

- N.B.:** i) Answer any TWO 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) "Oxygen is paramagnetic" – explain the term in according to MOT. | 08 |
| 1(b) Explain intermolecular and intramolecular hydrogen bonding with example. Mention the significance of hydrogen bond. | 12 |
| 1(c) What are the evidences of resonance? Draw the resonating structure of NO_3^- and O_3 ? | 10 |
| 2(a) With the help of a diagram describe the effect of different factors on atmospheric corrosion. | 10 |
| 2(b) Describe the mechanism of electrochemical corrosion. | 12 |
| 2(c) What are the differences between galvanizing and tinning? | 08 |
| 3(a) What is binding energy? How it is related to stability of the nucleus? Explain with diagram. | 12 |
| 3(b) How will study the mechanism of an organic reaction by using radioisotopes? | 08 |
| 3(c) Make a differences between chemical reaction and nuclear reaction. | 10 |

SECTION-B

- | | |
|---|----|
| 4(a) What is relative lowering of vapour pressure? Prove that the vapour pressure of a solution is directly proportional to the mole-fraction of the solvent. | 10 |
| 4(b) Define osmotic pressure of a solution. How is this used to determine the molecular weight of the solute? | 10 |
| 4(c) Draw the phase diagram of water. Find out the degrees of freedom of various zone in the diagram. | 10 |
| 5(a) State the law of mass action. "Chemical equilibrium is a dynamic process"– Justify. | 08 |
| 5(b) Derive a relation among K_p , K_c , and K_x for the reaction: $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$. | 12 |
| 5(c) At 59°C and under a pressure of 4 atm., N_2O_4 is 63% dissociated into NO_2 . Calculate the equilibrium constant. | 10 |
| 6(a) "The half-life of a first order reaction is concentration independent". Explain mathematically. | 10 |
| 6(b) What is order of reaction? Differentiate between molecularity and order of a reaction. | 10 |
| 6(c) The rate of chemical reaction at 310K is double of that at 300K. Calculate the activation energy of the reaction. | 10 |

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
Department of Mechatronics Engineering
B. Sc. Engineering 1st Year 1st Term Examination, 2020

EEE 1131
(Electrical Circuits)

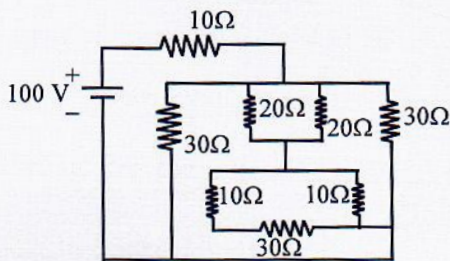
Time: 1 Hour 30 Minutes

Total Marks: 120

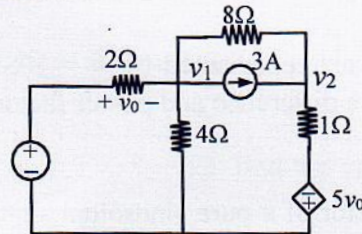
- N.B.:** i) Answer any TWO questions from each section in separate scripts.
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SECTION-A

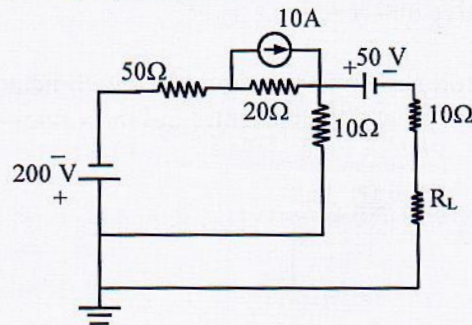
- 1(a) Explain how KVL follows the laws of conservation of energy. 05
- 1(b) Determine the current supplied by 100 V DC source as shown in the figure. 12



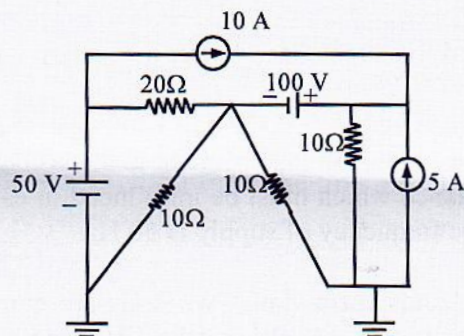
- 1(c) Determine v_1 and v_2 in the circuit given below. 13



- 2(a) Determine the Thevenin equivalent circuit with respect to load R_L for the circuit shown in the figure using superposition theorem. 10

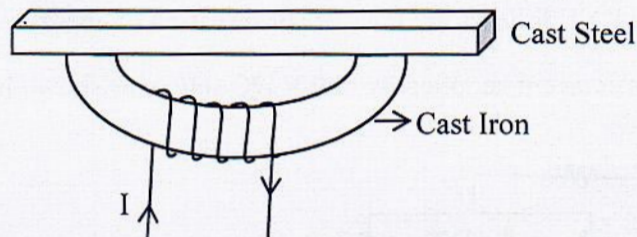


- 2(b) Find the node voltages of the circuit shown in the figure using node voltage method. 12



