

PH28101 KINETICS AND THERMODYNAMICS

Answer all questions

1. Explain the concept of thermodynamic limit. Define 'extensive variables' and 'intensive variables' with examples. [3]
2. Define 'mole'. What is the mass of 3 moles of  $\text{CO}_2$ ? [3]
3. Define heat and heat capacity. The heat capacity of 0.125 kg of water is measured to be  $523 \text{ JK}^{-1}$  at room temperature. Calculate the heat capacity of water (a) per unit mass (b) per unit volume. [3]
4. State the third law of thermodynamics. "Thermometers work!" Can this surmise the third law of thermodynamics? Justify. [3]
5. What do you mean by 'functions of state' and 'exact differentials'. Give suitable examples. Let a system be described by two parameters  $x$  and  $y$ . Let  $f = xy$ . Show whether the function is an exact differential. [3]
6. Show that  $C_p - C_v = \left[ \left( \frac{\partial U}{\partial V} \right)_T + p \right] \left( \frac{\partial V}{\partial T} \right)_p$  [3]
7. Calculate the heat change in a reversible isothermal expansion of an ideal gas. [3]
8. State and prove the Carnot's theorem. [3]
9. Calculate the rise in temperature when a gas for which  $\gamma = 1.5$  is adiabatically compressed to 8 times its original pressure assuming its initial temperature of be  $27^\circ\text{C}$ . [3]
10. A reversible engine converts  $1/6^{\text{th}}$  of the heat input into work. If the temperature of the sink is reduced by  $60^\circ\text{C}$ , its efficiency is doubled. Find the temperature of the source and sink. [3]





**राष्ट्रीय प्रौद्योगिकी संस्थान पटना / NATIONAL INSTITUTE OF TECHNOLOGY PATNA**  
**मध्य सेमेस्टर परीक्षा / MID SEMESTER EXAMINATION,**  
**जनवरी- जून २०२५ / JAN-JUNE 2025**

कार्यक्रम/ Program: यूजी & डीडी/UG & DD सेमेस्टर/Semester: २/२ विभाग/Department: एच.एस.एस/HSS  
 विषय क्रमांक/Course Code: एचएस २७१०१/ एचएस २८१०१/ एचएस २९१०१/ HS27101/HS28101/HS29101  
 शाखा/Branch: एम&सीटी/एपी&एमई/सीएस&टी/M&CT/ AP&ME/CS&T/  
 पाठ्यक्रम नाम/Course Name: विज्ञान, समाज और नैतिक मूल्य/ Science, Society and Ethical Value  
 पूर्ण अंक / Full Marks: ३० / 30 परीक्षा की अवधि/Duration of Examination: २ घंटा / 2 hours

**सभी का उत्तर दें / Answer ALL**

१. विज्ञान, समाज, नैतिकता और मूल्य के बीच संबंध स्थापित करें। किन्हीं तीन मूल्य सिद्धांतों पर चर्चा करें जो सार्वभौमिक रूप से स्वीकार्य हों। किन्हीं तीन मूल्य सिद्धांतों पर चर्चा करें जो सार्वभौमिक रूप से स्वीकार्य हों।

[०५]

Establish the relationship between Science, Society, Ethics and Value. Discuss any three value principles that are universally acceptable.

[05]

२. नीतिशास्त्र के विभिन्न सिद्धांतों की व्याख्या करें। उन विभिन्न पूर्व-अपेक्षित स्थितियों पर चर्चा करें जो आपको कोई भी नैतिक निर्णय लेने में मदद करती हैं।

[०५]

Explain the various theories of Ethics. Discuss the various pre-requisite conditions that help you to take any ethical decision.

[05]

३. कथन को ध्यान से पढ़ें और अपने उत्तर के लिए ईवीएम सिद्धांतों को लागू करके निम्नलिखित प्रश्नों के उत्तर दें:

रामकृष्ण एक इंजीनियर हैं। स्नातक स्तर की पढ़ाई के तुरंत बाद, उन्होंने एक अच्छी नौकरी पाने के लिए संघर्ष किया। लगभग तीन साल तक अस्थायी नौकरी करने के बाद, उन्हें एक कंपनी में नौकरी मिल गई जो उन्हें अच्छा वेतन देने पर सहमत हुई। वह नौकरी पाने, कंपनी में शामिल होने और काम करना शुरू करने से बहुत खुश था। वह ईमानदार था और जल्द ही उसने अपने मालिकों की सराहना अर्जित कर ली। एक साल बाद उन्हें सैलरी में बड़ी बढ़ोतरी दी गई। जिस कंपनी में वह काम कर रहा था वह सिगरेट बनाने वाली मशीनें बनाने वाली एक विनिर्माण इकाई थी। कंपनी अच्छा प्रदर्शन कर रही थी क्योंकि सिगरेट की बहुत मांग थी। प्रारंभ में, रामकृष्ण अपनी नौकरी के निहितार्थ से अनजान थे। एक दिन, उन्होंने दुकानों और सड़क पर सिगरेट उत्पादक कंपनियों के विज्ञापन देखे, जिनमें यह उल्लेख किया गया था (अनिवार्य घोषणा के रूप में) कि सिगरेट पीना स्वास्थ्य के लिए हानिकारक है और इससे कैंसर हो सकता है। वह अपनी नौकरी के बारे में सोचने लगा। वह अपनी कंपनी को ऐसी मशीनें बनाने में मदद कर रहे थे जो सिगरेट का उत्पादन करती थीं, जिनका उपयोग करने पर लोगों के स्वास्थ्य में गिरावट होने की संभावना थी। वह उन लोगों के लिए जिम्मेदार महसूस करते थे जो धूम्रपान करते थे और कैंसर से मर गए थे। उसे लगा कि वह हत्यारा है या कम से कम उसका सहयोगी है। वह बहुत दुखी हो गया। उनके दोस्तों ने उन्हें सांत्वना देने की कोशिश की लेकिन उन्हें लोगों के बीमार पड़ने और अंततः मरने में अपनी भूमिका के बारे में चिंता होती रही।

- (क). रामकृष्ण की नैतिक और नैतिकता में कोई समानता/अंतर बताएं।

[२.५]

- (ख). रामकृष्ण के सामने मौजूद समस्या का संभावित समाधान खोजें।

[२.५]



Read the statement carefully and answer the following questions by applying EVM principles for your answer:

Ramakrishna is a engineer. Immediately after his graduation, he struggled to get a decent job. After doing temporary jobs for nearly three years, he got a job in a company that agreed to pay him a good salary. He was elated to have landed the job, joined the company, and started working. He was sincere worker and soon earned the appreciation of his bosses. He was given a big hike in salary after one year. The company he was working for was a manufacturing unit producing cigarette-making machines. The company was doing well as there was a great demand for cigarettes. Initially, Ramakrishna was unaware of the implications of his job. One day, he happened to see advertisement of cigarette producing companies on shops and on the road, where it was mentioned (as a mandatory declaration) that cigarette smoking is injurious to health and may cause cancer. He started thinking about his job. He was helping his company make machines that produced cigarettes that when used by people were likely to cause deterioration in their health. He felt responsible for the people who smoked and died of cancer. He felt that he was murderer or at least an accomplice to it. He became very unhappy. His friends tried to console him but he continued to worry about his role in causing people to fall ill and eventually die.

(a) Point out any similarity/contraction of morality and ethics of Ramakrishna. [2.5]

(b) Find out the possible solution for the existing problem faced by Ramakrishna. [2.5]

४. प्रोफेशन, प्रोफेशनल और प्रोफेशनलिज्म से आप क्या समझते हैं? कम से कम चार प्रमुख विशेषताओं पर चर्चा करें जो एक प्रोफेशनल को अवश्य प्रदर्शित करनी चाहिए। [०५]

Define Profession, Professional, and Professionalism. Discuss at least four key characteristics that a professional must exhibit. [05]

५. प्रोफेशनल की विशेषताओं की व्याख्या करें और उन्हें अनुभवहीन से अलग करें। [०५]

Explain the features of professionals and distinguish them from amateurs. [05]

६. चिकित्सा, कानून या इंजीनियरिंग जैसे कम से कम दो अलग-अलग क्षेत्रों से उपयुक्त उदाहरणों के साथ एक प्रोफेशनल की जिम्मेदारियों पर चर्चा करें। [०५]

Discuss the responsibilities of a professional with suitable examples from at least two different fields, such as medicine, law or engineering. [05]

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# NATIONAL INSTITUTE OF TECHNOLOGY PATNA

Department of Chemical Science & Technology  
MID SEMESTER EXAMINATION, MARCH 2025

B. Tech: Semester-II, MAE, APME & MCT  
Course Name: Engineering Chemistry; Course Code: CH211101, CH28101 & CH27101

Max. Marks: 30.....

