Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 1st Year 1st Term Examination, 2018

CHEM 1111

Chemistry

Full Marks: 210 Time: 3 hrs

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

SECTION–A

1. (a) Write down the main features of valence bond theory of complex compound formation. Discuss about success of this theory. 10
   (b) Describe the Sidjwick's electronic theory of complex compound formation. Calculate the effective atomic number of the following: $[Cr(H_2O)_6]^{3+}$, $[Zn(NH_3)_4]^{2+}$, $[Co(NH_3)_6]^{2+}$, $[FeF_6]^{4-}$, $[Fe(CN)_6]^{3-}$ and $[Ni(CN)_4]^{2-}$ 12
   (c) "Co^{2+}" complexes oxidize easily to "Co^{3+} complex"- explain. 05
   (d) Write down the limitations of valance bond theory. 08

2. (a) What is H-bonding? Explain intramolecular and intermolecular H-bonding. 10
   (b) "Metal are good conductor of heat and electricity"- explain. 09
   (c) What is meant by electrolytic cell and Galvanic cell? Write down the sing convention and types of reaction of these cells at anode and cathode. 08
   (d) What do you mean by equivalent conductance? Discuss the graphical presentation of equivalent conductance verses $\sqrt{concentration}$ of strong and weak electrolytes. 08

3. (a) Discuss the principle of determination of P^H of a solution with the help of glass electrode. 10
   (b) What is the origin of EMF? Derive Nernst's equation for the determination of EMF of a cell. 10
   (c) What is transport number? Prove that summation of transport number of cations and anions is equivalent to one. 08
   (d) Draw the schematic diagram of lithium ion battery. Mention each term. Write down the charging and discharging equation of lithium ion battery. 07

4. (a) Write down the differences between order and molecularity. 10
   (b) Derive an equation for rate constant of a first order reaction. Prove that half-life value of a first order reaction does not depend upon initial concentration of the reactants. 12
   (c) Explain steady state approximation. 05
   (d) Write down the steps of chain reaction with example. 08

SECTION–B

5. (a) Draw a neat phase diagram of one component water system and explain the curves, areas, and point with reference to the phase rule. 10
   (b) Explain the terms: i) phase, ii) component, and iii) degree of freedom. 09
   (c) "Fusion curve of ice has a negative slope"- explain. 07
   (d) Discuss salient features of lead-silver system. 09

6.	(a)	Explain the terms: i) Adsorption, ii) Sorption, and iii) Adsorbent.	09
	(b)	Write down the differences between chemisorptions and physical adsorption.	06
	(c)	Mention the application of adsorption technology in daily life.	08
	(d)	Deduce Langmuir adsorption isotherm and discuss this equation for the limiting condition of very low and very high pressure.	12
7.	(a)	What is Tyndall effect? Why do lyophobic colloids show Tyndall effect?	08
	(b)	Write down the differences between lyophilic and lyophobic colloids.	08
	(c)	What is electrophoresis? How does the phenomenon provide information about the sign of charge on particles?	08
	(d)	Discuss the origin and structure of electrical double layer. How does the zeta potential differ from thermodynamic electrode potential?	11
8.	(a)	Derive Freundlich adsorption isotherm. Write down its limitations.	10
	(b)	Describe two methods for the preparation of lyophobic sols.	07
	(c)	Write down the application of colloids in artificial kidney machine.	10
	(d)	What is micelle? How will you detect a colloid solution forms micelle?	08

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PHY 1111

Modern and Solid State Physics

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
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SECTION–A

1. (a) What do you understand by length contraction and time dilation? What are proper length and proper interval of time? 10
   (b) Describe the Michelson-Morley experiment and explain the physical significance of the negative result. 15
   (c) Find the velocity of an electron that must be given so that its momentum is 50 times its rest mass times the speed of light. What is the energy at this speed? 10

2. (a) What is the origin of X-rays? Discuss the properties and applications of X-rays. 12
   (b) Show that electron cannot stay in the nucleus but it can stay on an atom. 13
   (c) Calculate the De-Broglie wavelength of electron and alpha particle. 10

3. (a) Explain uncertainty principle and mention some applications of it. 10
   (b) Show that in the limit of very large quantum numbers quantum physics gives the same result as that of classical physics. 15
   (c) The work function of potassium is 2.2 eV. When ultraviolet light of wave length 3550 A^0 falls on a potassium surface. What is the maximum energy in electron volts of photoelectrons. 10

