BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2012-2013

Sub : **EEE 105** (Electrical Circuits II)

Full Marks : 210                                                  Time : 3 Hours

The figures in the margin indicate full marks.

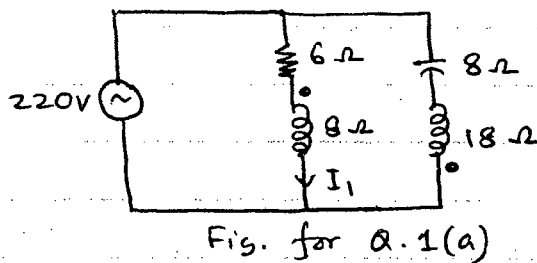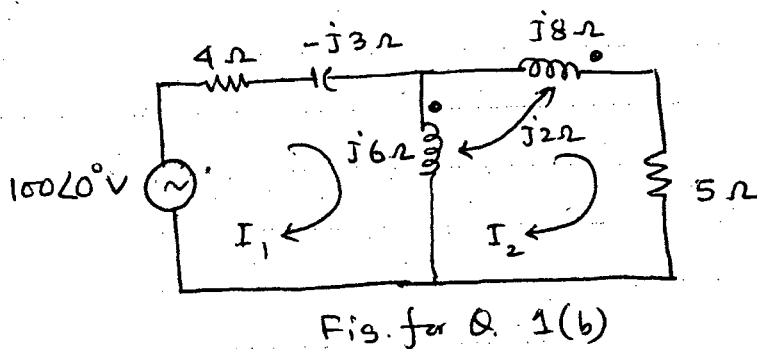USE SEPARATE SCRIPTS FOR EACH SECTION

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**SECTION – A**

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) Find the current $I_1$ in the circuit shown in Fig. for Q. 1(a) if the coefficient of coupling of the two coils is 0.5.                                                                                           **(17)**


Fig. for Q. 1(a)

   (b) Calculate the currents $I_1$ and $I_2$ in the circuit shown in Fig. for Q. 1(b).                      **(18)**


Fig. for Q. 1(b)

2. (a) For a balanced 3-phase system, show that the phase relation between line currents and line voltages is identical for both Y-connected and Δ-connected loads and show this relation by a three-origin vector diagram. Draw the three origin vector diagram for acb sequence for 80% lagging p.f. load.                                                                                   **(17)**

   (b) A 415 V, 3-phase, 50 Hz load draws 11.25 kW at 0.7 p.f. lagging at an efficiency of 84%. The load is Δ-connected. Find (i) the input power, (ii) input line current, (iii) phase current and (iv) KVA rating of capacitor bank to be connected to improve the p.f. to 0.9 lagging.                                                                                                                    **(18)**

3. (a) What is the characteristic impedance of a filter? Derive the expressions of characteristic impedances of T and π filter sections.                                                         **(12)**

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## EEE 105

**Contd ... Q. No. 3**

(b) Show that for both T and π sections, the characteristic impedance is the geometric mean of open-circuit and short-circuit impedances. **(12)**

(c) Derive the fundamental filter equation in terms of its series and shut arm impedances. **(11)**

4. (a) Find the current $i$ at t = 2 × 10$^{-3}$ sec for the circuit shown in Fig. for Q. 4(a). Assume that the switch was at postion-1 for a long time. **(18)**



Fig. for Q. 4 (a)
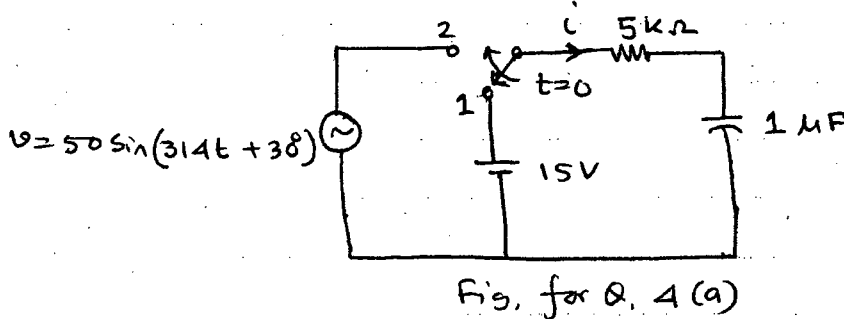
(b) A series RLC circuit is suddenly energized with an alternating voltage, $e = 141$ $sin(377t - 45°)$ volts, where, R = 1Ω, L = 0.041 H, C = 18.7 μF and initial charge on the capacitor, $Q_o = 0$. Find the current $i$ for t > 0. **(17)**