Maximum Time: 2 hours

**Instruction:**

1. Attempt All questions.
2. Assume any suitable data, if necessary.

		Marks	CO	BL
1.	Write the different types of gaseous fuels and their properties and applications.	4	CO2	L4
a).				
b).	Calorific value is an important property of solid fuels. Explain. Calculate the HCV and LCV of a coal specimen from the following data per kg of coal: Carbon: <sup>208.2</sup> 70%, Hydrogen: <sup>3.4500</sup> 8%, Oxygen: 10%, Sulfur: 3%, and the remaining ash.	4	CO3	L5
c).	Correlate the working principle of solar cells as an alternative non-renewable energy.	2	CO3	L4
d).	Write the reactions involved in the combustion of fuels by radical mechanism pathways.	2	CO3	L5
e).	Distinguish between octane number and cetane number. What happens if I mix with 91 octane and 98 octane? What happens if petrol is put in a diesel car? Explain Briefly.	3	CO5	L5
2.	How can the transport no be determined by applying Kohlrausch's law? Explore the coulometer and explain its role in determining transport no.	4	CO3	L4
a).				
b).	The molar conductance at infinite dilution for sodium acetate and HCl at 30°C is $91.0 \times 10^{-4}$ and $426.16 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$ , respectively. Also $\text{H}^+$ ion in HCl, $t_+$ is 0.821, and for $\text{CH}_3\text{COO}^-$ ion in $\text{CH}_3\text{COONa}$ , $t_-$ is 0.556. Assuming $t_+ = t_-$ . Calculate the $\Lambda^\circ_m$ for $\text{CH}_3\text{COOH}$ .	3	CO3	L4
c).	Correlate the molar conductance <sup><math>\Lambda_m</math></sup> of dilution with (i) ionic mobility and (ii) ionic conductance. <sup><math>\mu_0</math></sup>	2	CO2	L4
d).	Deduce the asymmetric effect of Debye-Hückel's theory of strong electrolytes.	3	CO3	L5
e).	Write and explain calomel electrodes working principle and their properties.	3	CO3	L5





**National Institute of Technology, Patna**  
**Department of Electrical Engineering**  
**EE27101, EE28101, EE29101: Elements of Electrical Engineering**

Second Semester, MID Term Examination (Jan-June 2025)

Name and Roll Number:

Max mark: 30

All questions are compulsory

1. Determine the value of current  $I_2$  and voltage  $V_a$  for the circuit shown in Fig. 1 using superposition theorem. (06) (CO:1, BL:1&2)

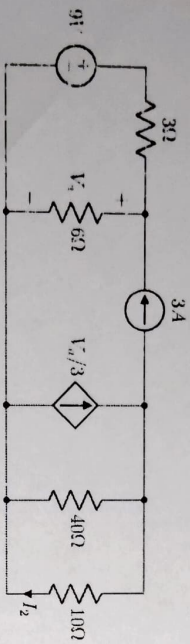


Figure 1: Circuit Diagram for Q. No. 1

2. Use the node-voltage method to determine the voltage  $V$  in the circuit of Fig. 2. (CO:3, BL:3) (06)

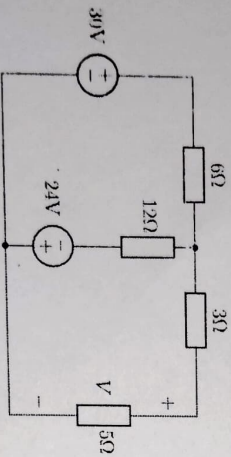


Figure 2: Circuit Diagram for Q. No.2

3. For the equivalent delta-star loads (shown in Fig. 3), develop the mathematical relations for  $R_A$ ,  $R_B$ , and  $R_C$  in terms of  $R_{AB}$ ,  $R_{BC}$ , and  $R_{CA}$ . (06) (CO:1, BL:1&2)

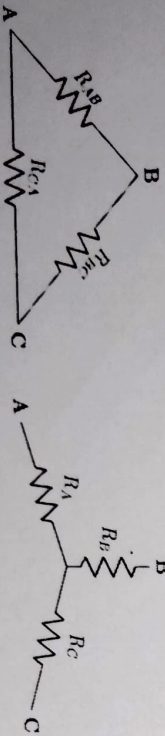


Figure 3: Delta-Star Circuits for Q.No.3

$$R_A = \frac{R_{AB} \cdot R_{AC}}{R_{AB} + R_{BC} + R_{CA}}$$

$$R_B = \frac{R_{AB} \cdot R_{BC}}{R_{AB} + R_{BC} + R_{CA}}$$

$$R_C = \frac{R_{BC} \cdot R_{CA}}{R_{AB} + R_{BC} + R_{CA}}$$

4. Determine the resonance frequency of the circuit given in Fig. 4. Draw the resonance phasor diagram, displaying all voltages and currents. What will be the circuit's equivalent resistance? (06) (CO:2, BL:3)