4. (a) Explain correspondence principle on the basis of Bohr's theory. 12
   (b) Derive an expression for radius and energy of an electron orbit of the hydrogen atom. 13
   (c) Write down the quantum numbers of the electrons for n = 3. 10

SECTION–B

5. (a) What is packing fraction? Calculate the packing fraction of SC, BCC, and FCC lattice. 13
   (b) What is Miller indices? Discuss the procedure for finding Miller indices. 12
   (c) The ratio of the axial units of a certain ortho-rhombic crystal is a:b:c = 0.424:1:0.367. Find the Miller indices of the crystal faces whose intercept are i) 0.212:1:0.183, ii) 0.848:1:0.732, and iii) 0.424:α:0.123 10

6. (a) Explain the formation of different energy bands in a solid and hence distinguish between an insulator, a semiconductor and a conductor. 10
   (b) Derive an expression for Debye specific heat of a solid at constant volume and discuss it at low and high temperatures. 15
   (c) The Debye temperature of diamonde is 2000^0K. Calculate the mean velocity of sound in diamonde, given the density and atomic mass of diamonde as 3500 kg/m^3 and 12 amu respectively. If the interatomic spacing is 1.54 A^0, estimate the frequency of the dominant mode of lattice vibration. 10

7. (a) Discuss the properties of conductor, insulator, and semiconductor. 12

(b) What is Band theory of solid? Derive an expression for velocity of electrons according to Band theory. 09

(c) The electronic properties of copper may be deduced by assuming that each atoms contributes one electron. The atomic weight of copper is 63.54 and the density is $8.96X10^3$ kgm^{-3}. Show that electronic molar heat capacity and the molar atomic heat capacity are comparable at 3.2 K. ($\theta_D = 300\ K$). 14

8. (a) What is active medium? Derive the rate equation of two level LASER system. 15

(b) Explain the principle construction and working of a Ruby LASER. 10

(c) A LASER beam $\lambda = 6000A^{\circ}$ on earth is focused by a lens of diameter 2m on the crater on the moon. The distance of the moon is $4X10^8$ m. How big is the spot on the moon? Neglect the effect of earth's atmospheres. 10

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IPE 1101

Manufacturing Process-I

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
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SECTION–A

1.	(a)	Define casting. Draw a typical diagram of mold showing varies parts of it.	12
	(b)	Briefly explain the seven-main stages of sand casting process cycle.	13
	(c)	Write down the essential properties of a good core.	10
2.	(a)	Define pattern and mold. List different types of pattern used in casting and briefly describe the match plate pattern and loose piece pattern.	15
	(b)	Write short notes on i) Distortion allowance ii) Tapper allowance.	12
	(c)	Explain the hot chamber and cold chamber die casting.	08
3.	(a)	Write down the step-by-step procedure of expanded polystyrene casting process.	12
	(b)	Briefly describe the properties of molding sand.	15
	(c)	Briefly describe the mold materials.	08
4.	(a)	Describe the working principle of extrusion molding process with necessary figure. Also mention the application, advantages and disadvantages of this process.	16
	(b)	Write down the differences between injection blow molding and stretch blow molding.	07
	(c)	Write short notes on following casting defects: i) Hot-tears ii) Blow holes iii) Mis-run.	12

SECTION–B

5.	(a)	What are the basic differences among welding, soldering and brazing? Discuss with examples.	10
	(b)	Make a classification of various welding processes. Differentiate between consumable and non-consumable electrode.	13
	(c)	Describe the types of flames obtained in gas-welding process with mentioning their applications.	12
6.	(a)	State the important functions of flux and filler metal used in welding process.	10
	(b)	What is spot welding? Explain the basic working principle of resistance spot welding.	13
	(c)	Write notes on i) LBM ii) EBM.	12
7.	(a)	Define rolling. Classify rolling process according to rolling arrangement with necessary sketch.	13
	(b)	Briefly describe different types of extrusion processes for metal forming processes.	12
	(c)	What is meant by "Extrusion ratio"? Write down the equation for area reduction drawing.	10
8.	(a)	Discuss different types of forging operations with net sketch.	15
	(b)	Write notes on the following sheet metal working operations:	20

i) Notching
ii) Lancing
iii) Perforating
iv) Blanking
v) Slitting

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MATH 1111

Mathematics-I

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
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SECTION–A

1 (a) A function $f(x)$ is defined as follows; 13

$f(x) = 2x + 2$ for $x \geq 1$

$= 4$ for $-3 \leq x < 1$

$= -2x - 3$ for $x < -3$

Discuss the continuity and differentiability of $f(x)$ at x = 1.

