L-1/T-1/MME **Date : 11/11/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

**L-1/T-1** B. Sc. Engineering Examinations 2018-2019

Sub : **MME 131** (Introduction to Metallurgy and Materials)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

## SECTION – A

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

1. (a) What are the differences between cast iron and wrought iron? Describe the stages of making wrought iron from pig iron in a puddling furnace. **(5+15=20)**

   (b) 'The puddling furnace remained the bottleneck of the industry'-why? **(5)**

   (c) 'The mass production of cheap steel only became possible after the introduction of the Bessemer process'-explain. **(10)**

2. (a) How was copper discovered by early man? **(5)**

   (b) What are the major types of materials? Write down some of their distinguishing features and applications. **(18)**

   (c) Why are defects important in crystalline solids? With the help of a schematic representation explain the different types of point defects. **(4+8=12)**

3. (a) Define unit cell. Calculate the atomic packing factor of FCC and BCC crystals. With neat sketches, show the octahedral and tetrahedral interstitial sites in a FCC crystal. **(2+15+8=25)**

   (b) What are the similarity and differences between the FCC and HCP structure? **(10)**

4. (a) How does a material deform? What factors are influential in determining the mobility of dislocations? **(5+8=13)**

   (b) How are strengthening mechanisms and dislocation motion related? **(22)**

## SECTION – B

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

5. (a) Draw a typical stress strain curve. Label the followings in the curve and define them: Proportional limit, Proof stress, Ultimate tensile strength and Modulus of elasticity. Which one among these properties is considered as the design limit and why? **(18)**

Contd ..... P/2

**MME 131**

**Contd ... Q. No. 5**

(b) What is true stress? Compare true stress-strain behaviour with engineering stress-strain behaviour with the help of necessary figure. **(7)**

(c) Define Moh's hardness scale. Arrange minerals according to their ascending order of hardness value. **(10)**

6. (a) As temperature decreases, a ductile material can become brittle. Which term does best describe this transition? Draw a suitable diagram to show this transition. State how the transition can be measured. **(10)**

(b) Explain how we can get useful information on the fatigue property both for a ferrous and non-ferrous metal from the curve produced by a series of test results. Sketch a fatigue fractograph and label it. **(18)**

(c) With examples differentiate between substitutional and interstitial solid solutions. **(7)**

7. (a) Platinum and gold are completely soluble in both liquid and solid states. The melting point of platinum is 1774°C and that of gold is 1063°C. An alloy containing 40% gold starts to solidity at 1599°C by separating crystals of 15% gold. An alloy containing 70% gold starts to solidity at 1399°C by separating crystals of 37% gold. **(20)**

(i) Draw the equilibrium diagram to scale on graph paper and label all points, lines and areas.

(ii) For an alloy containing 70% gold, what is the temperature of initial solidification and final solidification? Calculate the chemical composition and relative amounts of the phases present at 1338°C.

(b) Sketch a layout of metal fabrication techniques. **(10)**

(c) After welding, a number of distinct regions can be identified in the weld area-Mention the regions and their locations. **(5)**

8. (a) Drying and firing techniques are critical for ceramic piece that has been formed.-Justify it with distinct differentiation between drying and firing operations. **(13)**

(b) Classify the non-destructive testing techniques. Select two different techniques to identify surface defects on a ferrous metal and a non-ferrous metal object. Explain, with figures, how surface defects can be identified by these two techniques. **(22)**

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

**L-1/T-1** B. Sc. Engineering Examinations 2018-2019

Sub : **EEE 155** (Electrical Engineering Fundamentals)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

## SECTION – A

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

1. (a) Find $V_1$, $V_2$ and $V_3$ in the circuit of Fig. 1(a) using nodal analysis. **(18)**

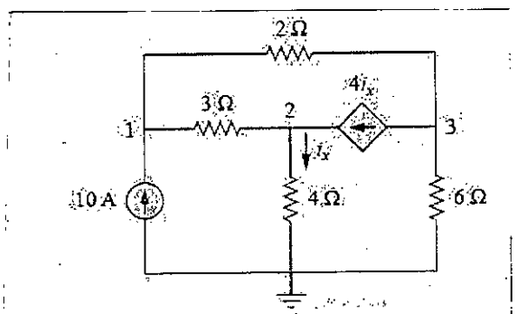


Fig. for Ques. 1(a)