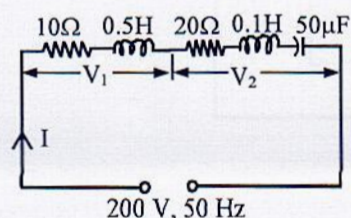
- 2(c) State and explain maximum power transfer theorem. Derive the equation for maximum power and the conditions to transfer maximum power. 08

- 3(a) Define the following terms 06
 (i) Ampere's circuital law, (ii) Magnetomotive force, (iii) Reluctance.
- 3(b) Classify and explain the losses associated with magnetic circuit. How these losses can be mitigated? 10
- 3(c) A magnetic circuit shown in the figure consist of a cast iron semi-circle having outer and inner diameter 10 and 4 inch respectively. This cast iron semi-circle is connected perfectly to a cast steel slab having volume 160 cubic inches. The width and the thickness of the slab is equal and the length is 19 times higher than the width. Determine the MMF required to establish a flux of 2 mW in the magnetic circuit. The relative permeability of cast iron and cast steel are 5000, 4000 respectively. 14



SECTION-B

- 4(a) What is the significance of rms value? Using analytical method determine the rms value of a sinusoidal wave. 10
- 4(b) Sketch the waveforms of voltage and current represented by $v = 10\sin(\omega t + 30^\circ)$ and $i = 10\cos(\omega t + 60^\circ)$. Hence find out the phase difference and power factor. Also comment that which one is leading or lagging. 10
- 4(c) Prove that the form factor and the crest factor of a pure sinusoidal signal is 1.1 and $\sqrt{2}$ respectively. 10
- 5(a) Show that the power consumed in a pure inductance is zero. 12
- 5(b) What is the difference between active and reactive power? 04
- 5(c) Draw a vector diagram for the circuit shown in the figure below indicating the resistance and reactance drops, voltages V_1 and V_2 and the current. Find the values of (i) I (ii) V_1 and V_2 (iii) Pf. 14



- 6(a) Describe the two wattmeter method for three phase power measurement. 08
- 6(b) The two wattmeter A and B, give readings as 5000 W and 1000 W respectively during the power measurement of 3- ϕ , 3 wire, balanced load system. If the voltage of the circuit is 400V, what is the value of capacitance which must be introduced in each phase to cause the whole power to appear on A. the frequency of supply is 50 Hz. 12
- 6(c) Explain the importance of power factor correction. Two coils are connected in parallel across 200 V, 50 Hz mains. One coil takes 0.8 kW and 1.5 kVA and other coil takes 1.0 kW and 0.6 kVAR. Calculate (i) resistance and (ii) Reactance of a single coil which would take the same current and power as the original circuit. 10

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
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B. Sc. Engineering 1st Year 1st Term Examination, 2020

Hum 1131

(Sociology and Engineering Ethics)

Time: 1 Hour 30 Minutes

Total Marks: 120

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

- 1(a) What is meant by sociology? Explain the scope of sociology with relevant example. 15
- 1(b) Explain the emergence of sociology in the socio-cultural context. 15
- 2(a) Define social structure. Discuss the different elements of social structure. 15
- 2(b) What is meant by scientific method? Narrate different steps of scientific research. 15
- 3(a) What is socialization? How does culture influence on socialization and personal development of a human being? 15
- 3(b) What is globalization? Discuss the changing pattern of family and marriage in our society. 15

SECTION-B

- 4(a) "Ethics is the science of ultimate good" – explain it. 12
- 4(b) Show the differences between morality and ethics. Explain the relations of the Honesty, Courage and Sharing with professional ethics. 18
- 5(a) Explain responsibility, liability, duty and rights in profession. 10
- 5(b) "My right is other's duty" – describe this elaborately. 10
- 5(c) What are the core ethical values of engineering? 10
- 6(a) Define a profession. Describe the characteristics that are responsible for converting an occupation to a profession. Is engineering a profession? Justify. 20
- 6(b) Describe the IEEE fundamental codes of ethics. 10

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechatronics Engineering

B. Sc. Engineering 1st Year 1st Term Examination, 2020

Math 1131

(Calculus and Geometry)

Time: 1 Hour 30 Minutes

Total Marks: 120

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

- 1(a) Discuss the continuity and differentiability of the function $f(x)$ at $x = -3$, where 12
- $$f(x) = \begin{cases} 2x - 1; & x \geq 4 \\ 7; & -3 \leq x < 4 \\ 1 - 2x; & x < -3. \end{cases}$$
- 1(b) Is Rolle's theorem applicable to the function $f(x) = \frac{2}{|x|+1}$ in any interval containing origin? Justify your answer. 10
- 1(c) If exist, find the inflection point of $y = 3x^3 + 9x^2 - 12x + 5$. 08
- 2(a) Verify mean value theorem for the function $f(x) = x^2 + 2x + 1$ in the interval $[-1, 1]$. 08
- 2(b) Show that, $f(x) = 2x^3 - 12x^2 + 30x + 10$ has neither a maximum nor a minimum. 08
- 2(c) If $u = F(y - z, z - x, x - y)$, find the value of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. 14
- 3(a) Find the equation of the tangent and the normal to the curve $f(x) = 4x^2 + 7x - 10$ at $x = 1$. 14
- 3(b) Find all possible asymptotes of the curve $x^3 + y^3 + 6Pxy = 0$, where P is a constant. 16