### SECTION – B
There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Find the average power absorbed by a 100 Ω resistor if current shown in Fig. for Q. No. 5(a) flows through this resistor. **(17)**



Fig. for Q. No. 5(a)
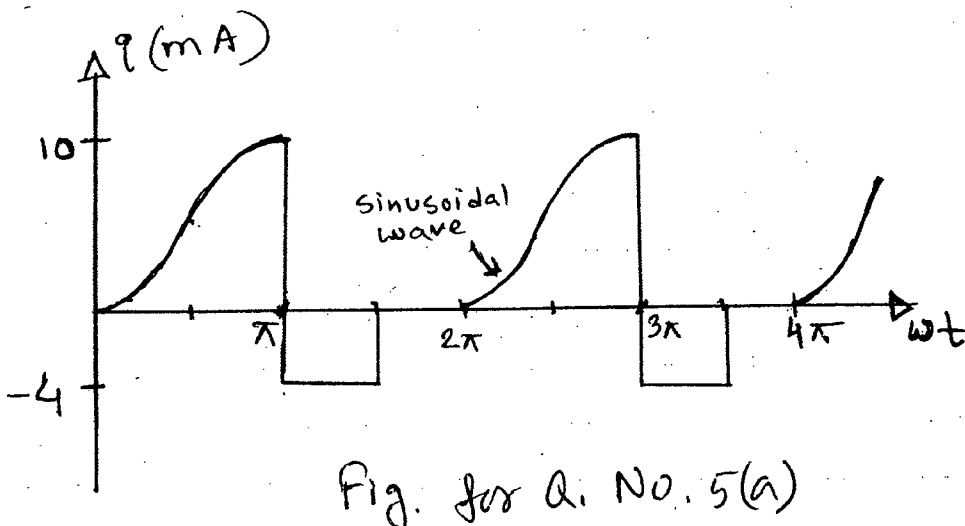
(b) Suppose a current $i = I_m sin\omega t$ is passed through a series branch consisting of an inductor and a capacitor. Show that real power absorbed by the inductor-capacitor branch is zero. Also derive the expression of energy delivered or received by the inductor-capacitor branch during a quarter of a cycle. **(18)**

## EEE 105

6. (a) A voltage $v = 141.4 \, sin\omega t - 70.7 \, sin(3\omega t + 30°)$ volts is impressed in the circuit shown in Fig. for Q. 6(a) with $\omega = 377$ radians per second. Determine (i) the value of total current, I, (ii) the total power supplied by the voltage source (iii) expression of the total current i. (iv) power factor of the whole circuit. **(25)**
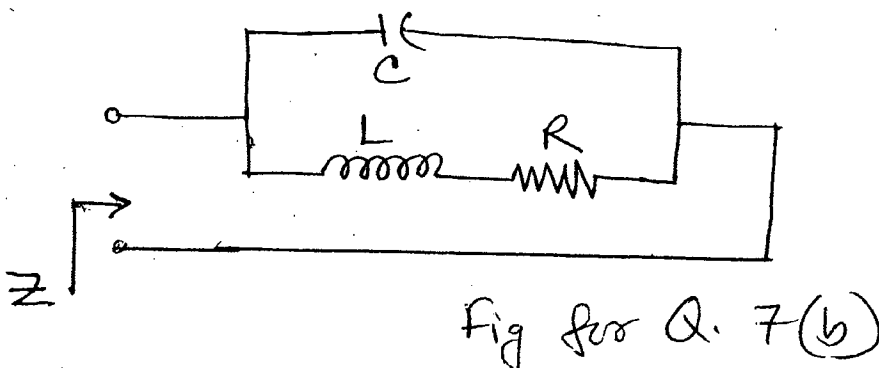


