DEPARTMENT OF PHYSICS
NATIONAL INSTITUTE OF TECHNOLOGY PATNA

DD-MSE

Time 3 hrs

PH 28101 KINETICS AND THERMODYNAMICS

Answer all questions

1 (a) Explain the concept of thermodynamic limit. In this context, define extensive and intensive variables with suitable examples. [3]

(b) What do you mean by heat capacity of a material? Prove the following equation: [6]

$$C_P - C_V = \left[\left(\frac{\partial U}{\partial V}\right)_T + p\right]\left(\frac{\partial V}{\partial T}\right)_p$$

(c) Calculate the heat capacity of an ideal monoatomic gas and hence prove that [5]

$$C_p - C_V = R$$

2 (a) Calculate the change in heat (ΔQ) for an isothermal expansion of an ideal gas. [3]

(b) For an adiabatic expansion of an ideal gas, prove that $pV^{\gamma} = constant$ [3]

(c) 1 mole of a gas at 127 ^{0}C expands isothermally until its volume is doubled. Calculate the work done and the heat absorbed in the process. [4]

(d) In a Wilson cloud chamber, the volume of the gas is increased in the ratio 1.375:1. If the initial temperature of the gas is 20 ^{0}C, find the final temperature. γ = 1.40 [4]

3 (a) Give the Clausius and Kelvin statement of the second law of thermodynamics. [2]

(b) Describe the working of a typical Carnot's engine and prove that $\frac{Q_h}{Q_l} = \frac{T_h}{T_l}$ [3]

(c) A reversible engine converts 1/6th of the heat input into work. If the temperature of the sink is reduced by 60 ^{0}C, its efficiency is doubled. Find the temperature of the source and sink. [4]

(d) Two Carnot engines A and B are operated in series. A receives heat at 900 K and rejects at T K. B receives the heat rejected by A and in turn rejects heat at 400 K. Calculate the value of T when the work output of A and B are equal. [5]

4 (a) Define and explain the interpretation of entropy. Calculate the change in entropy in terms of gas constant, when 1 mole of a gas expands isothermally to 4 times its volume. [4]

(b) Write down the Nernst's, Planck's and Simon's statement of the third law of thermodynamics. [3]

(c) Explain briefly the consequences of the third law of thermodynamics [3]

(d) Write down the expressions for the four thermodynamic potentials. [4]

5 (a) Show that $U = -T^2\left(\frac{\partial}{\partial T}\right)_V \frac{F}{T}$ and $H = -T^2\left(\frac{\partial}{\partial T}\right)_p \frac{G}{T}$ [4]

(b) Write down the four Maxwell's equations. Using the Maxwell's equations, prove that $\left(\frac{\partial C_V}{\partial V}\right)_T = T\left(\frac{\partial^2 p}{\partial T^2}\right)_V$ [4]

(c) Derive the Clapeyron equation which applies to any first order change of phase at constant T and p. [3]

(d) Draw and explain the C_p versus T graphs for a first order, second order and lambda transition. Give suitable examples. [3]

*****8/05/2024*****

National Institute of Technology Patna

Department of Mathematics

End Semester Examination : May 2024

Timi

ame: **Engineering Mathematics – II** Course Code: MA28101

: B.Tech. Material Sc. and Engineering

a: 3 Hrs Full Marks: 60

Answer All The Questions

1. There are three coins, identical in appearances, one of which is unbiased and other two are biased with probabilities 1/3 and 2/3 respectively, for a head. One coin is taken at random and tossed twice. If a head appears both times, what is the probability that the unbiased coin was chosen? [6M]

2. A coin is tossed three times in a succession. Let X denote the number of heads. Find the distribution function of the random variable X. [6M] 6

3. For a monotone sequence of events $\{A_n\}_{n=1}^{\infty}$, prove that, $P(\lim_{n\to\infty} A_n) = \lim_{n\to\infty} P(A_n)$ [6M] +3

4. The random variable X is distributed uniformly over the interval (0, 2). Find the distribution function of the larger root of the quadratic equation $t^2 + 2t - X = 0$. [6M] 6

5. Prove that $I = \int\int_D \left(\frac{1-x^2-y^2}{1+x^2+y^2}\right)^{\frac{1}{2}} dxdy = \frac{\pi}{4}\left(\frac{\pi}{2} - 1\right)$, where D is the positive quadrant of the circle $x^2 + y^2 = 1$. [6M] +3

