INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
HIMACHAL PRADESH

An Institute of National Importance under MoE

Saloh, Una – 177 209

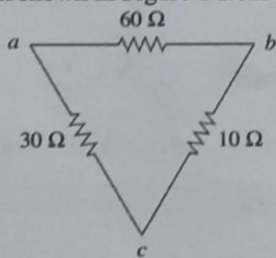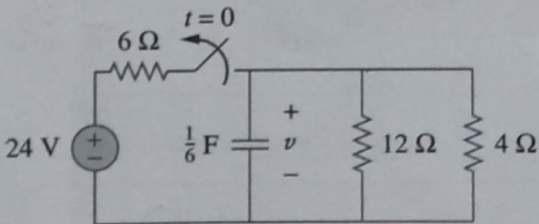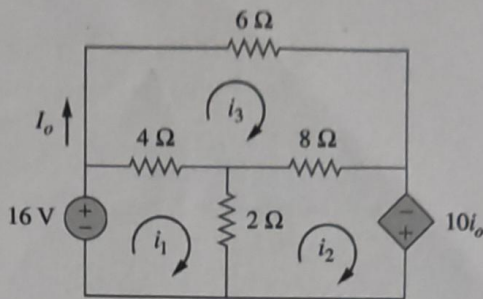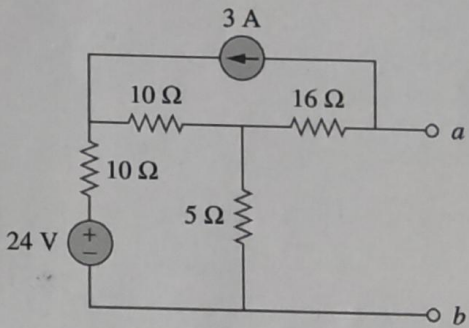Website: www.iiitu.ac.in

AY 2023-24
School of Electronics
End Semester Examination
29, Dec.'23
Curriculum – IIITUGCSE22
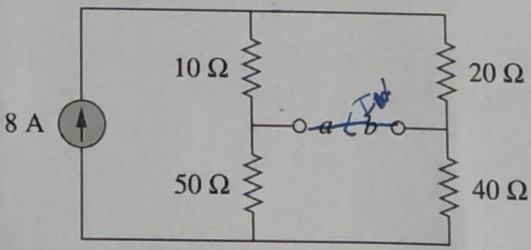
Degree	B. Tech.	Branch	CSE	Semester	I
Subject Code & Name	EEC103: Basic Electrical and Electronics Engineering				
Time: 180 Minutes	**Answer All Questions**			**Maximum: 100 Marks**	

Sr. No.	Question	Marks

1. a	Define the following terms:
	    (i) Phasor
	    (ii) Sinusoid
	    (iii) Self-inductance
	    (iv) Mutual inductance
	    (v) Transient response
		(5×1)

1. b	Transform the network shown in Figure 1 from Δ to Y. Figure 1: Circuit for question 1b	(5)
1. c	If the switch opens at t = 0 in the circuit shown in Figure 2, find voltage across the capacitor $v(t)$ for $t \geq 0$. Figure 2: Circuit for question 1c	(5)

1. d	Find currents i_1, i_2, and i_3 in the circuit shown in Figure 3.		(5)

Figure 3: Circuit for question 1d

2. a	Explain the following network theorems with appropriate circuit diagrams: (i) Compensation theorem (ii) Superposition theorem		(2.5×2)

2. b	Find the Thevenin's equivalent across terminals a-b for the circuit shown in Figure 4.		(5)

Figure 4: Circuit for question 2b

2. c	Find the Norton's equivalent across terminals a-b for the network shown in Figure 5.		(5)

Figure 5: Circuit for question 2c
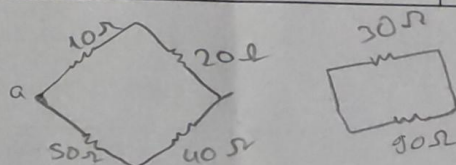
2.	d	Determine the maximum power that can be delivered to the load R in the circuit shown in Figure 6.	(5)
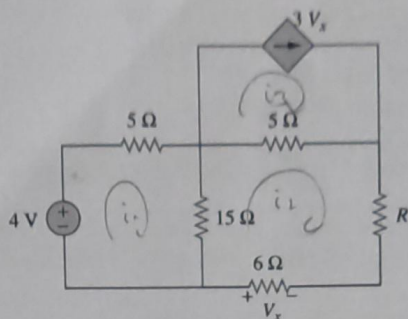
Figure 6: Circuit for question 2d