Fig for Q.6(a)
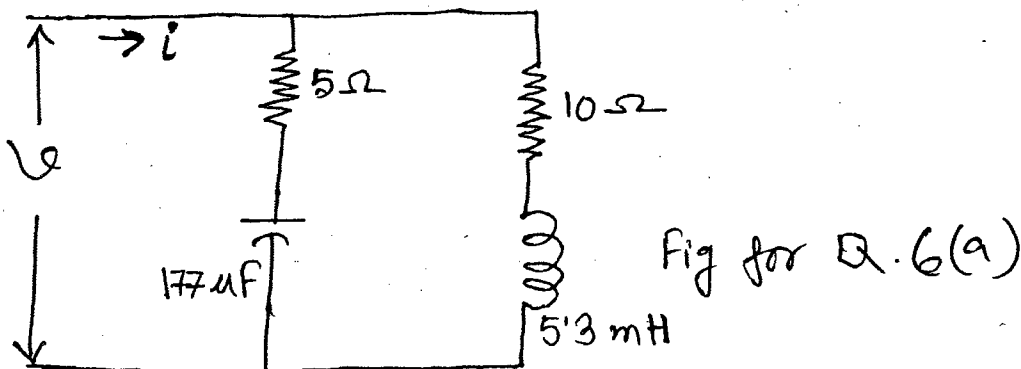
(b) Determine whether the following two waves are of the same shape? Give reason. **(10)**

$$e = 100 \, sin(\omega t + 30°) - 50 \, sin(3\omega t - 60°) + 25 \, sin(5\omega t + 40°)$$

$$i = 10 \, sin(\omega t - 60°) + 5 \, sin(3\omega t - 150°) + 2.5 \, cos(5\omega t - 140°)$$

7. (a) Analytically show that the maximum voltage across the inductor is obtained at a certain value of the inductance than the inductance at resonance when resonance is achieved in a series R-L-C circuit by varying inductance. Also explain briefly. **(16)**

(b)



Fig for Q. 7(b)

**(19)**

(i) Assuming that R is constant, find the resistance component Rz of z for the circuit shown in Fig. for Q. 7(b) in terms of L,R,C and $\omega$.

(ii) Also find the angular frequency at which Rz has its maximum value, while L = 20 $\mu$H, C = 20 $\mu$F, R = 100 $\Omega$.

# EEE 105

**Contd ... Q. No. 7**

(iii) What is $Q_P$ of this circuit?

(iv) What will be the value of R that will place the circuit in parallel resonance irrespective of frequency?

8. (a) The frequency of the sinusoidal voltage source in the circuit shown in the Fig. for Q. 8(a) is adjusted until the current $i_0$ is in phase with $v_s$. **(20)**

    (i) Find the frequency in hertz.

    (ii) Find the expression for $i_0$ at the frequency found in part (i) if $v_s = 80 \cos \omega t$ volt.
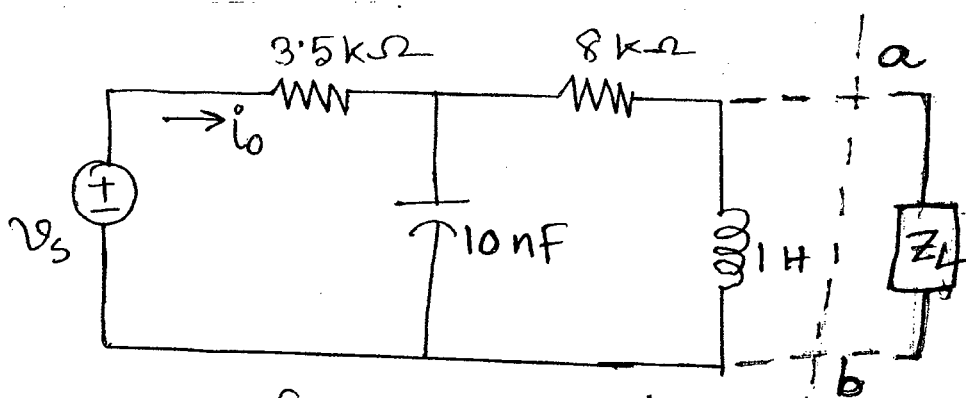


Fig. for Q. 8(a).

(iii) Find the load impedance, $Z_L$ across the terminal 'a' and 'b' in the circuit in Fig. for Q. 8(a). that results in maximum power transfer to the load. If the load impedance is replaced by a load resistance, $R_L$, determine the value of $R_L$ to achieve this condition.

