

Indian Institute of Information Technology Vadodara
MA 101: Introduction to Discrete Mathematics
Midsemester Examination

Maximum Marks: 40

Time: 2 hrs

- 1) Each question carries 5 marks.
- 2) Do not write anything, except your name and id on the question paper.
- 3) Write down answers in sequence.

1. Show that $\exists x P(x) \wedge \exists x Q(x)$ and $\exists x (P(x) \wedge Q(x))$ are not logically equivalent.
2. Show that these statements are equivalent. (i) $3x + 2$ is an even integer (ii) $x + 5$ is an odd integer (iii) x^2 is an even integer.
3. Find prime factorization of 385, and the remainder when 6^{2024} is divided by 385.
4. Let $f : X \rightarrow Y$ and $g : Y \rightarrow Z$ be functions. If f and $f \circ g$ are one-to-one, does it follow that g is one-to-one? Justify your answer. ~~No sense.~~
Yes ✓
5. Let $\mathbb{N} = \{1, 2, 3, \dots\}$. What is the relation between cardinalities of \mathbb{N}^3 and \mathbb{N}^2 ? Give justification for your answer.
6. Use resolution principal to check validity of the argument given below. Use propositional variables and define them at the beginning.
 Either Heena attended the meeting or Heena was not invited. If the boss wanted Heena at the meeting, then she was invited. Heena did not attend the meeting. If the boss did not want Heena there, and the boss did not invite her there, then she is going to be fired. Therefore, Heena is going to be fired.
7. Find all solutions, if any, to the system of congruences

$$\begin{aligned} x &\equiv 5 \pmod{6} \\ x &\equiv 3 \pmod{10} \\ x &\equiv 8 \pmod{15} \end{aligned}$$
8. Let $A = \{f : \mathbb{N} \rightarrow \{0, 1\} \mid f \text{ is a function}\}$. Is A countable, finite? Give justification.