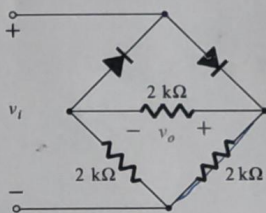|			

3.	a	Define the following terms:
		   (i) n-type semiconductor
		   (ii) p-type semiconductor
		   (iii) Peak Inverse Voltage
		   (iv) Knee voltage
		   (v) Diode breakdown
			(5×1)

3.	b	Explain the working of a Zener diode in forward and reverse bias with suitable IV characteristics.	(5)
3.	c	Determine the output waveform for the input given in Figure 7(a) applied to the circuit given in Figure 7(b).	(5)
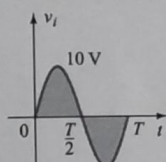
(a)   (b)

Figure 7: (a) Input and (b) circuit for question 3c

3.	d	Determine the output waveform for the input given in Figure 8(a) applied to the circuit given in Figure 8(b).	(5)

(a)   (b)

Figure 8: (a) Input and (b) circuit for question 3d

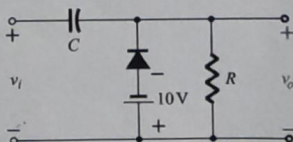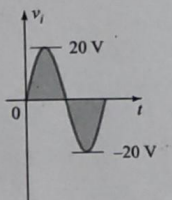|			
4. a	Define the following terms: (i) Bipolar and unipolar (ii) Current-controlled and voltage- controlled device (iii) Forward active mode of a BJT (iv) Cutoff mode of a BJT (v) Saturation mode a BJT		(5×1)
4. b	Explain the working of a PNP transistor with suitable diagrams.		(5)
4. c	Draw the input and output characteristics of an NPN transistor in common emitter configuration with suitable biasing diagrams.		(5)
4. d	Explain the working of a BJT as a switch.		(5)
5. a	List at least five differences between BJT and FET.		(5)
5. b	Explain the working of an n-channel JFET with suitable diagrams.		(5)
5. c	Sketch the transfer characteristics of a JFET defined by I_{DSS} = 20 mA and Vp = -10 V.		(5)
5. d	A JFET has a drain current of 5 mA. If I_{DSS} = 10 mA and V_{GS} (off) = – 6 V, find the value of (i) V_{GS} and (ii) V_P.		(5)

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AY 2023-24
School of Basic Sciences
CURRICULUM: IIITUGCSE22
End Semester Examination
28, Dec.'23

Degree	B. Tech.	Branch	CSE
Semester	I		
Subject Code & Name	BIC104: Introduction to Biotechnology		
Time: 180 Minutes	Answer All Questions		Maximum: 100 Marks

S. No.		Question	Marks

1.a (i) Calculate the magnification power of a light microscope when the plant cell is viewed using the 10X objective lens and 100X objective lens, respectively. **(2+2+1=5)**

(ii) Calculate the chlorophyll content of two plant leaves showing the absorbance values of A_{650} are 0.4 and 0.5, respectively.

(iii) Calculate the number of peptide bonds present in myoglobin protein comprised of 153 amino acids.

1.b (i) Human DNA contains 30% guanine on a molar basis. What are the mole percentages of adenine, cytosine, and thymine? **(2+2+1=5)**

(ii) Identify the bacterial cell from a mixture of three types of cells namely plant, animal, and bacteria based on structural differences.

(iii) The start of the coding region for the human globin gene reads 5'-ATGGTGCAC-3'. What is the sequence of the complementary strand for this segment of DNA?

1.c (i) Determine the amino acid sequence pattern of the peptide after the treatments of trypsin and cyanogen bromide to the given peptide Met-Gly-Ser-Met-Ala-Lys-Ala-Leu-Ser-Ala-Met-Ser-Ala-Pro. **(2.5+2.5=5)**

(ii) Solve the code of mRNA sequence for amino acids pattern as follows:
5'-AUGGAGAGCUAUCAUCCACCACCAGUGAUCCUGUAA-3'
What would happen to the peptide sequence when the twelfth nucleotide of the mRNA, an uracil residue, is mutated by replacing it with an adenine residue?

1.d Model the block diagram for DNA replication and associated protein role in the semi-conservative replication. **(5)**

2.a Outline the working of Next Generation Sequencing technology employed for generating the massive biological data with a suitable example. **(5)**

2.b Model the block diagram of the amplification process of a target gene using polymerase chain reaction. **(5)**

2.c Construct the process of DNA libraries and screen to identify cloned genes of interest. **(5)**

2.d   (i)   Draw the separation pattern of three DNA fragments of 200 bp, 250 bp,   (2.5+2.5=5)
and 300 bp using agarose gel electrophoresis.