(b) Using the source transformation method, find the current $I_o$ in the circuit shown in Fig. 1(b). **(17)**

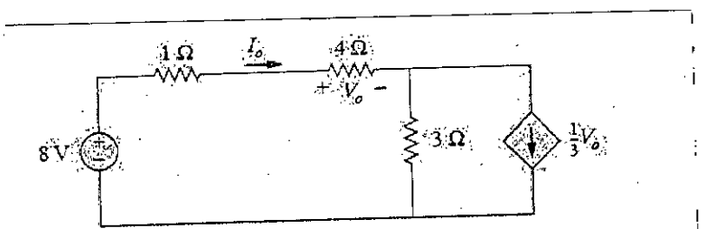


Fig. for Ques. 1(b)

2. (a) Determine the value of R that will draw the maximum power from the rest of the circuit in Fig. 2(a). Calculate the maximum power consumed by this resistor. **(17)**

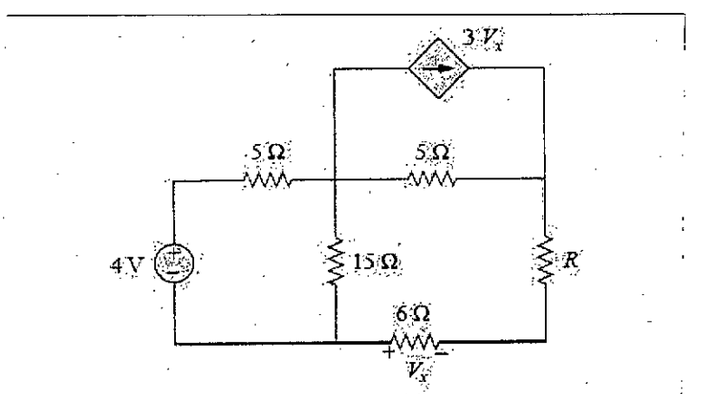


Fig. for Ques. 2(a)

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## EEE 155(MME)

**Contd ... Q. No. 2**

(b) Find the equivalent resistance $R_{eq}$ for the circuit shown in Fig. 2(b). All resistors are 1 Ω. **(18)**

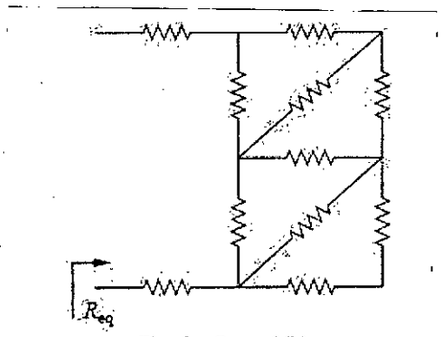


Fig. for Ques. 2(b)

3. (a) Find the Norton equivalent circuit for Fig. 3(a) at terminals a-b. **(17)**

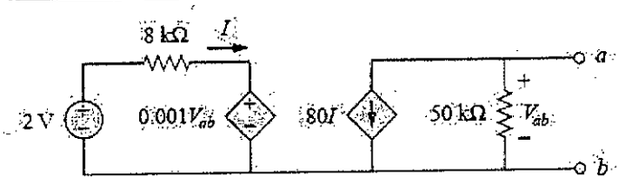


Fig. for Ques. 3(a)

(b) Using the superposition theorem, find the voltage $V_0$ for the circuit in Fig. 3(b). **(18)**

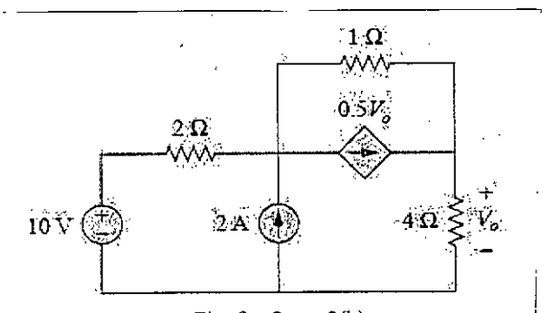


Fig. for Ques. 3(b)