6. Evaluate $\int\int_D \sqrt{(x+y)}dxdy$ where D is the parallelogram bounded by the lines $x + y = 0$, $x + y = 1$, $2x - 3y = 0$ and $2x - 3y = 4$. [6M] 6

7. If r is the position vector of any point $P(x, y, z)$ prove that $\text{grad}r^n = nr^{n-2}r$. [6M] 6

8. If $grad\phi = (y + \sin z)i + xj + x\cos zk$ find ϕ. [6M] 6

9. If $I = \int_0^{\infty} \frac{x^{n-1}}{1+x}dx = \frac{\pi}{\sin n\pi}$ show that $\Gamma(n)\Gamma(1-n) = \frac{\pi}{\sin n\pi}$, where $o < n < 1$. [6M] +4

10. Evaluate $\int_0^{\infty} \frac{x^{m-1}+x^{n-1}}{(1+x)^{m+n}}dx$. [6M] 6

*****ALL THE BEST*****

National Institute of Technology Patna
Department of Electrical Engineering
Elements of Electrical Engineering (EE27101, EE28101, EE29101)
End Semester Exam, Date: 09 May 2024

Timing: 02:00 PM to 05:00 PM | Jan-June 2024 | Max mark: 60

1. A circuit consists of two coils in series connected to a 200 V a.c. supply. The first coil has a resistance of 5Ω and inductive reactance of 10Ω. The second coil has a resistance of 6Ω and inductive reactance of 8Ω. calculate
   (a) the total impedance of the circuit, the current, the circuit phase angle, the voltage drop in each coil (12)

2. Write down the frequency, the r.m.s. and peak values of a voltage wave expressed as $v = 14.1\sin 1000\pi t$. Write down the expressions for the current flowing when this voltage is applied across:
   (a) a 5Ω resistor, a 1 mH inductor of negligible resistance and a 150μF capacitor.
   Sketch the waveforms of these currents showing clearly,
   (b) the phase relationship of each current to the applied volatge, the peak value of each current. (13)

3. In the network shown in Figure 1 determine
   (a) the value of the load resistance to give maximum power transfer and
   (b) the power delivered to the load (10)

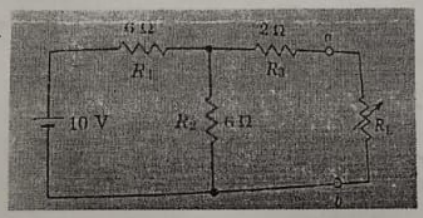

Figure 1: Electrical Network

4. Write short note on
   (a) PMMC
   (b) CT (10)

5. Do the following for DC Generator
   (a) Discuss basic structure of electric machines.
   (b) Describe in detail construction of DC Generator.
   (c) Discuss the types of DC machines based on the connection of the field winding with the armature. (15)

NATIONAL INSTITUTE OF TECHNOLOGY PATNA

End Semester Examination, Department of HSS

B.Tech.- M.Tech.-DD- MA- MCT / DD- PH- MSE/ DD-CH- CT

UG Dual Degree Sem. II, Session Jan- June 2023-2024

Science, Society and Ethical Values (HS27101/ HS28101/29101)

M.M. 60

- **Note:** Attempt all question in 250- 300 words each.
- Each question carries equal marks.

1. Discuss the relevance of **Science, Society and Ethical Values** for a student of Engineering as a subject.
2. Differentiate between influence and inspiration with example.
3. Explain the meaning of morality, ethics and value with example.
4. What are the basic attributes of profession? Differentiate profession with occupation.
5. Discuss the role of communication and skill in making our life professional and happy.

- नोट: सभी प्रश्न 250-300 शब्दों में लिखें। प्रत्येक प्रश्न के अंक समान हैं।

1. इंजीनियरिंग के एक छात्र के लिए एक विषय के रूप में **विज्ञान, समाज और नैतिक मूल्यों** की प्रासंगिकता पर चर्चा करें।
2. उदाहरण सहित प्रभाव और प्रेरणा में अंतर स्पष्ट करें।
3. नैतिकता, सदाचार एवं मूल्य का अर्थ उदाहरण सहित समझाइये।
4. पेशे के मूल गुण क्या हैं? पेशे को व्यवसाय से अलग करें।
5. हमारे जीवन को पेशेवर और खुशहाल बनाने में संचार और कौशल की भूमिका पर चर्चा करें।