(ii) Find out the protein separation pattern of three different sizes of 25 kDa, 50 kDa, and 75 kDa using the size exclusion chromatography.

3.a Demonstrate the working mechanism of four different of vaccines with suitable   (5)
examples.

3.b Outline the protoplast fusion technology and regeneration of a hybrid plant with   (5)
a commercial example.

3.c   (i)   Calculate the isoelectric point (pI) of an amino acid arginine if the data   (3+2=5)
of pK_1, pK_2, and pK_R are 2.17, 9.04, and 12.48 respectively. Interpret the significance of the obtained pI data pertaining to protein structure.

(ii) Calculate the specific activity, and yield (%) of a target protein for each step from the given purification data as follows:

Purification step	Total Protein (mg)	Total Activity (U)	Specific Activity	Yield %
A	5000	15000		
B	1000	7500		

3.d Examine the process of fusion protein design and its application to isolate a   (5)
recombinant protein of interest.

4.a Illustrate the process of nuclear reprogramming of somatic cells to produce   (5)
induced pluripotent stem cells.

4.b Draw the DNA fingerprinting pattern of the identical twins, non-identical twins and   (5)
recombinant DNA copies.

4.c Examine the unit operations processes employed in the wastewater treatment.   (5)

4.d Make use of aerobic and anaerobic mechanism of biodegradation of waste   (5)
materials with special reference to man-made pollutants.

5.a What types of biological databases can be used in bioinformatics? Enlist the   (5)
molecular data formats and their visualization tools.

5.b   (i)   Explain how do patents protect drugs and devices?   (2+ 3=5)

(ii) Summarize the two leading bioethics approaches with suitable examples.

5.c Apply the bioethics approaches on the following situation: Biopharma company   (5)
develops a vaccine for a deadly disease without the complete validation of 12 years of drug discovery regulatory check but early studies show that the vaccine is effective in only about 60% of patients, should the biopharma company wait to bring the vaccine to market while they work to improve its efficacy and people suffering from the disease die, or should it be available immediately.

5.d Make use of the Food Drug and Administration regulatory body in quality check   (5)
of the biopharma products, particularly to the drug phase testing.

****GOOD LUCK*****

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AY 2023-24
School of Computing
Curriculum: IIITUGCSE22
End Semester Exam
December 26, 2023

Degree	B.Tech.
Branch	CSE
Semester	I
Subject code/name	MAC111/ Engineering Mathematics
Time	180 minutes
Maximum Marks	100

Answer all the questions.

Q. No.	Questions	Marks
1(a)	Solve the following system of equations using Gauss Elimination method: $$y - z = 3$$ $$-2x + 4y - z = 1$$ $$-2x + 5y - 4z = -2$$	5
1(b)	Examine if the system below is consistent: $$x_1 + x_2 + 2x_3 + 2x_4 + x_5 = 1$$ $$2x_1 + 2x_2 + 4x_3 + 4x_4 + 3x_5 = 1$$ $$2x_1 + 2x_2 + 4x_3 + 4x_4 + 2x_5 = 2$$ $$3x_1 + 5x_2 + 8x_3 + 6x_4 + 5x_5 = 3$$	5
1(c)	Determine the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} -3-\lambda & 1 & -3 \\ 20 & 3-\lambda & 10 \\ 2 & -2 & 4-\lambda \end{bmatrix}$. Is the matrix A diagonalisable?	5
1(d)	Reduce the quadratic form $Q = 2x^2 + y^2 - 3z^2 - 8yz - 4zx + 12xy$ into canonical form and find its nature, rank, index and signature.	5
2(a)	Determine the radius and the interval of convergence of the power series $$\sum_{n=0}^{\infty} 2^n (x-3)^n.$$	5

