_2^3 \dfrac{\sqrt{5-x}}{\sqrt{x}+\sqrt{5-x}}dx$

   (d) $\int_0^{\pi} x\cos^4 x\,dx$

7. a) If $I_{m,n} = \int_0^{\pi/2}\sin^m x.\cos x^n xdx$ then show that $I_{m,n} = \dfrac{m-1}{m+n}I_{m-2,n}$ and (13)

     hence evaluate $\int_0^{\pi}\sin^4 x.\cos^5 xdx$.

  b) Evaluate $\lim\limits_{n\to\infty}\left[\dfrac{n^2}{(n^2+1)^{3/2}}+\dfrac{n^2}{(n^2+2^2)^{3/2}}+\dfrac{n^2}{(n^2+3^2)^{3/2}}+........\dfrac{n^2}{(2n^2)^{3/2}}\right]$. (10)

  c) Establish the relation between Gamma and Beta function. (12)

8. a) Find the area bounded by the curve $r = a(1+\cos\theta)$ (11)

  b) Find the volume of the solid generated by the revolution of the ellipse $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1$ about x axis. (12)

  c) Find the arc length of the curve $x^{2/3}+y^{2/3}=a^{2/3}$. (12)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st year 1st Term Examination, 2016
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) Explain simple harmonic motion and discuss its oscillatory behavior. (08)
    b) Show that the total energy of a particle executing simple harmonic motion is constant. (09)
    c) Discuss the sharpness of resonance. (08)
    d) Two SHM's acting simultaneously on a particle are given by the equation. (10)
$$Y_1 = 2\sin(\omega t + \pi/4)$$
$$Y_2 = 3\sin(\omega t + \pi/3)$$
    Calculate (i) amplitude (ii) phase constant (iii) time period of the resultant vibration.

2.  a) Show that the energy of a plane progressive wave is $E = 2\pi^2 \rho n^2 a^2$ where the symbols have their usual meaning. (10)
    b) What is Doppler's effect in Sound? Obtain an expression for the apparent frequency of a note when the source and the listener are (i) moving towards each other, (ii) moving away from each other. (15)
    c) Two aeroplanes pass each other in opposite directions and one of them is blowing a whistle of frequency 540 Hz. Calculate the frequencies of the notes heard in the other aeroplane (i) before and (ii) after they have passed each other. Velocity of either of the aeroplanes is 540 km/hr and velocity of sound $= 350\ ms^{-1}$. (10)

3.  a) What is bel and phone? Discuss the factors influencing loudness. (08)
    b) Explain Sabine's reverberation formula. (17)
    c) Calculate the (i) acoustic intensity (ii) acoustic pressure of a plane, acoustic wave in air of intensity level of 80 decibels reference to $10^{-12}\ watt/m^2$ (10)

4.  a) What is radioactivity? State and explain radioactive decay law. From the decay law deduce an expression for half-life of a radioactive sample. (12)
    b) Explain nuclear fission and nuclear fusion reactions with example. What is the source of energy release in nuclear fission? Calculate the energy released in a fission of $^{235}U$ nucleus. (13)
    c) Calculate the mass defect and binding energy of a deuteron. Given that $_0n^1 = 1.008665$ amu $_1H^1 = 1.007825$ amu and $_1H^2 = 2.01403$ amu; (10)

*Page: 1 of 2*

5.  a) Define equivalent lens and equivalent focal length. Explain the defects astigmatism, coma and curvature. Explain how they can be minimized. (13)

    b) Explain Huygens's principle. (12)

    c) In the Newton's rings experiment the diameter of the 5th ring was 0.336 cm and the diameter of the 15th ring=0.590 cm. Find the radius of curvature of the plano-convex lens, if the wavelength of the light used is 5890A. (10)

6.  a) Explain interference of light using suitable diagram. Discuss interference of light analytically and obtain the conditions of maximum and minimum intensities. (12)

    b) Discuss about the phenomenon of interference of light due to reflected light in thin film. Why do colors appear in thin film? (13)

    c) In Youngi double slit experiment the separation of the slits is 1.9 mm and the fringe spacing is 0.31 mm at a distance of 1 m from the slits. Calculate the wavelength of light. (10)

7.  a) Discuss the Fraunhofer diffraction at a single slit. Draw the intensity distribution for the diffraction pattern. (15)

    b) What do you mean by polarization of light? Explain how a Nicol prism produces plane polarized light. (10)

    c) A plane grating has 15000 lines per inch. Find the angle of separation of the 5048 $A^0$ and 5016$A^0$ lines of helium in the second order spectrum. (10)

8.  a) What is the photo electric effect? Write down the Einsteins hypothesis about photoelectric effect. (10)

    b) Deduce the time dependent Schrodinger wave equation. Give the significance of the wave equation. (15)

    c) An x-ray photon of wavelength 0.3 A° undergoes a 60⁰ compton scattering. Find the wavelength of scattered photon and the kinetic energy imparted to the recoiling electron? (10)