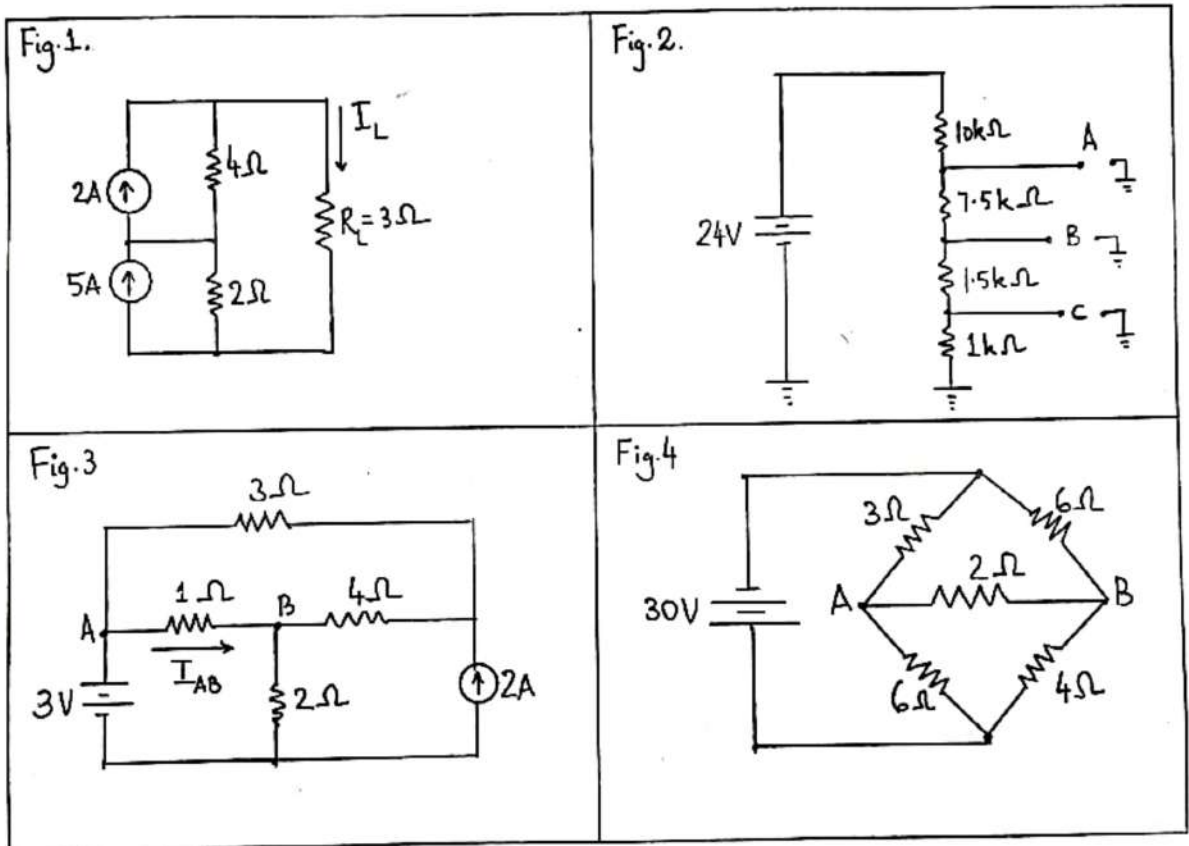
Full Marks: 80

Date: 08/10/2024
Time: 9:30 PM - 11:30 AM

Instructions:

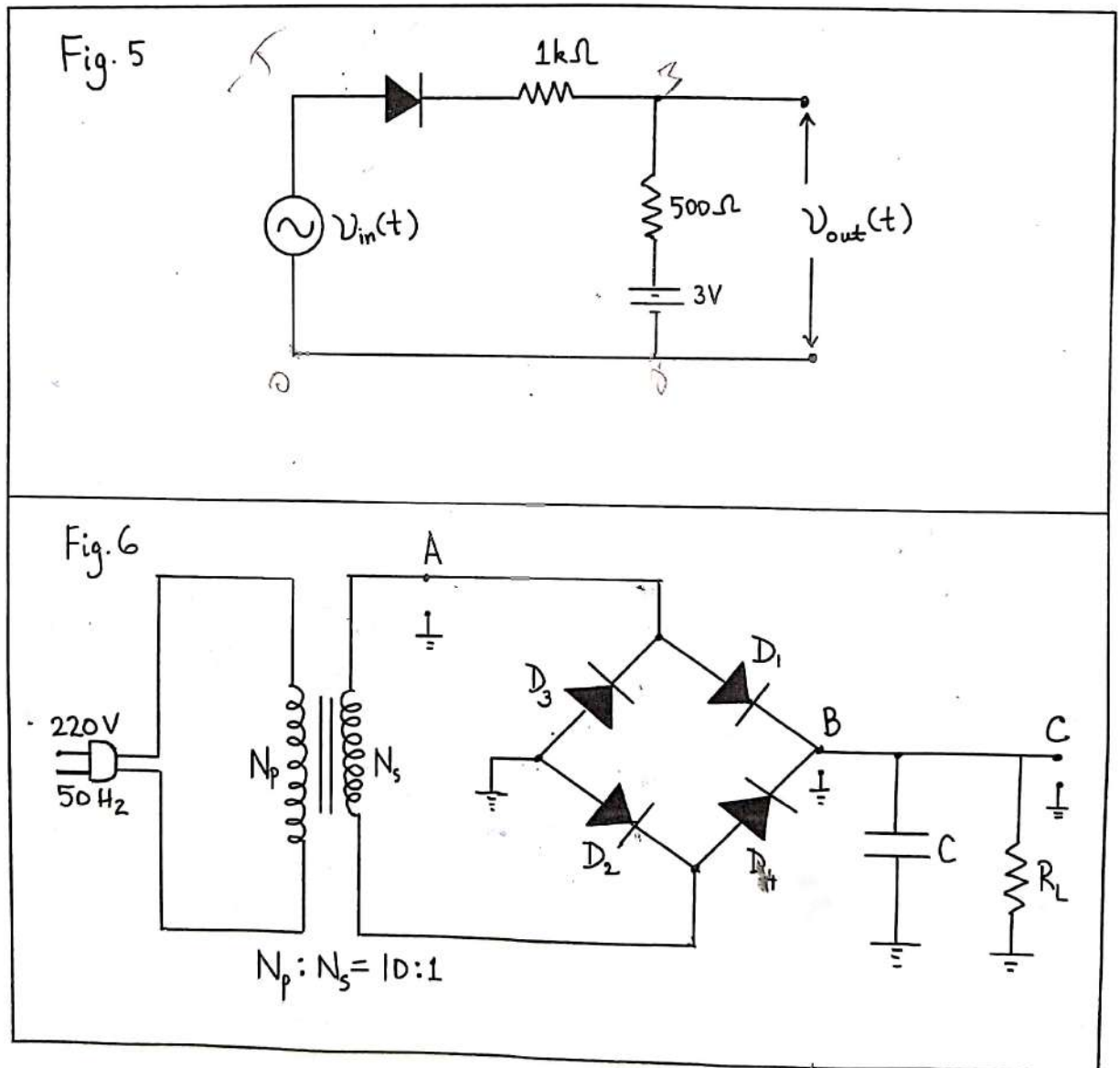
1. Attempt **ALL** the questions. Each question carries equal marks.
2. Answer each question sequentially beginning on a new page.
3. Use of a scientific calculator is permitted.