4. (a) Using Nodal Analysis, determine the node voltages for the circuit in Fig. 4(a). **(18)**

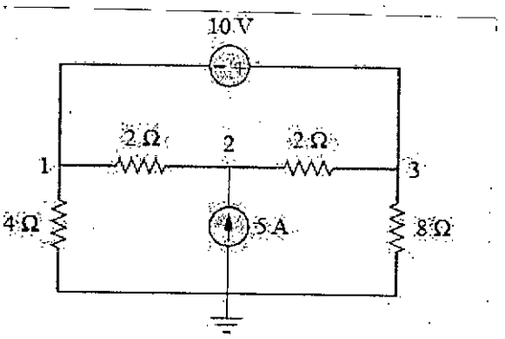


Fig. for Ques. 4(a)

Contd ..... P/3

## EEE 155(MME)

**Contd ... Q. No. 4**

(b) For the circuit in Fig. 4(b), determine $v_x$ and the power absorbed by the 12 Ω resistor. **(17)**

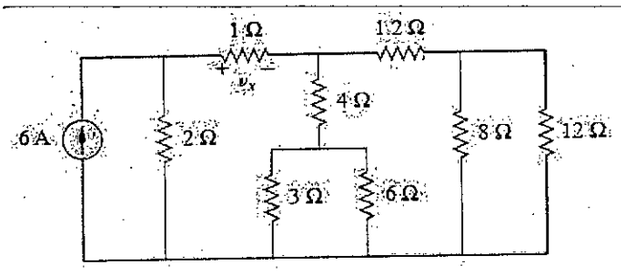


Fig. for Ques. 4(b)

## SECTION – B

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

The symbols have their usual meanings.

5. (a) Draw the Phasor diagram of a series RLC Circuit. Assume $X_L > X_C$. **(5)**

(b) Using phasor approach, determine $i(t)$ of the following equation: **(15)**

$$\frac{d^3i}{dt^3} + 3\frac{di}{dt} - 5i + 4\int idt = 20t\,sin(10 + 20^\circ)$$

(c) Find the effective and average voltage of the Figure given for Question No. 5(c) **(15)**

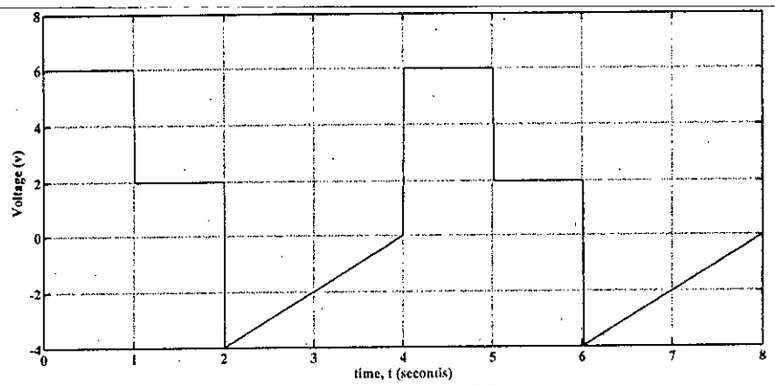


Fig. for Question No. 5(c)

6. (a) Solve for the current $i_o$ in the circuit of Fig for Question No. 6(a) using nodal analysis where $i_s = 6\cos(200t + 15°)$ A. **(20)**

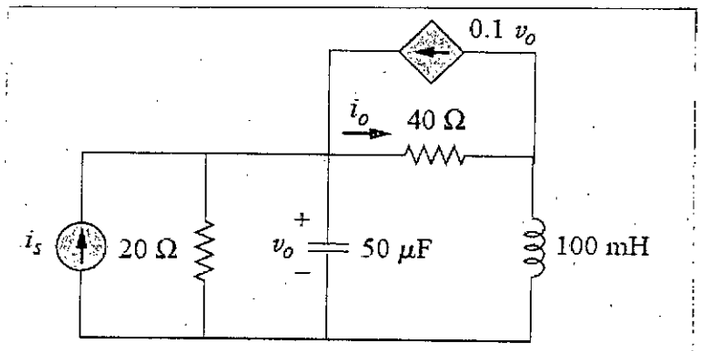


Fig. for Question No. 6(a)

