**L-1/T-2/EEE** **Date : 18/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 105** (Electrical Circuit 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**.

The symbols have their usual meanings.

1. (a) For a balanced 3-phase system, show that $I_L = I_P$ and $V_L = \sqrt{3}V_P$ for Y-connection and $I_L = \sqrt{3}I_P$ and $V_L = V_P$ for Δ-connection. **(9)**

   (b) Show that the real power, reactive power and power factor of a balanced 3-phase system can be written as: **(9)**

   $P = \sqrt{3}V_L I_L \cos\theta$, $P_x = \sqrt{3}V_L I_L \sin\theta$ and power factor $= \dfrac{P}{\sqrt{3}V_L I_L}$

   (c) In the measurement of total power of a balanced 3-phase delta connected load using two wattmeter method, the readings of the two wattmeters are 1560 W and 2100 W respectively. If the line voltage is 220 V, calculate (i) the per phase average power, (ii) the per phase reactive power. (iii) the power factor and (iv) the phase impedance. **(17)**

2. (a) Show that the total reactive power of a three wire, three phase load can be measured by two reactive volt-ampere meters. **(15)**

   (b) A 3-phase motor takes 10 kVA at 0.6 p.f. (lagging) from a source of 220 v line to line. It is in parallel with a balanced delta load having 32 Ω resistance nad 12 Ω capacitive reactance in series in each phase. Find (i) line current, (ii) total volt-ampere, (iii) power factor of the combination, and (iv) kVA rating of capacitor bank to be connected to improve the p.f. to 0.95 (lagging). Assume the motor to be Y-connected. **(20)**

3. (a) What is the characteristic impedance of a filter? Derive the expressions of characteristic impedances of T and π section filters. **(10)**

   (b) Show that the transmission constant of both T and π section filter can be expressed as

   $\gamma = 2\log_e\left[\sqrt{1+\frac{z_1}{4z_2}}+\sqrt{\frac{z_1}{4z_2}}\right]$, where the symbols have there usual meanings. **(10)**

   (c) In the circuit shown in Fig. for Q. 3(c), calculate the attenuation constant in nepers and phase shift in radian, if the operating frequency is 200 Hz. **(15)**

Contd ..... P/2

## EEE 105

**Contd ... Q. No. 3(c)**

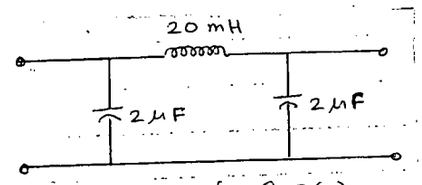



Fig. for Q. 3(c)

4. (a) Find the average power delivered to the 16 Ω resistor in the circuit shown in Fig. for Q. 4(a). **(18)**

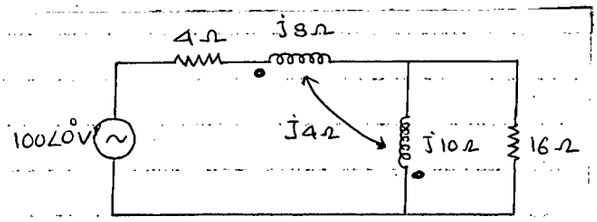



Fig. for Q. 4(a)

(b) The RC circuit shown in Fig. for Q. 4(b) has an initial charge on the capacitor $Q_o$ = 25 μC with polarity as indicated. The switch is closed at t = 0 applying a voltage, v = 100 Sin (1000t + 30°) Volt. Find the expression of current i for t > 0. **(17)**

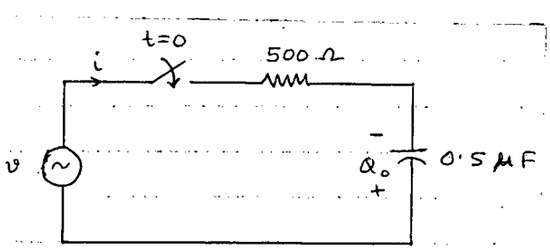



Fig. for Q. 4(b)

