

NATIONAL INSTITUTE OF TECHNOLOGY PATNA

DEPARTMENT OF MATHEMATICS

END-SEMESTER EXAMINATION : DECEMBER 2024

ENGINEERING MATHEMATICS - I

TIME: 3 HOURS

COURSE CODE: MA111101

MAXIMUM MARKS:  $6 \times 10 = 60$

Answer all questions

1. (a) Reduce the following matrix into normal form

$$A = \begin{pmatrix} 1 & 0 & 1 & 1 \\ 1 & 1 & -1 & 2 \\ 2 & 0 & 1 & 0 \\ 0 & -1 & 1 & 3 \end{pmatrix}.$$

Hence find its rank.

- (b) Determine whether the set

$$S = \{-1 - x + 2x^2, 2 + x - 2x^2, 1 - 2x + 4x^2\}$$

is a basis for  $P_2(R)$ .

[3+3=6 marks] [CO.1]

2. Determine the eigenvalues and eigenvectors of the matrix

$$A = \begin{pmatrix} 2 & 0 & 1 \\ 1 & 0 & 1 \\ 1 & -2 & 0 \end{pmatrix}$$

State Cayley-Hamilton's theorem. Verify Cayley-Hamilton theorem for the given matrix  $A$ . Hence deduce  $A^{-1}$ . [3+3=6 marks] [CO.1]

3. Check the convergence of the series

$$1 + \frac{2.x}{2!} + \frac{3^2.x^2}{3!} + \frac{4^3.x^3}{4!} + \dots \quad \text{for } x > 0.$$

[6 marks] [CO.2]

4. Show that the function

$$f(x, y) = \begin{cases} xy \frac{x^2 - y^2}{x^2 + y^2}, & \text{when } x^2 + y^2 \neq 0; \\ 0, & \text{when } x = 0, y = 0 \end{cases}$$

is continuous and possesses first partial derivatives at  $(0,0)$ . Test the differentiability of the function at  $(0,0)$ . [6 marks] [CO.2]

5. Let  $V$  is a function of  $x$  and  $y$ , and if,  $x = u \cos \alpha - v \sin \alpha$  and  $y = u \sin \alpha + v \cos \alpha$ , where  $\alpha$  is a constant, show that

$$\left(\frac{\partial V}{\partial x}\right)^2 + \left(\frac{\partial V}{\partial y}\right)^2 = \left(\frac{\partial V}{\partial u}\right)^2 + \left(\frac{\partial V}{\partial v}\right)^2.$$

[6 marks] [CO.2]

6. If  $V = \cos^{-1} \frac{x+y}{x^{1/2} + y^{1/2}}$ , then show that

$$x \frac{\partial V}{\partial x} + y \frac{\partial V}{\partial y} + \frac{1}{2} \cot V = 0.$$

[6 marks] [CO.2]

7. Find the extremum value of the function

$$f(x, y, z) = (x + y + z)^3 - 3(x + y + z) - 24xyz + a^3.$$

[6 marks] [CO.2]

8. Solve the differential equation

(a)  $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0.$

(b)  $\frac{dy}{dx} + \frac{y}{x} \log y = \frac{y}{x^2} (\log y)^2.$

[3+3=6 marks] [CO.3]

9. (a) Use the method of variation of parameter to solve the differential equation  $y'' + 4y = 4 \tan 2x$ .

(b) Solve the differential equation  $(D^2 - 2D + 3)y = \cos x + x^2$ .

[3+3=6 marks] [CO.3]

10. Solve the simultaneous differential equations

$$\begin{aligned}\frac{dx}{dt} + x &= y + e^t \\ \frac{dy}{dt} + y &= x + e^t.\end{aligned}$$

[6 marks] [CO.3]

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NATIONAL INSTITUTE OF TECHNOLOGY PATNA  
END SEMESTER EXAMINATION, JULY-DEC 2024

Program: B. Tech Semester: 1 Department: HSS  
Course Code: HS12101 (B) & HS111101, HS16101 (B), HS19101  
Branch: ME & MEA and EE & Chem Tech.  
Course Name: Communicative English  
Full Marks: 45 Duration of Examination: 3 Hours