(b) Find the expression of $v_x$ in the circuit of Fig. for Q. 8(b) using nodal analysis. **(15)**
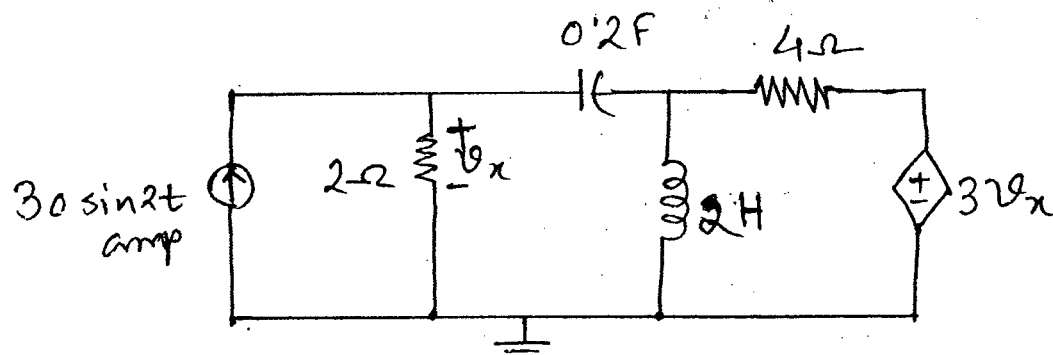


Fig. for Q. 8(b)

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2012-2013

Sub : **CHEM 101** (Chemistry -I)

Full Marks : 210                          Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Define solution and classify it into different classes. Give at least one example of each class. **(5)**

   (b) How does the absorption and evolution of heat take place during the dissolution of a solid in water? Explain, why during the dissolution of all gases in water evolution of heat takes place? **(15)**

   (c) Describe distribution law with suitable example. Discuss one important application of distribution law. Show that multiple stage extraction is always more efficient than single stage extraction. **(15)**

2. (a) What do you understand by osmotic pressure and reverse osmosis? Describe an important application of reverse osmosis. Discuss laws of osmotic pressure. **(10)**

   (b) Derive a mathematical expression which correlates the depression of freezing point and molecular weight of a solute. Define Cryoscopic constant. **(13)**

   (c) 5.0 g of a substance dissolved in 50 g water lowers the freezing point by 1.2°C. Calculate the molecular weight of the substance. The cryoscopic constant of water is 1.85 °c/m. **(12)**

3. (a) What is phase rule? Describe the terms involved in phase rule with suitable examples. **(10)**

   (b) Derive mathematical expression of phase rule. **(5)**

   (c) Draw the phase diagram of sulphur and discuss the diagram at length. **(20)**

4. (a) What is the important information obtained from the photoelectric effect? How did it help in developing Bohr atomic model? Deduce the equation for the determination of energy difference between two energy levels of Bohr atomic structure. **(13)**

   (b) Why should there be a number of subsidiary quantum numbers and magnetic quantum numbers for most of the principal quantum number? Discuss with suitable examples. **(8)**

   (c) Discuss the important physical and chemical properties of noble gas elements. **(7)**

   (d) What is LASER? Discuss the principle of LASER production in relation to noble gas. **(7)**

# CHEM 101(EEE)

## SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) What are meant by chemical potential ($\mu$) and Gibb's free energy (G)? **(6)**

(b) Derive a mathematical model relating the Gibb's free energy change ($\Delta G$) and equilibrium constant (K). Mention the significance of the obtained equation. **(8+4)**

(c) Explain the effect of temperature on equilibrium constant (K). **(8)**

(d) For the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, the values of $K_p$ at 298 K and 338 K are 0.141 atm. and 2.80 atm respectively. Calculate the average enthalpy change and comment on the result. **(9)**

6. (a) What is the main objective of kinetic study? What are the main factors which govern the kinetics of a reaction? Explain. **(8)**

(b) Derive an expression for the rate constant of a first order reaction. Prove that a first order reaction is never complete. **(8+2)**

(c) Derive the rate law for a consecutive reaction. **(10)**

(d) Decomposition of a gas follows second order kinetics. It takes 40 minutes for 40% of the gas to be decomposed when its initial concentration is $4.0 \times 10^{-2}$ mole/L. Calculate the rate constant. **(7)**