2(b)	Examine if the series $\sum_{n=1}^{\infty} \left(\dfrac{1}{\ln(n+2)} - \dfrac{1}{\ln(n+1)} \right)$ is convergent.		5
2(c)	Show that the series $\sum_{n=1}^{\infty} \dfrac{(-1)^n(n+2)}{2^n+5}$ is absolutely convergent.		5
2(d)	If $\sum u_n$ is a positive terms convergent series, then show that the series $\sum u_n^2$ is also convergent. Is the converse true?		5
3(a)	Examine the function $f(x,y) = \begin{cases} \dfrac{x^2-y^2}{x^2+y^2}, & (x,y) \neq (0,0) \\ 0, & (x,y) = (0,0) \end{cases}$ for continuity at origin.		5
3(b)	Given that $x = e^u + e^{-v}$, $y = e^{-u} - e^v$. Consider z is a function of x and y, prove that $$\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y}.$$		5
3(c)	Sketch the region of integration and evaluate the integral: $$\int_0^\pi \int_0^{\sin x} y\, dy\, dx$$		5
3(d)	Investigate the function $f(x,y) = 6x^2 - 2x^3 + 3y^2 + 6xy$ for all the local maxima, local minima and saddle points.		5
4(a)	Determine if $W = \{(x_1, x_2, x_3) : x_1^2 + x_2^2 + x_3^2 \leq 1; x_1, x_2, x_3 \in \mathbb{R}\}$ is a subspace of $\mathbb{R}^3$.		5
4(b)	Define spanning set for a vector space V. Determine if $(x,y,z) \in \mathbb{R}^3$, belongs to the span of $u_1 = (1,1,1)$, $u_2 = (1,2,3)$, $u_3 = (1,5,8)$.		5
4(c)	Examine whether the given set of vectors are linearly independent or dependent in $\mathbb{R}^4$: $$\{(1,1,1,1), (1,2,3,2), (2,5,6,4), (2,6,8,5)\}.$$		5
4(d)	Find the dimension and a basis of the solution space W of the homogeneous system: $\begin{aligned} x + y + 2z &= 0 \\ 2x + 3y + 3z &= 0 \\ x + 3y &= 0 \end{aligned}$		5
5(a)	Let $T : \mathbb{R}^3 \to \mathbb{R}^3$ be a linear transformation defined by $T(x,y,z) = (x+z, x+y, x+y+z)$. Determine the matrix representation of T w.r.t. standard basis in $\mathbb{R}^3$.		5
5(b)	Show that $T : \mathbb{R}^2 \to \mathbb{R}^2$ defined by $T(x,y) = (x + 2y, 3x - y)$ is a linear transformation.		5
5(c)	Define range space of a linear transformation. Find the null space, rank and nullity of the linear transformation T defined in question 5(b).		5

5(d)	Consider the following two bases of $M_{2\times2}$	5

$$B_1 = \left\{ \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix} \right\}$$

and

$$B_2 = \left\{ \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}, \begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix}, \begin{bmatrix} 1 & -1 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \right\}.$$

Find the transition matrices P and Q from basis B_1 to B_2 and B_2 to B_1, respectively. State the relation between P and Q.

******* All the best*******

$$2^n \left(\cancel{\ } - \frac{5}{2} - \cancel{\ } \right)^n$$

$$\frac{(-1)^n (2)^n (+1)^n}{2}$$

$$\frac{(-1)^n (22)^n}{2}$$

$$\frac{\sin^2 n - t}{2}$$

$$2 \sin n \cos t \, d\, n - t$$

AY 2023-24

SCHOOL OF BASIC SCIENCES
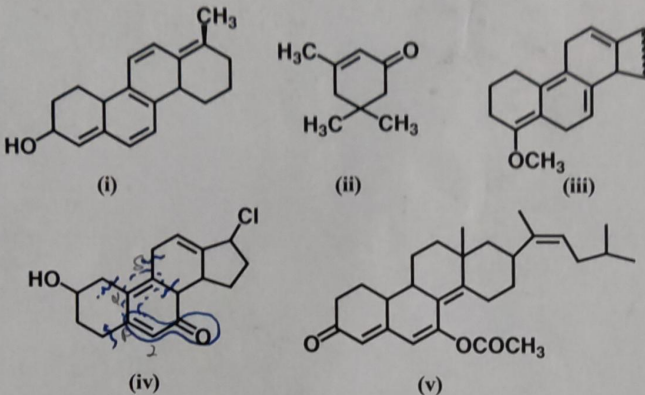
CURRICULUM: IIITUGCSE22

End Semester Examination

27, Dec.'23 (09:00 AM – 12:00 PM)

Degree	B. Tech.	Branch	CSE
Semester	First		
Subject Code & Name	CYC102: Engineering Chemistry		
Time: 180 Minutes	Answer All Questions		Maximum: 100 Marks