**Section A**

Short Answer Questions. Each question carries one mark. 10M

1. Create a new word by combining the prefix "bio-" with a suitable root word and define its meaning.
2. Form a noun from the verb "to educate" and use it in a sentence.
3. Give the antonyms of the words: optimist, expand.
4. Give synonyms of the words: identical, creek.
5. Give two sentences using the homophones "bare" and "bear" correctly, highlighting their meanings.
6. Differentiate between "affect" and "effect" by giving their meaning and using each correctly in a sentence.
7. What is the one-word substitution for
  - a) a person who studies insects
  - b) a platform for speakers or conductors
8. Use the following phrasal verbs in a sentence:
  - a) Carry out
  - b) Put off
9. Give the meaning of the following idioms and use it in a sentence:
  - a) Through thick and thin
  - b) Bite the bullet
10. From the following list of names, identify which one is an eponym and briefly explain its significance:
  - a) Ohm
  - b) Einstein
  - c) Curie
  - d) Gravity

**Section B**

Answer the following Questions. Each question carries one mark.

7 M

1. Rewrite the following sentence to improve clarity:  
"The engineer who was late to the meeting because of traffic he missed the important discussion."
2. Which of the following sentences is grammatically correct?
  - a) The list of items are on the table.
  - b) The group of students were excited about the trip.
  - c) The team is winning the championship.
  - d) The data were analyzed carefully.
3. Convert the following active voice sentence to passive voice.  
"The technician repaired the machine."
4. Convert this direct speech into indirect speech:  
"She said, 'I will finish my project tomorrow.'
5. Identify and correct the punctuation error in this sentence:  
"My favorite subjects are mathematics physics and chemistry."
6. Identify the error in this sentence:  
"Each of the students have submitted their assignments on time."
7. Choose the correct modal verb to complete this sentence:  
"You \_\_\_\_\_ (must/can) submit your application by Friday if you want to be considered for the scholarship."

### Section C

8 M

Answer the following questions.

1. Differentiate between voiced and voiceless consonants by providing three examples for each category. (4 marks)
2. What is communication skill and why is it important for everyday life? Discuss the types. (4 marks)

### Section D

20 M

Long Answer Questions.

1. Explain Johari Window and its application within an organization. (10 marks)  
OR
2. Explain the Eisenhower Matrix Technique of Time Management. How can you utilize this technique in your everyday life? (10 marks)
3. Write a job application for a job posting you saw on LinkedIn regarding post of a Robotics Engineer at McKinsey. Follow the proper format. (10 marks)  
OR
4. What is a resume? Discuss all the important features of a resume. (10 marks)



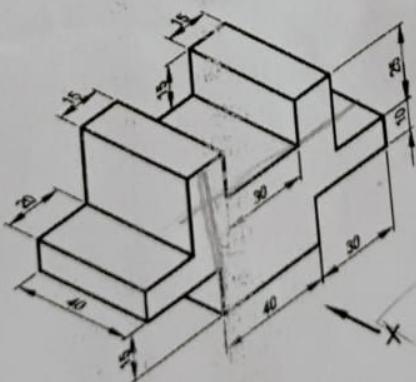
National Institute of Technology, Patna  
Department of Mechanical Engineering  
End Semester Examination (July-December 2024)

Stream: B.Tech.-ME (Section B) & B.Tech.-MAE  
Subject: Engineering Graphics  
Time: 3 Hours

Semester: 1st  
Subject codes: ME12101, ME111101  
Full Marks: 60

Instructions: Answer any four questions. All questions carry equal marks.