## SECTION – B

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

5. (a) If a current i = $I_m$ sinωt flows through a series RL circuit, derive the expression for impedance of entire circuit, instantaneous power, real power, and reactive power. Also draw the waveshape of instantaneous power. **(18)**

(b) Determine the effective value of the sinusoidal signal shown in the Fig. for Q. No. 5(b). **(17)**

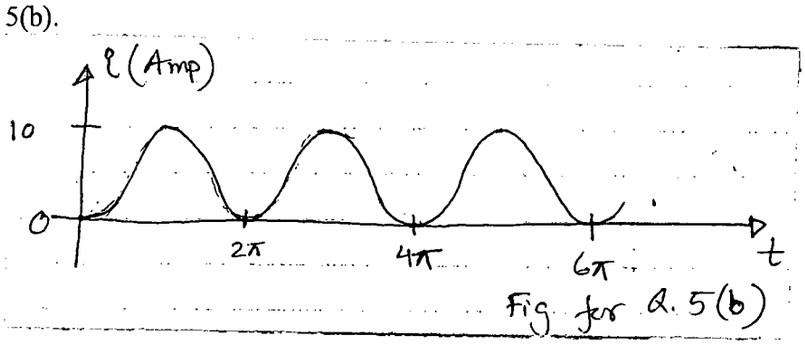



Fig. for Q. 5(b)

Contd ..... P/3

## EEE 105

6. (a) Determine the load impedance $Z_{load}$ to receive maximum power for the network given in Fig. for Q 6(a). Also calculate the maximum power received by the load. Find the power factor of the circuit under this condition. **(17)**

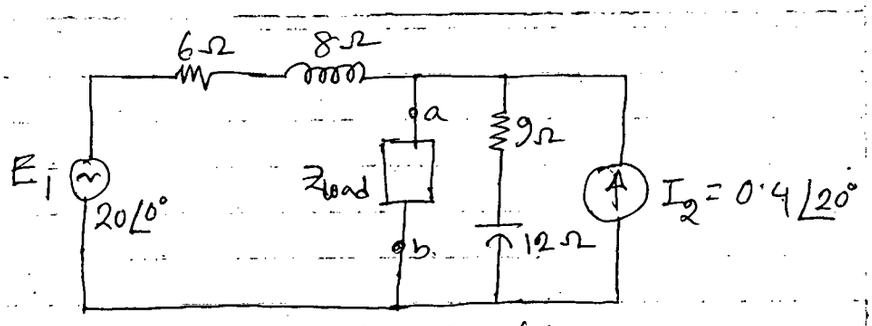



Fig. for Q. 6(a)

(b) A voltage, v = 282.8 Sin 500t volts is applied to a circuit shown in Fig. for Q. 6(b), and the resulting current is found to be i = 7.590 cos(500t – 63.43°) amperes. Power consumed by the resistance $R_2$ is 320 W. Determine the value of $R_1$, $R_2$, and C while the value of inductor, L is given 10 mH. **(18)**

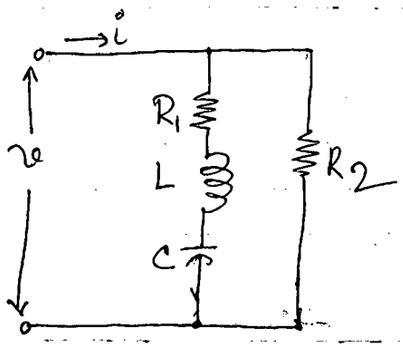



Fig. for. Q. 6(b)

7. (a) Draw the phasor diagram for the circuit given in Fig. for Q. 7(a). Consider $I_2$ as reference. **(12)**

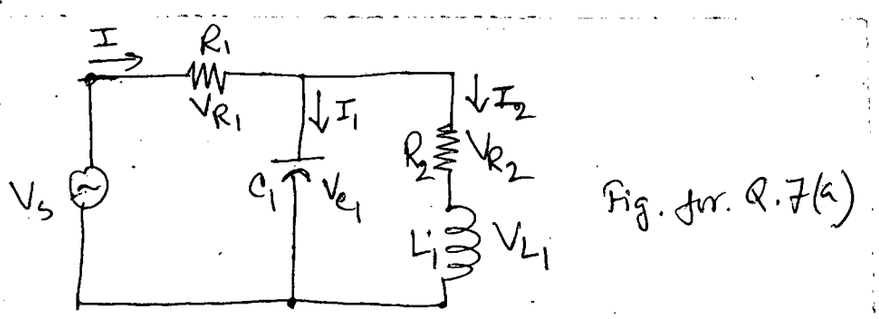



Fig. for. Q.7(a)

