KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1ˢᵗ Year 1st Term Examination, 2019
ESE 1101
(Fundamentals of Energy Resources)

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) Assume reasonable data if any missing.

SECTION – A

1(a). What is meant by energy resources? How are they classified? Describe some adverse effects of non-renewable energy sources.   10

1(b). What is energy cycle of the earth? Briefly explain the energy flow in the earth energy cycle with neat sketch.   14

1(c). Define renewable and non-renewable sources of energy. Distinguish between commertial and non-commertial sources of energy.   11

2(a). What are the forms of energy? Briefly explain energy conversion in photocells.   06

2(b). Define nuclear energy. Explain the working princile of nuclear power with neat schematic diagram.   12

2(c). Differentiate between nuclear fission and nuclear fusion. How does energy gets liberated in nuclear reaction?   12

2(d). Discuss in brief the hazards of using nuclear fuels.   05

3(a). What are the different grades of coal? How do you understand the ranking of coal?   06

3(b). Discuss the several stages in the conversiuon of wood to coal with schematic diagram.   10

3(c). Illustrate the origin and formation of petroleum along with organic and inorganic theories.   14

3(d). State the advantages and disadvantages of using coal to produce electricity.   05

4(a). What is natural gas? How is it formed? Mention the typical composition of natural gas.   08

4(b). Explain in brief the extraction of petroleum oil. Compare primary oil recovery and secondary oil recovery.   12

4(c). What is crude oil? How various grades of oil are obtained from crude oil? Expalin.   10

4(d). Compare the characteristics between natural gas and LPG.   05

SECTION – B

5(a). What reactions are responsible for liberating energy within the sun? How solar radiation is measured on earth surface?   09

5(b). Describe schematically the eight possible path ways for conversion of solar energy.   09

5(c). What is meant by Doping in PV technology? How a PV cell works? Explain with neat sketch.   09

5(d). How solar radiation data can be obtained for a location where there is no radiation measuring facility? Explain.   08

6(a). What is meant by bioenergy? How is it formed? Briefly describe the resource potential of 08 biomass energy.

6(b). Describe the origin of biomass energy. Explain the detail process of bio-chemical 10 conversion of biomass.

6(c). Describe in details the anaerobic digestion process for biogas. Explain the parameters to 12 be controlled to achieve the biogas production efficiently.

6(d). What is biogas? Describe the fixed dome type biogas plant. 05

7(a). How power is extracted from hydro power resources? Describe the classifications of 09 hydro power plants based on constructional feature.

7(b). Write a brief note on water turbines. How propeller turbine differs from Kaplan turbine? 08

7(c). Differentiate between under shot wheel and over shot water wheel with neat sketch. 08

7(d) What factors to be considered for site selection of wind energy conversion devices. 10 Explain in brief.

8(a). In which context, geothermal energy is considered as renewable energy? Write down the 09 fields of application of geothermal energy.

8(b). What are the environmental effects of geothermal energy? Explain in brief. 08

8(c). What is meant by OTEC? With neat sketch, describe the closed cycle OTEC system. 08

8(d). How tidal energy is converted to power? Explain with neat sketch, how the single basin 10 ebb cycle system works.

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1st Year 1stTerm Examination, 2019
Ch 1113
(Chemistry 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.
iii) Assume reasonable data if any missing.

SECTION – A

1(a).	How will you show that radioactivity is nothing but a nuclear property?	08
1(b).	Describe the equation, $N = N_o\, e^{-\lambda t}$.	10
1(c).	What is a nuclear reactor? Explaine the different components of a nuclear reactor.	12
1(d).	Calculate the binding energy in MeV of ^4_2He which has a mass of 4.00390 amu. The masses of a proton, a neutron and an electron are 1.007825, 1.008668 and 0.0005852 amu, respectively.	05

2(a).	What is the principle of a Li-ion battery? Discuss the electrochemistry of such batteries.	12
2(b).	What is a fuel cell? Illustrate the working principle of a fuel cell.	12
2(c).	Write down the fundamentals of cyclic voltametry. Draw the following graphs for cyclic voltametry: (i) E vs t (ii) I (current) vs E (potential)	11