Contd ..... P/4

# EEE 155(MME)

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

(b) Two loads connected in parallel draw a total of 2.4 kW at 0.8 pf lagging from a 120-V rms, 60-Hz line. One load absorbs 1.5 kW at a 0.707 pf lagging. Determine: **(15)**

(i) the pf of the second load.

(ii) the parallel element required to correct the pf to 0.9 lagging for the two loads.

7. (a) Using Norton's theorem, fund $v_0$ in the circuit of Fig. for Question No. 7(a) **(22)**

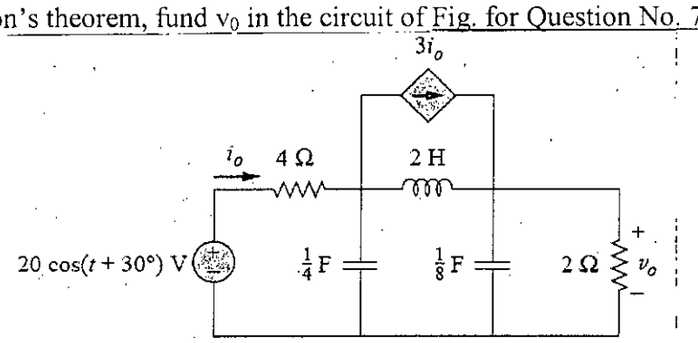


Fig. for Question No. 7(a)

(b) Determine the load impedance that maximize the average power drawn from the circuit of Fig. for Question No. 7(b). What is the maximum average power? **(13)**

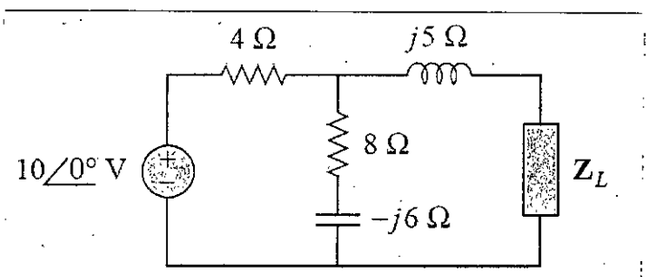


Fig. for Question No. 7(b)

8. (a) What is the average power absorbed by an inductor? **(5)**

(b) Show that for power distribution the three-phase system uses a lesser amount of wire than the single-phase system for the same line voltage and the same absorbed power. **(12)**

(c) Assume that two balanced loads are connected to a 240-kV rms 60-Hz line, as shown in Fig for Question No. 8(c). Load 1 draws 30 kW at a power factor of 0.6 lagging, while load 2 draws 45 kVAR at a power factor of 0.8 lagging. Assuming the *abc* sequence, determine: **(18)**

(i) the complex, real, and reactive powers absorbed by the combined laod.

(ii) the line currents,

(iii) the kVAR rating of the three capacitors Δ-connected in parallel with the load that will raise the power factor to 0.9 lagging and the capacitance of each capacitor.

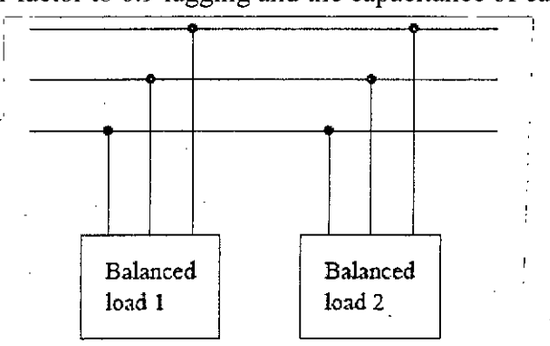


Fig. for Question No. 8(c)

L-1/T-1/MME Date : 04/11/2019

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **PHY 103** (Optics, Waves and Oscillations)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