(b) Analytically show that the maximum voltage across the inductor is obtained at a higher value of the inductance than the inductance at resonance when resonance is achieved in a series R-L-C circuit by varying inductance. **(13)**

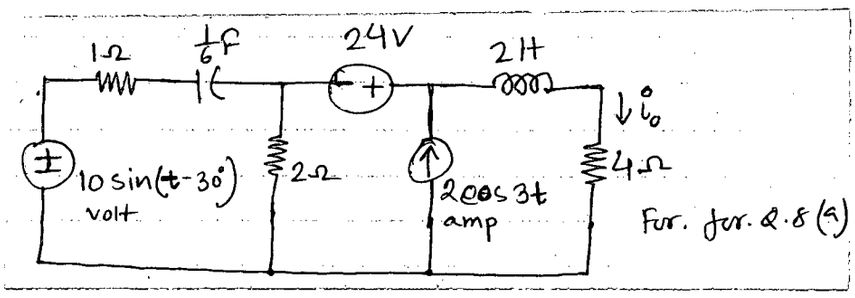
(c) Are the following two wares of the same form? Give reasons. **(10)**

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

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

**EEE 105**

8. (a) Find the expression of current $i_o$ through 4 Ω resistance of the circuit shown in Fig. for Q. 8(a) **(18)**




(b) (i) For a series R-L-C circuit, show that width of passband = $\frac{R}{L}$ radian/second. **(17)**

(ii) Also show that, for this series circuit, quality factor, $Q_s = \frac{1}{R_s}\sqrt{\frac{L}{C}}$

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L-1/T-2/EEE **Date : 24/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **PHY 165** (Electricity and Magnetism, Modern Physics and 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) State the postulates of special relativity and using these postulates obtain inverse Lorentz-transformation equations. **(23)**

   (b) Considering relativistic formula for the addition of velocities show that the speed of light is an absolute constant independent of the frame of reference. **(6)**

   (c) The speed of an electron in a uniform electric field changes from 0.95c to 0.98c, where 'c' is the speed of light. Calculate the work done (in MeV) on the electron to change that velocity. **(6)**

2. (a) What is photoelectric effect? Describe an experimental arrangement to study the dependence of photoelectric effect on the intensity and the frequency of light. **(17)**

   (b) Review briefly the failures of wave theory of light to explain the results of photoelectric effect and show how quantum theory of light gives satisfactory explanation of the effect. **(12)**

   (c) An X-ray photon of wavelength 0.01 nm is reflected at an angle 90° with its original direction after collision with an electron at rest. Find the energy it loses on collision. **(6)**

3. (a) Show with arguments that electrons cannot exist in a nucleus of radius $5 \times 10^{-15}$ m but the presence of protons in that nucleus is entirely plausible. **(7)**

   (b) Irene Curie and Frederic Joliot performed an experiment with α-particles, which were emitted from a polonium source and then allowed to hit a beryllium target, causing emission of unknown radiation of energy "E" from the target. Thereafter, this radiation, assumed by them as γ-ray, stroke a hydrogen-rich paraffin slab and knocked out protons from it of recoil energy 'K' by head-on collision. Show how they derived the following relation: $K = \frac{1}{2}\left(k + \sqrt{k^2 + 2m_p C^2 K}\right)$, where $m_p c^2$ is the rest energy of a proton. **(18)**

   (c) (i) What will be the de Broglie wavelength of 20 MeV neutrons, which are presently used to measure nuclear dimension?