Q1. In the circuit shown in Fig.1, convert current sources to voltage sources and calculate the current I_L through the resistor $R_L = 3\Omega$. $\frac{18}{7}$



- Q2. Fig. 2 shows a voltage divider circuit. Determine the voltage that can be measured at terminals A, B, and C with respect to the ground.
- Q3. Use superposition theorem to determine current I_{AB} indicated in the circuit shown in Fig. 3.
- Q4. Apply Thevenin's theorem across the terminals A and B in the circuit shown in Fig. 4. Draw the Thevenin equivalent circuit mentioning the value of Thevenin voltage and resistance.

- Q5. An intrinsic Germanium rod has the following dimensions: length = 1cm; width = 1mm; and thickness = 1mm. At temperature $T = 300\text{K}$, the intrinsic carrier density in Germanium is $2.5 \times 10^{13} \text{ cm}^{-3}$, the mobility of electrons is $\mu_e = 3900 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ whereas the mobility of holes is $\mu_h = 1900 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$. Determine (i) electrical conductivity, (ii) electrical resistivity, and (iii) electrical resistance of the given rod.
- Q6. Determine built-in potential of the p - n homojunction formed in a Silicon sample by doping it with the acceptor atoms $N_A = 10^{15} \text{ cm}^{-3}$ and with the donor atoms $N_D = 10^{15} \text{ cm}^{-3}$ at $T = 300\text{K}$. [Assume intrinsic carrier density at $T = 300\text{K}$ to be 10^{10} cm^{-3}]
- Q7. Consider the circuit shown in Fig. 5. For the input voltage $v_{in}(t) = 15 \sin(314t) \text{ V}$, and assuming the ideal diode model, plot the output waveform $v_{out}(t)$ indicating the values of maximum and minimum voltage.
- Q8. Draw the waveform observed at terminals A, B, and C indicated in Fig. 6.



$\frac{1}{2} \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = \frac{1}{2} m \frac{d}{dt} (v^2)$
 $\frac{1}{2} m \frac{d}{dt} (v^2) = \frac{1}{2} m \frac{d}{dt} (v^2)$

Mid-semester Examination 2024-25
PH100: Mechanics and Thermodynamics

Marks: 30

Time: 120 Minutes

- All questions are compulsory and their marks are indicated in square brackets.
- All questions need to be answered sequentially without fail. Non-compliance with instructions will invite a deduction in marks.
- In case you feel any question/s is/are incorrect or have insufficient instruction then write in the answer book with your justification without wasting any time.