## SECTION – A

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

1. (a) Explain – Interference of light. **(8)**

(b) What are Newton's rings? Give necessary theory of Newton's rings method for the determination of the wavelength of monochromatic light. **(20)**

(c) Green light of wavelength 5100 Å from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen 200 cm away is 2 cm. Find the slit separation. **(7)**

2. (a) What are Fraunhofer class of diffraction and diffraction grating? **(8)**

(b) Derive an expression for intensity distribution in the Fraunhofer diffraction pattern from double slit. Write down the conditions for position of maxima and minima. **(20)**

(c) What should be the minimum number of lines in a grating which will just resolve in the second order for the lines whose wavelengths are 5890 Å and 5896 Å ? **(7)**

3. (a) What is meant by polarization of light? **(5)**

(b) State Brewster's law. What is double refraction? Write down Huygen's explanation on double refraction. Explain the terms – Quarter and half wave plates. **(20)**

(c) State Malus' law. The refractive index for plastic is 1.25. Calculate the angle of refraction for a ray of light incident at the polarizing angle. **(10)**

4. (a) Describe the defects coma and astigmatism. Explain how they may be minimized. **(10)**

(b) What is achromatism? Derive the condition of achromatism for two thin lenses placed in contact. Discuss the validity of the condition for the choice of the lenses. **(18)**

(c) The focal length of an achromatic combination of two lenses in contact is 150 cm. If the dispersive powers of the materials of the two lenses are 0.018 and 0.027, calculate the focal lengths of the two lenses. **(7)**

Contd ..... P/2

**PHY 103**

## SECTION - B

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

5. (a) What is an equivalent lens? In what respect it is called equivalent? **(7)**

(b) Show that the deviation produced by a thin lens is independent of the position of the object. **(10)**

(c) Derive expressions for the focal points of a co-axial system of two lenses separated by a finite distance. **(10)**

(d) Two lenses of powers +2.5 and -5.0 diopters are kept co-axially separated by 30 cm. Find the positions of focal points. **(8)**

6. (a) What is a polarizing microscope. Discuss its uses. **(7)**

(b) Describe the construction and working principle of a polarizing microscope. **(20)**

(c) Distinguish between the orthoscopic and conoscopic modes of a polarizing microscope. **(8)**

7. (a) What are Lissajous' figures? On what factors do they depend? **(7)**

(b) Derive a general expression for the resultant vibration of a particle simultaneously acted upon by two initially perpendicular simple harmonic vibrations having same period but different phase and amplitude. Find out the condition for circle and straight line. **(20)**

(c) An ideal spring has force constant K. A mass m is suspended from it. The spring is cut in half and the same mass is suspended from one of the halves. Is the frequency of the oscillator the same before and after the spring cut? How are the frequencies related? **(8)**

8. (a) Explain the term wave motion and discuss about the different types of waves. **(7)**

(b) Discuss analytically the formation of stationary wave due to reflection at free boundary. Explain how the characteristics changes with position and formation of nodes and antinodes. **(20)**

(c) The equation of a particular standing wave on a string is $y = 0.30 \sin(5x) \cos(300t)$ meter. Find the (i) amplitude of the vibration at antinode position (ii) velocity and wavelength of the component waves whose superposition can give rise this standing wave. **(8)**

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L-1/T-1/MME **Date : 31/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **CHEM 107** (Inorganic and Physical Chemistry)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

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## SECTION – A

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

1. (a) Write down Lewis dot formula for the following: **(6)**

(i) $O_2$ (ii) $C_2H_2$ (iii) $ClF_3$

(b) What is Octet Rule? Explain the deviations from the Octet Rule in covalent compounds with examples. **(7)**

(c) Applying Valence Bond Theory. Describe the formation of $SF_6$ molecule using hybrid orbitals. **(10)**

(d) Draw the structures and name the geometries of the following compounds on the basis of VSEPR theory: **(12)**

(i) $XeF_2$ (ii) $IF_5$ (iii) $NH_3$ (iv) $SO_2$

2. (a) Write down the general form of Schrödinger's Wave Equation and define each term of it. The acceptable solutions of this equation must have certain properties. What are these? **(8)**