   (ii) Calculate the minimum energy of γ-rays necessary to disintegrate a deuteron into a proton and a neutron. Given masses of a proton, neutron and deuteron are 1.00759, 1.00898, and 2.01471 u, respectively. **(6+4)**

Contd ..... P/2

## PHY 165

4. (a) Distinguish metal, semiconductor, superconductor and insulator. What are ohmic and non-ohmic conductors? **(10)**

(b) What is current density? Write down the microscopic form of Ohmic law. Derive an expression for the drift velocity of electron in terms of current density and number of electrons per unit volume. **(15)**

(c) Show that the power, P, per unit volume transformed into Joul heat in a resistor can be written as $P = j^2\rho$ and $P = \frac{E^2}{\rho}$, where the symbols have their usual meaning. **(10)**

## SECTION – B

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

5. (a) Define electric field. Write down an expression for electric field $\vec{E}$ due to a point charge. Briefly discuss the gravitational and magnetic analog of electric field $\vec{E}$. **(7)**

(b) Fig. 5(b) shows a circular plastic disk of radius R having a uniform positive surface charge density σ on its upper surface. Derive an equation for the electric field $\vec{E}$ at point P, a distance Z from the disk along its central axis. What will be the form of this equation for the following limiting cases **(18)**

(i) for $R \to \infty$ keeping Z finite

(ii) for $Z \to 0$ keeping R finite

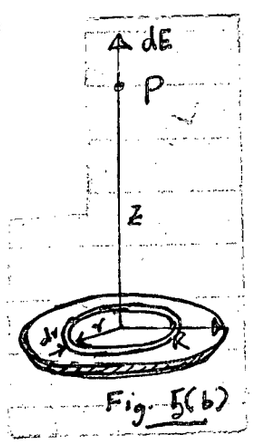

Fig. 5(b)

(c) The disk of Fig. 5(b) has a surface charge density σ of $+ 5.3 \times 10^{-6}$ coul/m$^2$ on its upper surface. **(10)**

(i) Calculate the electric field at the surface of the disk

(ii) Using the binomial theorem, find an expression for the electric field at a point on the central axis far from the disk.

6. (a) Define electric potential. What is an equipotential surface? Distinguish electric potential (V) and the electric field E. **(7)**

(b) Derive an expression for the electric potential V at any point P of space due to a dipole as shown in the Fig. 6(b). Discuss when V attains its greatest positive and negative values. What is the value of V in the equatorial plane (θ = 90)? **(18)**

Contd ..... P/3

**PHY 165**

**Contd ... Q. No. 6(b)**

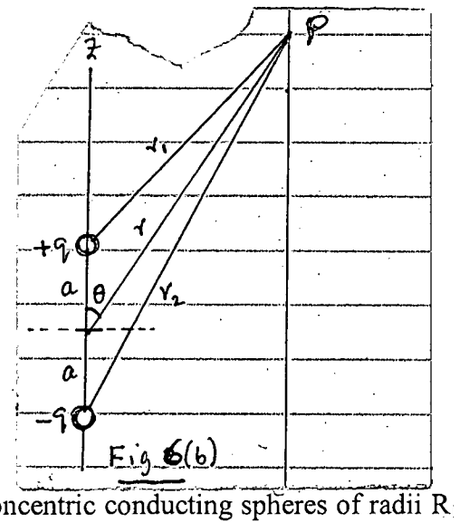


Fig 6(b)

(c) Two thin insulated concentric conducting spheres of radii $R_1$ and $R_2$ carry charges $q_1$ and $q_2$ respectively. Derive expressions for E(r) and V(r), where r is the distance from the center of the spheres. Plot E(r) and V(r) from r = 0 to r = 4.0 meters for $R_1$ = 0.50 meter, $R_2$ = 1.0 meter, $q_1 = +2.0 \times 10^{-6}$ coul, and $q_2 = +1.0 \times 10^{-6}$ coul.