1. Answer the following questions briefly.

- (a) State and explain Newton's laws of motion.
- (b) Write down the velocity and acceleration in the plane polar coordinates. Find the rate of change of radial and tangential vector with respect to time.
- (c) If the work integral $\int_a^b \mathbf{F} \cdot d\mathbf{l}$ is path-independent, then \mathbf{F} must be a non-conservative force. (True/False) Under what conditions, \mathbf{F} can be a conservative force?
- (d) What is the quality factor of an oscillator? Estimate its magnitude for a lightly damped oscillator.
- (e) Let consider two masses m_1 and m_2 under the influence of central force. Discuss the scenario in which these two masses remain bounded. [10 Marks]

2. (a) State Kepler's laws of planetary motion. (b) Before landing men on the moon, the Apollo 11 space vehicle was put into orbit about the moon. The mass of the vehicle was 9,979 kg and the period of the orbit was 119 minutes. The maximum and minimum distances from the center of the moon were 1,861 km and 1,838 km. Assuming the moon to be a uniform spherical body, what is the mass of the moon according to these data? $G = 6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$. [3+4=7 Marks]

3. With physical examples, discuss undamped, damped, forced, and forced damped harmonic oscillation. Consider the forced harmonic oscillation and forced damped harmonic oscillation with the driving force as $F_0 \cos(\omega_d t)$ and the damping force as $-bv$. By plotting the displacement curve, discuss the resonance situation in both cases. [6 Marks]

4. (a) What do you understand from elastic and inelastic collisions? Give physical examples.

(b) A particle of mass m and velocity v_0 collides elastically with a particle of mass M initially at rest and is scattered through angle θ in the center of the mass system. (i) Find the final velocity of m in the laboratory system. (ii) Find the fractional loss of kinetic energy of m . [3+4=7 Marks]

$Q = N \hbar^2 \theta$

Indian Institute of Information Technology Vadodara
Introduction to Programming and Problem Solving (IT101)
Mid Semester Examination

(Marks 25)

Time: 60 Minutes

Note: (a) Attempt all questions.

(b) Answer must be written precise and to the point instead of using verbose.

(c) Mention **explicitly** any assumptions if used while answering the question.

1. Draw a flowchart to find maximum number among three numbers (5 Marks)
2. What are the storage classes in c? Explain the differences with examples. (5 Marks)
3. What are the different data types supported by the 'C' language? (5 Marks)
4. Define a recursion . Write a C program with recursive function for multiplying two integers using addition where a function call is passed with two integers m and n. (5 Marks)
5. Write a program in C to find the reverse of a number. If input is 324 then output should be 423. (5 Marks)



Indian Institute of Information Technology Vadodara

Course Name: Spoken and Written Communication

Course Code: HS101

Total Marks: 60

Time: 02 hrs

Semester: I

N.B: For essay-type answers, the word limit is 175 to 200 words minimum.

Answer the following questions -

1. What is the difference between listening and hearing? Elaborate on the five types of listening. (5)
2. What is the origin of the word "communication"? Explain the Shannon-Weaver model while providing an illustration to clarify its concepts. (5)
3. (i) What is the difference between CC and BCC? (1)
(ii) As a student at IIITV, write an email to your HS101 professor, to request an extension on an upcoming project due to unforeseen circumstances. (4)
4. The phrase "Carpe Diem" or "Seize the Day" is a central theme in *Dead Poets Society*. How does this concept influence the choices and lives of the students? (5)
5. Name three nasal, two bilabial plosives/stop, and two fricative alveolar consonant sounds. (5)
6. Provide the phonetic transcription of the following words: (5)
 1. parsley
 2. tea
 3. cook
 4. kiwi
 5. garlic
 6. mint
 7. bird
 8. baking
 9. flour
 10. thick
7. What is the primary focus of Julian Treasure's talk *How to Speak So People Would Listen*? (5)
8. Examine the role of uniforms in shaping perceptions and interactions within various social contexts. (5)
9. How do cultural variations in kinesics, involving body language, gestures, and facial expressions, differ worldwide, and can you provide examples of these variations? (5)
10. Draw and label the main organs involved in the production of speech sounds. (5)
11. Discuss three faulty listening habits that people may exhibit and explain how these habits can impact communication. (5)
12. *We are more connected than ever, but we are also more alone* - Sherry Turkle. Comment. (5)