7. (a) Define heat of reaction. Derive mathematical relationship between heat of reaction at constant volume and at constant pressure. **(2+8)**

(b) What is heat of combustion? Discuss how heat of combuston can be experimentally determined. **(3+4)**

(c) What do you mean by the ionic product (Kw) of water and how is it related with the concentrations of hydrogen and hydroxyl ions? Show that p kW is equal to 14 at 25°C. **(6)**

(d) How is relative strength of acids determined? **(6)**

(e) What are the possible structures of $NH_4^+$ and $ICl_4^-$ ions? Justify them. **(6)**

8. (a) Differentiate between "$\psi$" and "$\psi^2$". Deduce Schrödinger wave equation. Mention the conditions applied for obtaining practicable solutions of wave function "$\psi$". Justify for having those conditions. **(13)**

(b) With the help of potential energy diagram discuss the formation of different kinds of chemical bonds. **(9)**

(c) How did Werner develop the theory of coordination/complex compounds? Mention the important points of the theory. **(7)**

(d) Comment on the formation of $H_2^+$ and $He_2^+$ ions and compare them with $H_2$ and $He_2$ molecules formation. **(6)**

**L-1/T-2/EEE**                                                          **Date : 28/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2    B. Sc. Engineering Examinations 2012-2013

Sub : **MATH 257** (Ordinary and Partial Differential Equations)

Full Marks : 210                                                    Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

Symbols have their usual meaning.

1. Solve the following differential equations:

   (a) $\dfrac{dy}{dx} = sin(x+y) + cos(x+y)$                                          (12)

   (b) $(x^2 - 2xy)dy + (x^2 - 3xy + 2y^2)dx = 0$                          (12)

   (c) $xy - \dfrac{dy}{dx} = y^3 e^{-x^2}$                                          (11)

2. (a) Write down the different rules of finding the integrating factor of the differential equations. Solve $(x^2 y - 2xy^2)dx - (x^3 - 3x^2 y)dy = 0$ by using an integrating factor.     **(12+12)**

   (b) If the population of a country doubles in 50 years, in how many years will it treble under the assumption that the rate of increase is proportional to the number of inhabitants.                                                                                (11)

3. Solve the following:

   (a) $(D^2 + D + 1)^4 y = 0$                                                  (10)

   (b) $(D^4 + 2D^3 - 3D^2)y = e^{2x} + sinx$                                    (12)

   (c) $(D^2 - 2D + 1)y = xe^x sinx$                                        (13)

4. (a) Solve $y\dfrac{d^2 y}{dx^2} - \left(\dfrac{dy}{dx}\right)^2 = y^2 \, log_e \, y$                          (10)

   (b) Solve the equation $[(x+3)D^2 - (2x+7)D + 2]y = (x+3)^2 e^x$ by the method based on factorization of the operator.                                          (14)

   (c) Solve the differential equation                                              (11)

$$x^2 \frac{d^2 y}{dx^2} - x\frac{dy}{dx} - 3y = x^2 \, log_e \, x$$

# MATH 257(EEE)

## SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Using the method of Fröbenius solve the differential equation,

$$(x - x^2)y'' + (1 - x)y' - y = 0, \quad near \quad x = 0.$$ **(25)**

(b) Using Lagrange's method solve,

$$(x^2 - y^2 - yz)p + (x^2 - y^2 - zx)q = z(x - y).$$ **(10)**

6. (a) Using Charpit's method find the complete integral of the partial differential equation,

$$z^2(p^2 z^2 + q^2) = 1$$ **(15)**

(b) Find the complete and singular integral of the following partial differential equations:

(i) $z = px + qy + c\sqrt{(1 + p^2 + q^2)}.$ **(10)**

(ii) $p^2 + q^2 = z^2(x + y).$ **(10)**

7. Solve the following higher order partial differential equations:

(a) $(D^2 + 2DD' + D'^2)z = 2\cos y - x\sin y.$ **(12)**

(b) $(3D^2 - 2D'^2 + D - 1)z = 4e^{x+y}\cos(x + y).$ **(12)**

(c) $(D - D' - 1)(D - D' - 2)z = \sin(2x + 3y)$ **(12)**

8. (a) Solve the following PDE:

$$x^2 \frac{\partial^2 z}{\partial x^2} - 4xy \frac{\partial^2 z}{\partial x \partial y} + 4y^2 \frac{\partial^2 z}{\partial y^2} + 6y \frac{\partial z}{\partial y} = x^3 y^4.$$ **(15)**