SECTION-B

- 4(a) Find the cylindrical and spherical polar co-ordinates for the point $(-8, 4, -1)$. 14
- 4(b) Find the equation of the plane perpendicular to each of the planes $x - 4y + z = 0$ and $3x + 4y + z - 2 = 0$ and at a distance unity from the origin. 16
- 5(a) Examine that the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$ are coplanar or not. If coplanar, then find the equation of plane containing them. If not, then find the shortest distance and equation of shortest distance between them. 18
- 5(b) Find the distance of $(-1, 2, 5)$ from the line through $(3, 4, 5)$ whose direction cosines are proportional to $(2, -3, 6)$. 12
- 6(a) Determine $\int_0^{\pi/2} \frac{\sin^2 x}{\cos x + \sin x} dx$. 15
- 6(b) Evaluate $\int_0^{\pi/2} \cos^n x dx$ when n is even or odd both the cases. 15

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
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MTE 1101
 (Mechatronic Systems)

Time: 1 Hour 30 Minutes

Total Marks: 120

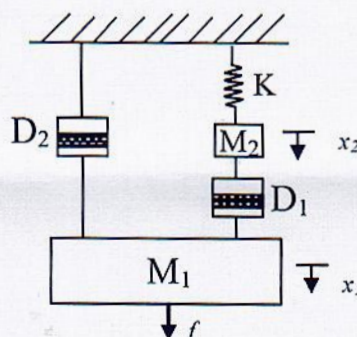
- N.B.:** i) Answer any TWO questions from each section in separate scripts.
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SECTION-A

- 1(a) Discuss the concept of a mechatronic system. What are the benefits of a mechatronic system over electrical and mechanical systems? 10
- 1(b) Explain the terms: (i) Sensitivity; (ii) Reproducibility; (iii) Dead zone; (iv) Hysteresis; (v) Linearity. 10
- 1(c) Define static error. A 0–150 V voltmeter has a guaranteed accuracy of 1% full scale reading. The voltage measured by this instrument is 75 V. Calculate the percentage limiting error. 10
- 2(a) Justify the statement: “Bourdon tube acts as a primary detector”. 10
- 2(b) Describe the working principle of a light sensor which can measure the angular speed of a motor shaft. 10
- 2(c) Assume you are designing a temperature control system for a pharmaceutical production plant. For this task you need a temperature sensor. On what basis you should select the sensor? 10
- 3(a) What is an actuator? Write down the differences between a sensor and transducer. 10
- 3(b) Suppose you are the chief engineer in an automobile company. There is a system that uses compressed air to transmit and control energy. Which type of this system is? What are its benefits and drawbacks? 10
- 3(c) Write short notes on: (i) Single acting cylinder; (ii) 2/2 direction control valve. 10

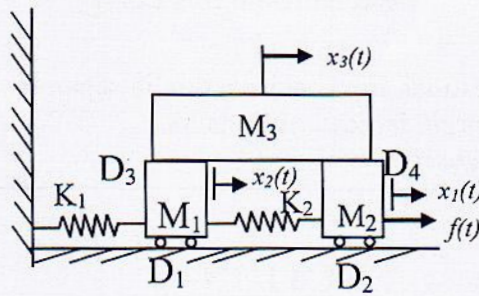
SECTION-B

- 4(a) Prove that the sensitivity of Wheatstone bridge $S_B = \frac{S_v E}{\frac{R}{S} + 2 + \frac{S}{R}}$, where the symbols have their usual meanings. 10
- 4(b) Find the state – space model of a mechanical system shown in the figure. Assume velocity of Mass 2 (M_2) as output. 12

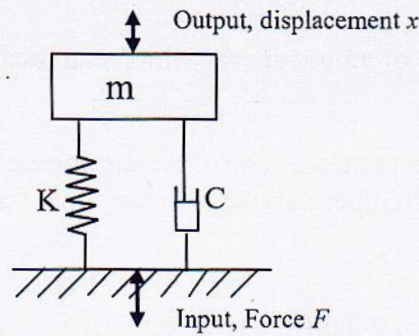


- 4(c) Suppose, you discover a voltmeter with zero error in your mechatronics lab. What type of this error is? Make a list of the sources and solutions to the error. 08

- 5(a) Draw the $f-i$ analogous electrical circuit of the mechanical system given in figure and write down the system equations. 12



- 5(b) State signal conditioning and why we need signal conditioning. Also suggest the modules that might be needed to interface the output of a microcontroller with an actuator. 10
- 5(c) Draw the block diagram of a generalized measurement system. How a smartphone can convert our speech into text? 08
- 6(a) Write down the steps of designing a feedback control system for production process. 10
- 6(b) State the output of a differential amplifier as given in figure. 10



- 6(c) Define smart sensor and actuator. State recent trends in mechatronic systems 10