(b) Draw radial distribution functions for 1s, 2s, 2p, 3s and 3p orbitals. **(10)**

(c) Calculate the wavelength of the particle in the following two cases: (i) The fastest serve in tennis is about 150 miles/h, or 68 m/s. Calculate the wavelength associated with a $6.0 \times 10^{-2}$ kg tennis ball travelling at this speed (ii) Calculate the wavelength associated with an electron ($9.1094 \times 10^{-2}$ kg) moving at 68 m/s. **(9)**

(d) Why d block elements form colored compounds? Explain. **(8)**

3. (a) What do you mean by effective nuclear charge? Calculate the effective nuclear charge of a 2p electron of fluorine atom. **(6)**

(b) State Periodic Law. Name three physical properties of an atom which can be used to explain periodic properties of elements. Discuss briefly. **(14)**

(c) Write a short note on diagonal relationship in Periodic Table. **(5)**

(d) How many shells, orbitals, neutrons and electrons are there in an atom having atomic weight 23 and atomic number 11? Write down the electronic configuration of that atom. **(10)**

Contd ..... P/2

## CHEM 107

4. (a) What are the colligative properties and why are they called so? State and deduce Raoult's Law of elevation of boiling point. **(4+12)**

(b) A solution of a non-volatile non-electrolyte solid in water has a vapor pressure of 31.5 mm Hg at 25 °C. The vapor pressure of water at this temperature is 27.3 mm hg. Calculate the molecular mass of that solid. **(7)**

(c) State and explain Henry's Law. What are the different forms in which this law can be expressed? **(12)**

### SECTION - B

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

Assume reasonable value for any missing data. Symbols used here bear usual meaning.

5. (a) Define hydrolysis. Derive an expression for the hydrolysis constant and pH of a solution of a salt of a weak acid and a strong base. **(12)**

(b) What is buffer capacity? Under what condition a buffer solution shows maximum buffer capacity? **(15)**

(c) What would be the pH of a 0.1M sodium acelate solution when the dissociation constant of acetic acid is $1.8 \times 10^{-5}$? **(8)**

6. (a) Define electrochemical cell and electrolytic cell. Explain the influence of electrolyte concentration on the emf of a cell and hence justify that the formula of mercurous chloride is $Hg_2Cl_2$ not HgCl. **(12)**

(b) Consider the following cell:

$$P + \left| H_2(g, 1atm) \right| HCl(aq) \left| AgCl(s) \right| Ag$$

Show the half cell reactions, overall cell reaction and find the expression for the emf of the cell. **(15)**

(c) Represent schematically the cell that gives the following half cell reactions: **(8)**

$$Mg \rightarrow Mg^{2+}(0.01M) + 2e, \quad E^\circ = +2.34V$$

$$Sn^{2+}(0.1M) + 2e \rightarrow Sn \quad E^\circ = -0.136V$$

Calculate the emf of the cell at 25°C.

Contd ..... P/3

## CHEM 107

7. (a)What do you mean by 'order of reaction'? How can you determine the order of reaction by half life method? **(12)**

(b) Derive an expression for the rate constant of a second order reaction and hence show how you can find the rate constant and the initial concentration of the reactant simultaneously. **(15)**

(c) A second order reaction is 40% complete in 40 minutes when the initial concentration of the reactions is $4 \times 10^{-2}$ mole/L. Calculate the specific reaction rate. **(8)**

8. (a) What are coupled reactions? With suitable example show how a thermodynamically non-spontaneous reaction can be spontaneous if coupled with a highly spontaneous reaction. **(12)**

(b) What is thermodynamic equilibrium constant? Show how you can predict the exothermic or endothermic nature of a reaction from the knowledge of the variation of equilibrium constant with temperature. **(15)**

(c) The equilibrium constant $K_p$ for the reaction $N_2 + 3H_2 = 2NH_3$ is $1.64 \times 10^{-4}$ at 400°C and $0.1444 \times 10^{-4}$ at 500°C. Calculate the mean heat of formation of 1 mole of ammonia from its elements in this temperature range. **(8)**

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L-1/T-1/MME **Date : 27/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **MATH 171** (Calculus and Differential Equation)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

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## SECTION – A

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

Symbols have their usual meaning.