(b) Solve the wave equation, $\frac{\partial^2 u}{\partial t^2} = q^2 \frac{\partial^2 u}{\partial x^2}$ for the displacement function $u(x,t)$ under

the boundary conditions: $u(o,t) = 0, \quad u(\pi,t) = 0, \quad u(x,o) = x, \quad u_t(x,o) = 0, \quad 0 < x < \pi.$ **(20)**

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**L-1/T-2/EEE**                                           **Date : 04/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2012-2013

Sub : **HUM 127** (Sociology, Science and Technology)

Full Marks : 210                                 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1.  (a) What is value neutrality? How do sociologists maintain value neutrality for studying social relationship? Write your answer in the context of sociological imagination with suitable examples. **(15)**

    (b) How does functionalist viewer differ from conflict viewer for explaining human society and its elements? **(20)**

2.  (a) 'Language manifests cultural traits of a society' - Explain. **(10)**

    (b) What do you understand by socialization? How do you think technology is changing the roles of different agents of socialization? **(15)**

    (c) What is dominant ideology? How does conflict perspective examine the influence of dominant ideology in the cultural practice of a society? **(10)**

3.  (a) What is social stratification? Explain caste system of social stratification highlighting Bangladeshi society. **(10)**

    (b) 'The history of all hitherto existing societies is the history of class struggle' - Explain this statement in the context of Karl Marx theory of social stratification. **(10)**

    (c) What is globalization? Discuss how information and communication technology is promoting globalization. Give example from your society. **(15)**

4.  Write short notes on <u>any three</u> of the following: **(35)**

    (a) Mass Media

    (b) Poverty reduction model

    (c) Deviance and crime

    (d) Modernization theory and Dependency theory.

# HUM 127(EEE)

## SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) How do you define human-ecology? **(8)**

   (b) Define man-made environment. What are the negative impacts of global warming? **(15)**

   (c) How can environmental destruction be brought under control? **(12)**

6. (a) What is meant by human resource development? **(10)**

   (b) Define demography. Write down the different evolutionary stages of city on the basis of Mumford's theory. **(15)**

   (c) What are the negative impacts of capitalism on society? **(10)**

7. (a) What do you mean by nuclear family? What functions does the family perform for society? **(15)**

   (b) What are the main forces of human migration? **(10)**

   (c) Briefly discuss the prerequisites and limitations of social planning. **(10)**

8. Write short notes on any THREE of the following: **(35)**

   (a) The growth of cities

   (b) Malthusian population theory

   (c) Sources of social change

   (d) Role of physical environment in social development.

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2012-2013

Sub : **PHY 165** (Electricity and Magnetism, Modern Physics, Mechanics)

Full Marks : 210                              Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Discuss charge and matter. With the help of an example show that the charge is conserved and quantized. **(8)**

   (b) Discuss Coulombs law and Gauss's law in electrostatics. Write down Gauss's law for Magnetism, Gravitation and for incompressible fluids. Derive Coulombs law from Gauss's law. **(20**

   (c) Apply Gauss's law to calculate the electric field $\overline{E}$ at any point due to a plane non-conducting thin sheet. **(7)**

2. (a) Define electric field. Show the patterns of electric lines of force around a charged plate (*t*), and two rods with equal and opposite charges. **(8)**

   (b) A thin non conducting rod of finite length *l* carries a total charge *q*, spread uniformly along it (Fig. 2(b). Show that the electric field E at point P on the perpendicular bisector is given by $E = \dfrac{q}{2\pi\varepsilon_o y}\dfrac{1}{\sqrt{l^2 + 4y^2}}$ , where the symbols have their usual meaning. **(15)**
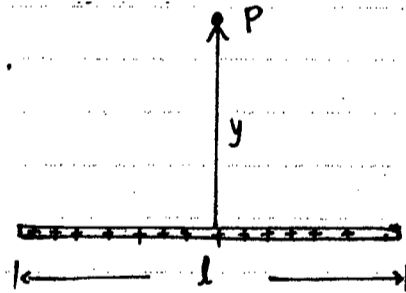