3(a).	Derive the Nernst equation. Explain how it is used to calculate the emf of a cell.	10
3(b).	Define EMF. Discuss a method for the p^H determination of a solution using glass electrode.	10
3(c).	Draw a complete diagram of 3-electrode electrochemical cell and indicate its different sections.	09
3(d).	Calculate the cell potential at 25 °C of the cell $Sn|Sn^{2+}(0.03M)\|Fe^{2+}(0.1M)|Fe$. Given that, $E^0_{Fe|Fe^{2+}} = 0.44V$ and $E^0_{Sn^{2+}|Sn} = -0.14V$	06

4(a).	State the law of mass action. "Chemical equilibrium can be initiated from either side"- explain.	09
4(b).	Describe the Van't Hoff's equation of temperature dependence of equilibrium constant.	10
4(c).	A 1.0 L vessel contained 0.0185 mole of PCl_3, 0.0158 mole of PCl_5 and 0.0870 mole of Cl_2 at 500 K in an equilibrium mixture. Calculate the value of K_p and K_c for the reaction: $$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$	08
4(d).	Discuss the effect of temperature and pressure on the following reaction: $$N_2(g) + H_2(g) \rightleftharpoons 2NH_3(g);\quad \Delta H = -92\ kJ/mol$$	08

5(a).	Distinguish between macromolecules and polymers.	08
5(b).	"Polymers are generally covalent compounds but, sometimes they conduct electricity."- Explain the mechanism to show conductivity of polymers.	09
5(c).	Outline the free radical mechanism of polymerization.	10
5(d).	How crosslink Silicone rubber can be synthesized? Explain.	08
6(a).	Define cetane number. How is the quality of diesel improved?	10
6(b).	Can solid fuel be converted into liquid fuel? If yes, so how? Explain.	10
6(c).	Differentiate between catalytic cracking and thermal cracking.	08
6(d).	High percentage of moisture is undesirable in a good fuel. Why?	07
7(a).	"Several heavy metals exert toxic effects in living systems." - Explain the mechanism of toxicity.	10
7(b).	Why ozone layer is formed in stratosphere?	07
7(c).	Discuss the biochemical effects of SO_x and NO_x.	10
7(d).	Explain about BOD and COD.	08
8(a).	Distinguish between homo-polymer and co-polymer.	08
8(b).	Derive the equation of $\bar{M}_n$ and $\bar{M}_w$.	10
8(c).	Explain the knocking mechanism of a fuel in an IC engine.	09
8(d).	What is natural gas? Write down its composition.	08

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1st Year 1st Term Examination, 2019
Hum 1113
(Sociology and Behavioral Science)
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) Assume reasonable data if any missing.

SECTION – A

1(a).	Define sociology. Discuss the impact of sociology on Engineering.	10
1(b).	What is society? What are the basic characteristics of society?	10
1(c).	What are meant by association and institution? Find out the differentiation between association and institution.	15
2(a).	What is social stratification? Why are human society stratified?	15
2(b).	What is social change? Explain the factors in a social change.	10
2(c).	What is social structure? What are the elements of social structure?	10
3(a).	What are the differences between culture and civilization?	10
3(b).	Explain the basic elements of culture.	10
3(c).	What are the purpose of social control? Discuss the role of agencies to create social control in our society.	15
4(a).	What is marriage? Why marriage is important in our society? Explain.	10
4(b).	What is family and what are the fucntions of a family?	10
4(c).	What are nuclear and joint family? What are the reasons for breaking joint family? Discuss.	15

SECTION – B

5(a).	Define organizational behavior.	05
5(b).	Why training is necessary for an organization's development?	15
5(c).	Show different steps of the training process.	15
6(a).	Find out the elements of good employee relation plan.	15
6(b).	Explain different steps of training evaluation.	15
6(c).	Show the difference between Maslow's and Aldefen's model.	05
7(a).	What is meant by organizational design?	05
7(b).	Explain different organizational structure and its preference.	15
7(c).	Discuss the social impacts of unemployment.	15
8(a).	What are the major leadership systems?	05
8(b).	Narrate the importance of quality of working life.	15
8(c).	Explain the importance of inter-group cooperation.	15

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1ˢᵗ Year 1st Term Examination, 2019
Math 1113
(Differential and Integral Calculus)
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) Assume reasonable data if any missing.   •

SECTION – A

1(a). Define exponential function, logarithmic function, and hyperbolic cotangent function with respective graphs.   10

1(b). Sketch the graphs of the followings: 05
       (i) $y = a\sqrt{x}$ (ii) $y = -ax^3$ (iii) $y = a/x$ (iv) $y = a/x^2$ (v) $y = -ax^2$
       where, a is a positive constant.