7. (a) What do you mean by stationary state? Write down a general expression for a stationary state and then show that the total energy of a particle described by stationary state remains constant with time. **(10)**

(b) Consider that a particle of mass m is confined inside a one-dimensional potential well having width L defined by $V(x) = \begin{cases} 0 \; if & 0 \le x \le L \\ \infty & Othewise \end{cases}$

Show that the energy of the particle inside the well is quantized (not continuous). Calculate the energy of first few excited stakes of the particle and show a relation between the ground state and excited state energy. **(20)**

(c) A particle of mass m is in the state $\Psi(x,t) = Ae^{-a\left(\frac{mx^2}{\hbar}+it\right)}$ where A and a are constants. For what value of V(x) does ψ satisfy the Schrödinger equation? **(5)**

8. (a) Consider that the planet Mars revolve round the Sun in an elliptic path having semi-major axis 'a' and semi-minor axis 'b'. Show that the time taken for Mars to make a complete revolution around the sun depends only on the semi-major axis 'a', not on the semi-minor axis 'b'. **(15)**

(b) Suppose you drop a rock off from the roof of the ECE building of height h. When it falls you snap a million photograph at random intervals. On each picture, you can measure the distance traveled by the rock. What is the average of all distances or the time average of the distance traveled. **(10)**

(c) What is the difference between expectation value and average value? Show how the expectation value of different quantity can be calculated using momentum and position operators. **(10)**

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**L-1/T-2/EEE** **Date : 28/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B.Sc. Engineering Examinations 2013-2014

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) What is Electrochemistry? Is it so important in the field of Science and Techonology? Illustrate your answer with examples. **(2+8=10)**

   (b) Write down the general representation of an electrochemical cell. Distinguish between (i) Electrochemical cell and Electrolytic cell (ii) Electronic conductor and Electrolytic conductor. **(4+4+4=12)**

   (c) Define the following terms:

   (i) Specific conductance, (ii) Equivalent conductance, (iii) Molar conductance **(6)**

   (d) Calculate the electrode potentials of the Cell: **(7)**

   $$Sn/Sn^{++}(0.1M)\|Fe^{++}(0.3M)|Fe$$

   Given that $E^0_{Sn/Sn^{++}} = 0.14$ volts, $E^0_{Fe^{+++}/Fe} = 0.036$ volts, Also Calculate the e.m.f. of the cell.

2. (a) Discuss the characteristics of Hard and Soft acids and bases with necessary examples. Explain with suitable example "The Hard and Soft Acid and Base (HSAB) Principle." **(5+5=10)**

   (b) Draw and explain the conductometric titration behavior of acid mixture ($HCl + CH_3 - COOH$) with NaOH solution. **(7)**

   (c) Discuss the application of Hard and Soft Acid and Base (HSAB) Principle in the field of Geochemical classification of the elements and their occurance in nature as minerals. **(10)**

   (d) You are supplied with $H_2SO_4$ of specific gravity 2.5. Calculate the amount of distilled water required to convert the acid into specific gravity 1.9. **(8)**

3. (a) What is Schrodinger's wave equation? How is it derived? How can it be used for describing different atomic orbitals? **(2+8+5=15)**

   (b) Discuss the classification of elements in the periodic Table. Find out the position of the following elements in the periodic Table: Cu, Cr, Ca, P, Al. **(8+5=15)**

   (c) Calculate the Kinetic energy of an electron in erg. emitted from the surface of tin metal (work function = $3.62\times10^{-12}$ erg.) by light of wavelength 5.5 Å. **(5)**

Contd ..... P/2

## CHE 101

4. (a) What are the Main features of Molecular Orbital theory (MOT). Distinguish between Bonding Molecular Orbital (BMO) and Anti Bonding Molecular Orbital (ABMO). **(7+2=9)**

(b) What is Werner theory of coordination compounds? Discuss effective Atomatic Number (EAN) Rule. Illustrate your answer with examples. **(5+5=10)**

(c) Draw the Molecular orbital diagram of the following molecules and calculate bond order. **(9)**

(i) CO, (ii) $NO^+$ (iii) $He_2^+$

(d) The Equivalent conductance of $NH_4Cl$, NaCl and NaOH at infinite dilution are 180.37, 130.51 and 286.49 $Ohm^{-1}equiv^{-1}cm^2$ respectively at 30°C. By applying Kohlrausch Law calculate the equivalent conductance of $NH_4OH$. **(7)**