(b) Find $\frac{dy}{dx}$, when $y = x^{\tan x} + (\sin x)^{\cos x}$. 10

(c) Write the indeterminate forms. Evaluate $\lim_{x\to 1}(\frac{x}{x-1} - \frac{1}{\log x})$. 12

2 (a) State Leibnitz's theorem. If $\log y = \tan^{-1} x$, then find the relation betweens y_{n+2}, y_{n+1}, y_n. 13

(b) State Rolle's theorem. Expand $x^3 + 2x^2 - 1$ in powers of $(x - 2)$. 12

(c) Find the equation of the tangent and normal to the curve $y(x-2)(x-3) - x + 7 = 0$ at the point where it cuts the x axis. 10

3 (a) Find the nth derivative of $y = \frac{x}{x^2-1} + \cos 5x$. 12

(b) Define subtangent and subnormal. Show that for the curve $by^2 = (x + a)^3$, the square of the subtangent varies as the subnormal. 13

(c) If $u = z\tan^{-1}(\frac{y}{x})$, then find the value of $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}$. 10

4 (a) Find the maximum and minimum values of u, where $u = \frac{4}{x} + \frac{36}{y}$ and $x + y = 2$. 12

(b) Find the radius of the curvature and center of curvature of the curve $y = x^3 + 2x^2 + x + 1$ at(0,1). 11

(c) Find the asymptotes of the curve 12

$x^4 - y^4 + 3x^2y + 3xy^2 + xy = 0$.

SECTION–B

5 Integrate any three of the followings: 35

i) $\int \sin^{-1}(\sqrt{\frac{x}{x+a}})\,dx$ ii) $\int \frac{dx}{(2x+3)\sqrt{x^2-2x-2}}$

iii) $\int \frac{dx}{\cos\alpha + \cos x}$ iv) $\int \frac{e^x dx}{e^x - 3e^{-x} + 2}$

6 Answer any three of the followings: 35

i) $\int_0^1 \frac{\log x}{\sqrt{1-x^2}}\,dx$

ii) If, $\int_0^a \frac{dx}{\sqrt{x+a}+\sqrt{x}} = \int_0^{\pi/4} \frac{\sin\theta d\theta}{\cos^2\theta}$, find the value of a.

iii) Show that $\int_0^{\pi/4} \log(1 + \tan\theta)d\theta = \frac{\pi}{8}\log 2$.

iv) Evaluate $\int_0^{\pi/2} \frac{\sin^2 x}{1+\sin x\cos x}dx$.

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HUM 1111

Economics

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
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SECTION–A

1. (a) Define Economics. Explain why it is necessary for an Industrial Engineer to study Economics. 15
   (b) Draw a curve which explains demand law. 10
   (c) Show the market equilibrium price and quantity by the functions $Q_d = 50 - 5P$ and $Q_s = -10 + 7P$. 10

2. (a) Explain with the help of indifference curves how a consumer allocates his income in order to attain equilibrium. 15
   (b) Prove that $MRS_{xy} = \frac{MU_x}{MU_y}$. 10
   (c) "Slope of a budget equation is the ratio of price of two products" 10

3. (a) What is the relation between AC and MC? Explain. 10
   (b) Distinguish between perfect competition and monopoly. 10
   (c) Explain the following terms: 15
   i) TFC ii) TVC iii) AC iv) MC.

4. (a) What do you mean by elasticity of demand? 05
   (b) How could you measure elasticity of demand at a particular point of a demand curve? 15
   (c) Explain with the help of diagrams how a firm attains least cost equilibrium. 15

SECTION–B

5. (a) What is GDP? Why does Economist use real GDP rather than nominal GDP to gauge economic well- being? 15
   (b) Which contributes more to GDP- the production of an economy car or the production of a luxury car, why? Explain the components of GDP. 20

6. (a) Explain the idea of inflation, demand pull inflation and cost push inflation. 15
   (b) What is national, private and public savings? Describe a tax-code that might increase private savings. If this policy was implemented, how would it affect the market for loan-able funds? 20

7. (a) What is the role of the financial system? What is stock? What is bond? How are the different? How are they similar? 15
   (b) What do you mean by the word "Productivity" in Economics? List and describe the determinants of worker's productivity. 20

8. Write short notes on the followings:
   (a) Natural Rate of unemployment 10
   (b) Sustainable development goals (SDG_s). 10
   (c) Fiscal policy and Monetary policy. 15