Sl. No.	Questions	Marks
1.a	What are the problems associated with hardness of water in boilers? Explain the utility of ion-exchange resins in overcoming these problems.	(5)
1.b	The analysis of water sample gives the following data: $Ca(HCO_3)_2 = 35$ ppm; $Mg(HCO_3)_2 = 20$ ppm; $MgSO_4 = 10$ ppm; $H_2SO_4 = 24$ ppm; $CaCl_2 = 5$ ppm; and $KCl = 20$ ppm. Calculate the amount of lime (95% pure) and soda (82% pure) needed for treating 1 million litres of water. If the cost of lime and soda are Rs. 150 and 250 per 1 Kg each respectively, determine the cost of chemicals used for treatment of 50 Kg water treatment.	(5)
1.c	With the help of a well-labelled diagram, explain the use of electrodialysis for desalination of water.	(5)
1.d	A 100 ml of water required 50 ml of 0.025 M EDTA solution for titration. Another 100 ml of the same water was boiled and precipitate was removed by filtration. The filtrate required 10 ml of 0.025 M EDTA for titration. Calculate the carbonate and non-carbonate hardness of water.	(5)
2.a	Discuss the behavior of polymers using Stress-Strain analysis curve. What are the factors responsible for plastic deformation?	(5)
2.b	Apply the concept of number average ($\overline{M_n}$) and weight average ($\overline{M_w}$) molecular masses to determine the Polydispersity Index (PDI) of the polymer with the following composition: 25 is 15%; 45 is 50%; 30 is 35%.	(5)
2.c	Write down the monomers used in the fabrication of the following: (i) Bakelite (ii) Kevlar (iii) Acrilan (iv) Teflon (v) Plexiglas	(5)
2.d	What are polymer composite materials? Discuss two important types of fibre-reinforced composites.	(5)
3.a	A coal sample was found to contain: C = 66.2%; H = 4.2%; O = 6.1%; N = 1.4%; S = 2.9%, Moisture = 9.7% and Ash = 2% by weight. Calculate the quantity of dry products of combustion, if 1 Kg of coal is burnt with 25% excess air.	(5)
3.b	What is meant by catalytic cracking of petroleum? Explain in detail the difference between Fixed-bed and fluidized-bed catalytic cracking process.	(5)
3.c	A sample of the Gondwana coal of Jharia was analyzed as follows: Exactly 2.620 g was weighed into a silica crucible. After heating for 1 hour at 115°C, the residue weighed 2.325	(5)

	g. The crucible was covered with a vented lid and strongly heated for exactly 7 minutes at $945 \pm 20°C$. The residue weighed 1.627 g. The crucible was then heated without cover, until a constant weight was obtained. The last residue was found to weigh 0.485 g. Calculate the percentage results of the above analysis. Also, determine to which type of analysis does the above description belong to?	
3.d	Discuss extreme pressure lubrication. How the incorporation of additives improve the lubricant properties?	(5)
4.a	Following the Woodward-Fieser rules, calculate λ_{max} for each of the following compounds (Fig. 1 i-v):	(5)

Fig. 1 (i-v): Structure of compounds for question 4 (a)

4.b	What is Thermal Analysis of material? Discuss the effect of temperature on the composition of Copper Sulphate Pentahydrate Crystals using thermal techniques of TGA, DTA and DSC.	(5)
4.c	Calculate the number of chemically equivalent ^1H signals and determine their spin multiplicity in ^1H NMR spectra of the following compounds: (i) $CH_3\text{-}CH_2\text{-}CO\text{-}CH_3$ (ii) $CH_2Cl\text{-}CH_3$ (iii) $CH_3\text{-}CH_2\text{-}CH_3$ (iv) $CH_3\text{-}CH_2\text{-}CH_2\text{-}Cl$ (v) $C_6H_5\text{-}CH_3$	(5)
4.d	Calculate the approximate wavelength of absorption associated with C-H bond in stretching vibration of methyl group. The force constant for single bond is 5×10^5 dynes/cm. The mass of carbon and hydrogen are 2×10^{-23} g and 0.167×10^{-23} g respectively.	(5)
5.a	Elucidate the differences between top-down and bottom-up approaches for nanomaterial fabrication. Explain in detail the sol-gel method of fabrication of nanoparticles.	(5)
5.b	A monochromatic radiation of $\lambda=450$ nm is incident on a solution of 0.04 M concentration of an absorbing substance. The intensity of the radiation is reduced to one-half of the initial value after passing through 50 mm length of the solution. Calculate the molar extinction coefficient of the substance.	(5)
5.c	What is Chromatography? Elucidate the differences between TLC and Column chromatography with a well labelled diagram.	(5)
5.d	Illustrate the detailed mechanism of Ziegler-Natta polymerization for the formation of high density polyethylene.	(5)

*** Good Luck ***