## SECTION – B

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

5. (a) State and deduce the phase rule. **(6)**

(b) Explain the deferent terms used in the phase rule. **(9)**

(c) Draw the phase diagram of water and describe the different parts of the diagram with the help of phase rule. **(13)**

(d) Discuss the solubility of gases in liquid with temperature with the help of a mathematical Model. **(7)**

6. (a) Derive the rate law for a first order reaction being opposed by another first oder reaction. **(10)**

(b) What is activation energy? Derive and explain Arrhenius equation. Show its application. **(3+10+2=15)**

(c) For the decomposition of a gas the value of rate constant (k) at 0°C is $2.46\times10^{-5}$ and $1.63\times10^{-5}$ at 30°C. Calculate the energy of activation (Ea) of the process and comment on the result. **(8+2=10)**

7. (a) What is critical solution temperature (CST). Draw a diagram of Phenol-Water system and explain the importance of such a diagram. **(2+8=10)**

(b) Why does the vapour pressure of a liquid fall when a non-volatile solute is dissolved in it? **(4)**

(c) Establish an empirical relation between the relative lowering of vapor pressure and the molecular weight of the solute. **(12)**

Contd ..... P/3

## CHE 101

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

(d) 0.562 gm of naphthalene was dissolved in 30 gm of carbon tetrachloride ($CCl_4$). If the normal boiling point $CCl_4$ is taken as 76.91°C, at what temperature the solution will boil at atmospheric pressure if $K_b = 5.02$ and molecular weight of naphthalene is 128? **(9)**

8. (a) Define Heat of Neutralization and heat of solution with suitable examples. How can you classify heat of solution? **(8)**

(b) How does heat of reaction vary with temperature? Derive Kirchoffs equation and use it to justify your answer. **(8)**

(c) For a homogeneous gaseous reaction at equilibrium with $\Delta h>0$, compute the expression for $K_p$ and $K_e$ in terms of initial number of moles of the reactants "a", "b" and "x" being the number of moles going into reaction at equilibrium. **(9)**

(d) For the reaction $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$, 0.326 moles of nitrogen and 0.439 moles of hydrogen were mixed at constant temperature 27°C in a 1 litre flask. The total number of moles at equilibrium was found to be 0.657. Find the volue of $K_p$ and $K_c$. **(10)**

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**L-1/T-2/EEE** **Date : 02/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

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

1. (a) For certain values of the constant $m$, the function $f(x) = e^{mx}$ is a solution of the differential equation $\frac{d^3y}{dx^3} - 3\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 12y = 0$. Determine all such values of $m$. **(11)**

   (b) Solve the following differential equations:

   (i) $\left(y + \sqrt{x^2 + y^2}\right)dx - xdy = 0,\ y(1) = 0$ (ii) $\frac{dx}{dt} + \frac{t+1}{2t}x = \frac{t+1}{xt}$ **(12+12)**

2. (a) Solve $\left(2xy^2 + y\right)dx + \left(2y^3 - x\right)dy = 0$ by finding an integrating factor. **(11)**

   (b) Find an integrating factor of the form $x^p y^q$ and solve

   $$\left(4xy^2 + 6y\right)dx + \left(5x^2y + 8x\right)dy = 0$$ **(12)**

   (c) The population $x$ of a certain city satisfies the logistic law $\frac{dx}{dt} = \frac{1}{100}x - \frac{1}{(10)^8}x^2$

   where time $t$ is measured in years. Given that the population of this city is 1,00,000 in 1980, determine the population as a function of time for t > 1980. **(12)**

3. Solve the following: ODEs:

   (a) $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = e^{-2x}(1 + \cos x)$ **(12)**

   (b) $\frac{d^4y}{dx^4} - 16y = x^2 \sin 2x + x^4 e^{2x}$ **(12)**

   (c) $x^2\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} - 6y = 10x^2$ **(11)**

4. (a) Use the method of operational factors to solve the equation **(12)**

   $\left[xD^2 - (x+2)D + 2\right]y = x^3$

   (b) Solve the following:

   (i) $x\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - \frac{dy}{dx} = 0$ **(11)**

   (ii) $y\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 = 1$ **(12)**

Contd ..... P/2

# MATH 257

## SECTION – B

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

5. (a) Using the method of Fröbenius solve the differential equation **(25)**

$x^2y'' + xy' + (x^2 - 1)y = 0$ in series near x = 0.