Fig. 2(b)

Show the form of the above equation as $l \to \infty$

   (c) An electron moving with a speed of $5.0 \times 10^8$ cm/sec is shot parallel to an electric field of strength $1.0 \times 10^3$ N/C arranged so as to retard its motion. (i) How far will the electron travel in the field before coming (momentarily) to rest and (ii) How much time will elapse? (iii) If the electric field ends abruptly after 0.8 cm, what fraction of its initial kinetic energy will the electron lose in traversing it? **(12)**

3. (a) Discuss Ampere's law, Biot-Savart law and Faraday's law. Briefly describe how these laws are used in measuring the magnetic field and induced emf in a conductor. **(10)**

# PHY 165(EEE)

## Contd ... Q. No. 3

(b) A plastic disk of radius $R$ has a charge $q$ uniformly distributed over its surface. If the disk is rotated at an angular frequency $\omega$ about its axis, show that (i) the induction at the center of the disk is $B = \dfrac{\mu_o \omega q}{2\pi R}$
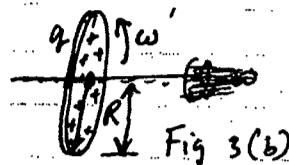
and Fig. 3(b) the magnetic dipole moment of the disk is $\mu = \dfrac{\omega q R^2}{4}$


Fig 3(b)

(15)

(c) A wire with a resistance of 6.0 Ohms is drawn out so that its new length is three times its original length. Find the resistance of the longer wire, assuming that the resistivity and density of the material are not charged during the drawing process. (10)

4. (a) State and explain uncertainty principle. (10)

(b) Illustrate the uncertainty principle by means of an experiment involving Diffraction of a beam of light through a narrow slit. (15)

(c) Can an electron stay inside the nucleus? Explain. (10)

## SECTION – B
There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) What are the shortcomings of classical mechanics? (5)

(b) Define the expectation values of dynamical quantities. (5)

(c) The state of a free particle is represented by a wave function $\psi (x, o) = N \, exp\left( -\dfrac{x^2}{2a^2} + ik_o x \right)$. Find out the factor N. In what region of space the particle is most likely to be found? (10)

(d) Write down the Schrödinger equation for a particle in one dimensional potential well described by $v(x) = 0$ for $-a < x < a$

$\qquad = \infty$ for $|x| > a$ and $x = \pm a$.

Find allowed energies and wave functions. Indicate graphically the first three wave functions for such a particle. (15)

6. (a) What is angular momentum? Show that the angular momentum for a system of particles about different points is $\vec{L}_A = \vec{L}_B + \vec{r}_{A,B} \times \vec{P}_{sys}$. (15)

The symbols have their usual meanings.

(b) State Kepler's laws of planetary motion. Show that the conservation of angular momentum implies Kepler's second law. (10)

(c) Derive the basic equation of planetary motion. (10)

# PHY 165(EEE)

7. (a) What is Compton effect? Show that the wavelength of the scattered photon is greater than the wavelength of incident photon. Calculate the value of Compton wavelength. **(25)**

(b) (i) Calculate the energy released by fission process for a single Uranium atom

(ii) Also calculate the energy released by 2 kg of Uranium in kWH. Given that mass of $^{235}U = 235.0457$ amu, mass of $n = 1.0087$ amu, mass of $^{141}Ba = 140.9177$ amu and mass of $^{92}Kr = 91.8854$ amu. Avogadro's number $= 6.023 \times 10^{23}$. **(10)**

8. (a) Derive the Lorentz transformation equations. Show that for $v \ll c$, Lorentz transformation reduces to Galilean transformation. **(23)**

(b) The formulae of relativistic energy and momentum are

$$E = \frac{m_o c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \quad \text{and} \quad P = \frac{m_o v}{\sqrt{1 - \frac{v^2}{c^2}}}$$

respectively. Show that the relativistic energy for all particle is $E = \sqrt{m_0^2 c^4 + p^2 c^2}$ and the energy of a mass-less particle (photon) is $E = P.C.$ **(12)**

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