1. Draw an ellipse when the distance of its focus from its directrix is 50 mm and eccentricity is  $2/3$ .  
Also, draw a tangent and a normal to the ellipse at a point 70 mm away from the directrix. (15)
2. Draw a parabola given the width and height of its enclosing rectangle as 105 mm  $\times$  75 mm, respectively. (15)
3. Draw the projections of the following points on a common reference line keeping the distance between their projectors 30 mm apart.  
(a) Point A is 20 mm below the H.P. and 50 mm in front of the V.P.  
(b) Point B is in the H.P. and 40 mm behind the V.P.  
(c) Point C is 30 mm in front of the V.P. and in the H.P.  
(d) Point D is 50 mm above the H.P. and 30 mm behind the V.P.  
(e) Point E is 20 mm below the H.P. and 50 mm behind the V.P. (15)
4. A 75 mm long line PQ is inclined at  $30^\circ$  to the V.P. and parallel to the H.P. Draw its projections when whole line lies in the same angle and the end P is  
(a) 25 mm in front of the V.P. and 40 mm above the H.P.  
(b) 25 mm behind the V.P. and 40 mm above the H.P.  
(c) 25 mm behind the V.P. and 40 mm below the H.P. (15)
5. The top view of a plane whose surface is perpendicular to the V.P. and inclined at  $45^\circ$  to the H.P. is a circle of diameter 50 mm. Draw the projections of the plane and determine its true shape. (15)
6. Pictorial view of an object is shown in the figure below. Using first angle projection, draw its (a) front view from the X-direction, (b) top view and (c) left-hand side view. (15)



\*\*\*\*\* End of the question paper \*\*\*\*\*



**Department of Electronics and Communication Engineering, NIT Patna**  
**End-Term Semester Examination**  
**Electronics Workshop (EC15103/ EC111103)**  
**B.Tech. Semester –I**

**Max Marks: 60**

**Time: 3:00 Hrs.**

**Note: All questions carry equal marks. Any missing data may be assumed suitably.**

- 1 (a) What are the various electronic workshop tools? List out it. Briefly describe any five of them.  
 (b) Draw the symbolic representation of the photodiode, varactor diode, CRO and NPN transistors.
  
- 2 (a) In the following circuit Fig. 1, an input voltage  $V_i = 10\sin 100\pi t$  is applied. Assume that the diode drop is 0.7 V when it is forward biased. The Zener breakdown voltage is 6.8V. Calculate the maximum and minimum values of the output voltage respectively.  
 (b) Calculate the current passing through ideal diode ( $i$ ) in Fig. 2.

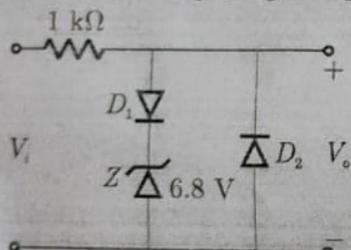


Fig. 1.

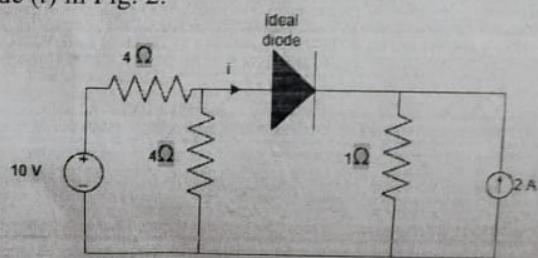


Fig. 2.

- 3 (a) Explain the working principle of soldering and desoldering with different components in details.  
 (b) Determine current flowing through diode  $D_2$  in the below Fig. 3. Assume the  $D_1$  is silicon diode and  $D_2$  is germanium diodes.

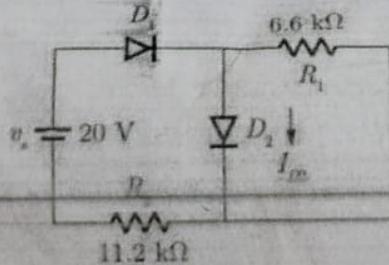


Fig. 3

What is an attenuator? Explain the T-type attenuator and derive each parameter of the attenuator. If the attenuation ( $A_{dB}$ ) of the attenuator and  $R_o$  (impedance) are 18 dB and  $600 \Omega$ , respectively, analyze the circuit. Based on this analysis, draw the T-type attenuator.

- 5 (a) If the current gain coefficient of common collector is 59, find out the value of the remaining two current gain.  
 (b) What is electromagnetic interference (EMI) in electronic systems, and also discuss types of Electromagnetic Interferences?
  
- 6 (a) Discuss the fixed voltage IC regulators with proper diagram.  
 (b) Explain in details of (i) constant current source IC regulators circuit (ii) variable output voltage IC regulator circuit.