(b) Solve $z(x+y)p + z(x-y)q = x^2 + y^2$ using Larange's method. **(10)**

6. (a) Find the integral surface of the linear partial differential equation $x(y^2+z)p - y(x^2+z)q = z(x^2-y^2)$

which contains the straight line x + y = 0, z = 1. **(11)**

(b) Use Charpit's method to find the complete integral of the partial differential equation

$q = (z + px)^2$. **(12)**

(c) Find the complete and singular integral of the partial differential equation

$z = ax + by - 2\sqrt{ab}$ **(12)**

7. Solve the following partial differential equations:

(a) $(D^2 + 2DD' + D'^2)z = 2\cos y - x\sin y$. **(11)**

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

(c) $(D - 3D' - 2)^2 z = 2e^{2x}\tan(y+3x)$.

where $D' \equiv \dfrac{\partial z}{\partial y}$ **(12)**

8. (a) Solve the following PDE: $x^2\dfrac{\partial^2 z}{\partial x^2} - 3xy\dfrac{\partial^2 z}{\partial x \partial y} + 2y^2\dfrac{\partial^2 z}{\partial y^2} + x\dfrac{\partial z}{\partial x} + 2y\dfrac{\partial z}{\partial y} = x + 2y$. **(15)**

(b) Solve the wave equation: $\dfrac{\partial^2 u}{\partial t^2} = c^2\dfrac{\partial^2 u}{\partial x^2}, \quad 0 \le x \le l,\ t \ge 0$ **(20)**

Subject to :

$u(0,t) = 0,\ u(l,t) = 0 \quad for\ t > 0,$

$u(x,0) = 0,\ u_t(x,0) = b\sin^3\left(\dfrac{\pi x}{l}\right),\ 0 < x < l.$

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**L-1/T-2/EEE** **Date : 07/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **HUM 127** (Sociology)

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) What is gender role? Do you think family perpetuates the traditional gender roles of a society? Write you answer based on the article Amish community. **(10)**

   (b) How does socialization shape human behaviour? Write your answer highlighting the changing functions of different agents of socialization. **(15)**

   (c) Discuss C.H. Cooley's looking glass-self theory of socialization. **(10)**

2. (a) Apply sociological analysis to one subculture with which you are familiar, describe the norms, values, argot, and sanctions evident in the subculture. **(20)**

   (b) What are the purpose of learning ethnocentrism and dominant ideology in sociology? **(15)**

3. (a) Briefly introduce various systems of social stratification. What types of social stratification systems are now practicing in Bangladesh? **(20)**

   (b) Critically discuss Karl Marx's theory of class differences. Cite examples relevant to your own society. **(15)**

4. Write short notes on any THREE of the followings **(35)**

   (a) Prerequisite of social planning

   (b) Advantages and disadvantages of Nuclear family

   (c) Incident of migration in 1971

   (d) Cyber crime

## SECTION – B

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

5. (a) How do you define human-ecology and green house gasses? **(6)**

   (b) Briefly discuss the potential consequences of global worming. **(14)**

   (c) How can environmental destruction be brought under control? **(15)**

6. (a) Write down the important characteristics of pre-industrial cities, industrials cities and post-industrial cities. **(12)**

Contd ..... P/2

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**Contd ... Q. No. 6**

(b) 'Private property is the terra forma of capitalism' – explain this statement on the basis of nature of capitalism. **(15)**

(c) How do you define industrialization and deindustrialization? **(8)**

7. (a) What do you mean by poverty? **(5)**

(b) Why do you think households today have more televisions than telephones? **(15)**

(c) 'World system analysis' is nothing but the unequal economic, political and social relationships in which certain industrialized nations (among them the United States. Japan and Germany) and their global corporations dominate the *core* of the system. – Discuss. **(15)**

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

(a) Globalization.

(b) Deviance.

(c) Fatalism

(d) Cyber crime.

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