1(c). What is meant by the continuity of a function at a point? Discuss the continuity of $f(x)$ 10
       and the existance of $f'(x)$ at $x = 2$ where –

$$f(x) = \begin{cases} 4x^2 - 3x & for\ 1 < x < 2 \\ 3x + 4 & for\ x \geq 2 \end{cases}$$

1(d). Write the physical meaning of detivative. Find the differential coefficient of   10
       $(\sin x)^{\cos x} + (\cos x)^{\sin x}$

2(a). Assume that oil spilled from a ruptured tanker spreads in a circular pattren whose radius   12
       increases ay a constant rate of 2 ft/s. How fast is the area of the spill increasing when the
       radius of the spill is 60 ft.

2(b). State Rolle's Theorem. Varify Rolle's Theorem for the fucntion $f(x) = x^2 + 5x - 6$ 11
       over $(-6, 1)$.

2(c). If $u = \log(x^3 + y^3 + z^3 - 3xyz)$, show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = \frac{3}{x+y+z}$ 12

3(a). A liquid form of penicillin manufactured by a pharmaceutical firm is sold in bulk at a   13
       proce of $tk.\ 200$ per unit. If the total production cost (in taka) for x unit is $C(x) =$
       $500,000 + 80x + 0.003x^2$ and if the prodcution capacity of the firm is at most 30,000
       units in a specified time, how many units of penicillin must be sold in that time to
       maximize the profit?

3(b). State Mean Value Theorem. If $f(x) = x^3 + 1$, then show that f satisfies the hypothesis   10
       of the Mean Value Theorem on the interval $[1, 2]$ and find all values of c in this interval
       whose existance is guaranted by the theorem.

3(c). (i) Find the local linear approximation of $f(x) = \sqrt{x}$ at $x_0 = 1$.   12

       (ii) Use tha local linear approximation in part (i) to approximate $\sqrt{1.1}$ and compare your
       approximation to the result produced directly by a calculating utility.

4(a). If $u = \sin^{-1}\left(\frac{x}{y}\right) + \tan^{-1}\left(\frac{y}{x}\right)$, then find the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$.   12

4(b). Find the Taylor series about $x = \frac{\pi}{3}$ for the function $f(x) = \sin x$.   11

4(c). Find the equation of the circle of curvature at the point $(3, 1)$ on the curve   12
       $y = x^2 - 6x + 1$.

SECTION – B

5. Evaluate any three of the followings: 35

   (a) $\int \sqrt{\dfrac{x}{a-x}}\, dx$ (b) $\int \dfrac{dx}{\sqrt{x^2 - 7x + 12}}$

   (c) $\int \dfrac{x + \sin x}{1 + \cos x}\, dx$ (d) $\int \dfrac{dx}{4x^2 + 4x + 2}$

6. Determine any three of the followings: 35

   (a) $\int_{-1}^{2} |x|\, dx$ (b) $\int_{0}^{2} x^2 \sqrt{x^3 + 1}\, dx$

   (c) $\int_{0}^{\pi/2} \dfrac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}}\, dx$ (d) $\int_{0}^{\pi/4} \log(1 + \tan\theta)\, d\theta$

7(a). State the Mean Value Theorem for the integral. Find the average value of $f(x) = x^2$ on the interval $[1, 4]$. Also determine a point x^* in $[1, 4]$ such that $f(x^*) = f_{avg}$ 08

7(b). What are meant by the Beta and Gamma functions? Prove that $\Gamma\left(\dfrac{1}{2}\right) = \sqrt{\pi}$.   13