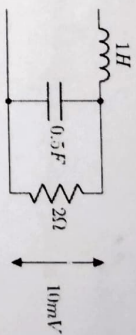


Figure 4: Circuit Diagram for Q.No. 4

5. Evaluate the value of currents  $I_1$ ,  $I_2$ ,  $V_{PQ}$ ,  $V_{AC}$  and  $V_{BD}$  for the circuit shown in Fig. 5. Find the active and reactive power delivered to the load. Also, draw the complete phasor diagram neatly by indicating various voltages, currents and their corresponding angles. (06) (CO:3, BL:3)

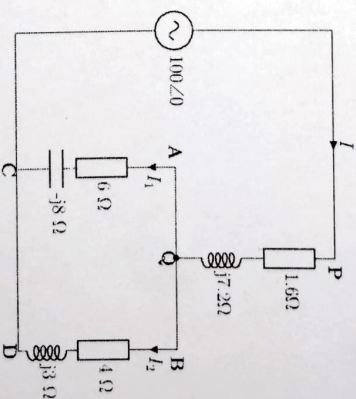


Figure 5: Circuit Diagram for Q. No.5

$$\frac{1}{10} + \frac{1}{5} = \frac{1}{50}$$

$$\frac{1}{50} = \frac{1}{50}$$

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{1 \cdot 0.5}} = \frac{1}{\sqrt{0.5}} = \sqrt{2}$$

$$X_L = \omega L = \sqrt{2} \cdot 1 = \sqrt{2} \Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{\sqrt{2} \cdot 0.5} = \sqrt{2} \Omega$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{2^2 + 0} = 2 \Omega$$

**National Institute of Technology Patna**  
**Department of Mathematics**  
**Mid Semester Examination : March 2025**

Course Name: **Engineering Mathematics – II**  
 Program: Applied Physics... & MAE (MA28101 & MA211101)  
 Duration: 2 Hrs

Course Code: MA28101/MA211101

Full Marks:  $5 \times 6 = 30$

Answer All The Questions

1. (a) Show that for the function  $f(z) = u + iv$  the C-R equation can be written as

$$\frac{1}{2} \left( \frac{\partial}{\partial x} + i \frac{\partial}{\partial y} \right) f = 0.$$

- (b) Find an analytic function  $f$  whose real part is

$$u(x, y) = \sinh x \sin y.$$

[CO.3]

2. (a) Find all the singularities and their types of the following functions.

$$(i) f(z) = \exp \left( \frac{1}{z-3} \right), \quad (ii) f(z) = \operatorname{cosec} \left( \frac{\pi}{z} \right)$$

- (b) Find the Laurent expansion of

$$f(z) = \frac{z^2 - z + 1}{z(z^2 - 3z + 2)}$$

in the region  $|z + 1| > 3$ .

[CO.3]

3. (a) Evaluate

$$\oint_C \frac{e^z}{z-2} dz$$

if  $C$  is (i) the circle  $|z| = 3$ , (ii) the circle  $|z| = 1$ .

- (b) Let  $a > e$ . Then using Rouché's theorem prove that the equation  $e^z = az^n$  has  $n$  roots inside the circle  $|z| = 1$ .

[CO.3]

4. (a) Discuss for what values of  $m$ , the improper integral  $\int_0^1 \frac{x^{m-1}}{1+x} dx$  converges and diverges.

(b) Evaluate  $\int_0^{\pi/2} \sqrt{\tan x} dx$ .

[CO.1]

5. (a) Prove that  $\int_0^1 \int_x^{1/x} \frac{y^2}{(x+y)^2 \sqrt{1+y^2}} dy dx = (2\sqrt{2} - 1)/2$ .

- (b) Evaluate the integral

$$\iiint x^\alpha y^\beta z^\gamma (1-x-y-z)^\lambda dx dy dz$$

over the tetrahedron formed by the coordinate planes and the plane  $x + y + z = 1$ .

[CO.1]