1. (a) Is $f(x)$ defined below continuous at x = 2? Does $f'(x)$ exist at x = 2? **(15)**

$$f(x)=\begin{cases} |x|, & 0<x<2 \\ 3-x & 2\le x\le 4 \\ x-2x^2, & x>4 \end{cases}$$

Also sketch $f(x)$.

(b) Evaluate the following limits:

(i) $\underset{x\to 2}{Lim}\left[\frac{4}{x^2-4}-\frac{1}{x-2}\right]$ **(10)**

(ii) $\underset{x\to 0^+}{Lim}\left(e^{2x}-1\right)^x$ **(10)**

2. (a) State Leibnitz's theorem and use this theorem to find the value of **(15)**
$(y_n)_0$, given that $y=\left[\ln\left\{x+\sqrt{1+x^2}\right\}\right]^2$.

(b) If $u=\tan^{-1}\left(\frac{x^3+y^3}{x+y}\right)$ then prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\sin 2u$. Hence or otherwise evaluate $x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}$. **(20)**

3. (a) A rectangular warehouse with a flat roof is to have a floor area of 9600 square feet. The interior is to be divided into store room and office space by an internal wall parallel to one pair of the sides of the sides of the warehouse. The roof and the floor area are same. Find the dimensions that minimize the total length of the wall. **(15)**

(b) State Cauchy's mean Value theorem and verify the same for the functions $x^2$ and $x^3$ in the interval (1, 2) and find all values of c in that interval those satisfy the conclusion of the theorem. **(10)**

(c) Show that in the parabola $\frac{2a}{r}=(1-\cos\theta)$ the tangent is inclined at a constant angle $\left(\pi-\frac{\theta}{2}\right)$ to the radius vector. **(10)**

Contd ..... P/2

# MATH 171

4. Workout the following integrals:

(a) $\int \frac{dx}{(x+1)\sqrt{1+2x-x^2}}$ **(11)**

(b) $\int \frac{(2x-1)dx}{\sqrt{2+4x+4x^2}}$ **(12)**

(c) $\int \frac{dx}{1+\sin x+\cos x}$ **(12)**

## SECTION - B

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

5. (a) Evaluate: **(11)**

$$\underset{n\to\infty}{Lim}\left\{\left(1+\frac{1}{n^2}\right)^{\frac{2}{n^2}}\left(1+\frac{2^2}{n^2}\right)^{\frac{4}{n^2}}\left(1+\frac{3^2}{n^2}\right)^{\frac{6}{n^2}}\ldots\ldots\ldots\left(1+\frac{n^2}{n^2}\right)^{\frac{2n}{n^2}}\right\}$$

(b) Prove that $\int_0^{\pi}\frac{x\tan x}{\sec x+\tan x}dx=\pi\left(\frac{\pi}{2}-1\right)$. **(12)**

(c) Prove that $\int_1^{\infty}\frac{\sqrt{x}}{(1+x^2)}dx=\frac{1}{2}+\frac{\pi}{4}$. **(12)**

6. (a) Find a relation between gamma function and beta function. **(11)**

(b) Determine the area included between $y^2=ax$ and $x^2+y^2=4ax$. **(12)**

(c) Find the volume generated by revolving one loop of **(12)**
$y^2(a+x)=x^2(3a-x)$ about x-axis.

7. Solve the following: **(10+14+11)**

(a) $(x+y+1)\frac{dy}{dx}=1$

(b) $\frac{dy}{dx}=\frac{x-y+1}{x+y-2}$

(c) $\frac{dy}{dx}-\frac{\tan y}{1+x}=(1+x)e^x\sec y$

8. (a) Find the integrating factor and hence solve: **(11)**

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

(b) Solve: $\frac{d^2y}{dx^2}-2\frac{dy}{dx}+y=x\sin x$. **(11)**

(c) Solve: $x^2\frac{d^2y}{dx^2}-x\frac{dy}{dx}-3y=x^2\log x$. **(13)**

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