7(c). Evaluate $\int_{0}^{6} f(x)$ if   06

$$f(x) = \begin{cases} x^2 & for\ x \leq 2 \\ 3x - 2 & for\ x \geq 2 \end{cases}$$

7(d) Evaluate the midpoint Riemann sum for $f(x) = 1 - x^2$ on the interval $[1, 3]$ with 4 equally spaced subintervals.   08

8(a). Find the area of the region bounded above by $y = x + 6$, bounded below by the $y = x^2$, and bounded on the sides by the lines $x = 0$ and $x = 2$.   09

8(b). Find the area bounded by the cardioid $r = a(1 - \cos\theta)$.   10

8(c). Determine the length of the following circle   07

         $\begin{aligned} x &= a\cos t \\ y &= a\sin t \end{aligned}$ $for\ 0 \leq t \leq 2\pi,\, a > 0$

8(d). Find the volume of the solid generated when the region enclosed by $y = \sqrt{x}$, $y = 2$, and $x = 0$ is revolved above y-axis.   09

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Energy Science and Engineering
B. Sc. Engineering 1st Year 1st Term Examination, 2019
Ph 1113
(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.
      iii) Assume reasonable data if any missing.

SECTION – A

1(a). Define simple harmonic motion. Show LC circuit behaves as simple harmonic oscillator.   10

1(b). Obtain an expression for the composition of two simple harmonic vibrations at right angle to each other having equal frequencies but differing in phase and amplitudes. What happens if two vibrations are (i) in the same phase (ii) in opposite phase?   15

1(c). Show that for a particle executing SHM, the instantaneous velocity is $\omega\sqrt{a^2 - y^2}$ and instantaneous acceleration is $-\omega^2 y$.   10

2(a). Define free, forced, damped and resonance vibration. Discuss the phenomenon of resonance and give some of its practical applications.   15

2(b). What id interference of sound wave? Distinguish between constructive and destructive interference.   10

2(c). Deduce the frequency and quality factor for a circuit with $L = 2mh, C = \mu F, and\ R = 2.2\Omega$ 10

3(a). What is Dulong Petit law? Explain classical theory of solid specific heat and show that $C_v = 3R$ 10

3(b). Show that, according to Einstein model, lattice heat capacity can be written as   15

$$C_v = 3R \left(\frac{\theta_E}{T}\right)^2 \frac{e^{\theta_E/T}}{(e^{\theta_E/T} - 1)^2}$$

where, $\theta_E = \frac{hv}{k}$

Hence, at low and high temperature compare the result with experimental observation.

3(c). Show that, for BCC structure, atomic packing fraction can be written as $\frac{\pi\sqrt{3}}{6}$ 10

4(a). What is fermi energy level? Explain briefly Fermi Dirac distribution.   10

4(b). Mention the outstanding properties of metal.   07

4(c). What is thermal conductivity? Find an expression for thermal conductivity.   10

4(d). Show that Hall coefficient $R_H = \frac{1}{ne}$ in e.m.u   08

SECTION – B

5(a). What is photoelectric effect? Establish Einstein's photoelectric equation and find (i) work function, (ii) plank's constant.   15

5(b). Explain Bohr's correspondence principle.   10

5(c). What is the threshold wavelength for a tungsten surface whose work function is 4.5 eV?   10

6(a). Describe vector atom model and explain the differential quantum number associated with it.   15

6(b). What are meant by space quantization and spin quantization?   10

6(c). Write down the quantum numbers of the electrons for $n = 3$.   10

7(a). Discuss the properties of Nuclear forces.   10

7(b). Define fission and fusion and distinguish between them.   08

7(c). Prove that average life is the inverse of decay constant.   07

7(d) The whole of 1 kg of U^{235} is fissioned. Calculate (i) the energy released and (ii) express it in kWh 10

8(a). Discuss the properties of a α, β and γ. Mention some applications of Radioactivity.   13

8(b). Explain the terms: 12

(i) Acute effect, (ii) Latent effect, (iii) Somatic effect, (iv) Genetic effect.

8(c). Calculate the half-life of radium.   10

(1 gm of radium is reduced by 2.1 mg in 5 years by α-decay)

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