(Pages : 6) **M – 2408**

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme under CBCSS

Mathematics

Complementary Course for Statistics

MM 1231.4 : MATHEMATICS II — ADVANCED DIFFERENTIAL AND INTEGRAL CALCULUS

(2020 Admission Regular)

Time : 3 Hours Max. Marks : 80

PART – A

Answer **all** questions. (Each question carries **1** mark)

1. Find f_{xy} if $f(x, y) = 2x^3y^2 + y^3$.

2. Find $\frac{\delta f}{\delta x}$ and $\frac{\delta f}{\delta y}$ if $f(x, y) = y(\exp(x+y))$.

3. Show that $xdy + 3ydx$ is inexact.

4. Write the Taylor expansion of a function $f(x, y)$ of two variables.

5. Evaluate $\int_0^1\int_0^1 x^2 y\,dy\,dx$.

P.T.O.

6. Evaluate $\int_0^1\int_0^2\int_0^1 dx\,dy\,dz$.

7. Evaluate $\frac{\Gamma(10)}{\Gamma(8)}$.

8. Write the integral expression for $\Gamma(p)$.

9. Evaluate the beta function $B(4, 1)$.

10. Express $\int_0^\infty \frac{x^3 dx}{(1+x)^5}$ as a beta function.

(10 × 1 = 10 Marks)

PART – B

Answer **any eight** questions. (Each question carries **2** marks)

11. Find the total derivative of $f(x, y) = x^2 + 3xy$ with respect to x, given that $y = \sin^{-1} x$.

12. Find the total differential of the function $f(x, y) = y\exp(x + y)$.

13. Write the chain rule for partial differentiation if $f(x, y)$ is a function in x, y and both x, y are functions of another variable u.

14. Find the rate of change of $f(x, y) = xe^{-y}$ with respect to u if $x(u) = 1 + au$ and $y(u) = bu^3$.

15. Define stationary point of two variable function. How to determine whether it is maximum or minimum?

16. Find the volume of the tetrahedron bounded by the three co-ordinate surface $x=0$, $y=0$ and $z=0$ and the plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.

17. Find the centre of mass of the solid hemisphere bounded by the surfaces $x^2+y^2+z^2=a^2$ and the xy-plane, assuming that it has a uniform density ρ.

18. State Pappu's second theorem.

19. A semicircular uniform lamina is freely suspended from one of its corners. Show that its straight edge makes an angle of 23° with the vertical.

20. Find the moment of inertia of a uniform rectangular lamina of mass m with sides a and b about one of the sides of length b.

21. A tetrahedron is bounded by the three coordinate surfaces and the plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$ and has density $\rho(x, y, z)=\rho_0\left(1+\frac{x}{a}\right)$. Find the average value of the density.

22. Define gamma function and show that $\Gamma(n+1)=n!$.

23. Evaluate $\Gamma\left(\frac{9}{4}\right)$.

24. Show that $x^2dy-(y^2+xy)dx$ is not exact.

25. Evaluate $B(6, 4)$.

26. Find $\int_0^\infty \frac{x^3dx}{(1+x)^5}$.

(8 × 2 = 16 Marks)

PART – C

Answer **any six** questions. (Each question carries **4** marks)

27. Derive the conditions for maxima, minima and saddle points for a function of two real variables.

28. Show that the function $f(x, y) = x^3 \exp(-x^2 - y^2)$ has a maximum at the point $\left(\sqrt{\frac{3}{2}}, 0\right)$ and minimum at $\left(-\sqrt{\frac{3}{2}}, 0\right)$.

29. The temperature of a point (x, y) on a unit circle is given by $T(x, y) = 1 + xy$. Find the temperature of the two hottest points on the circle.

30. Define beta function by a definite integral and show that $B(p, q) = B(q, p)$.

31. Find the volume of the region bounded by the paraboloid $z = x^2 + y^2$ and the plane $z = 2y$.

32. Find the mass of the tetrahedron bounded by the three coordinate surface and the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$, if its density is give by $\rho(x, y, z) = \rho_0\left(1 + \frac{z}{a}\right)$.

33. Explain the change of variable of variables in triple integrals.

34. Evaluate $\int \int_{x^2+y^2=a^2} (a + \sqrt{x^2 + y^2}\, dxdy)$.

35. Show that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$.

36. Evaluate $\frac{\Gamma\left(\frac{2}{3}\right)}{\Gamma\left(\frac{5}{3}\right)}$.

37. Express $\int_0^\infty x^5 e - x^{x^2} dx$ as a gamma function.

38. Show that $\Gamma(p+1) = p\Gamma(p)$

(6 × 4 = 24 Marks)

PART – D

Answer **any two** questions. (Each question carries **15** marks)

39. Transform the expression $\frac{\delta^2 f}{\delta x^2} + \frac{\delta^2 f}{\delta y^2}$ into one in ρ and ϕ. Where $x = \rho\cos\phi$ and $y = \rho\sin\phi$.

40. Find the stationary points of $f(x, y, z) = x^3 + y^3 + z^3$ subjected to the following constraints :

    (a) $g(x, y, z) = x^2 + y^2 + z^2 = 1$;

    (b) $g(x, y, z) = x^2 + y^2 + z^2 = 1$ and $h(x, y, z) = x + y + z = 0$.

41. Evaluate the integral $I = \int_{-\infty}^{\infty} e^{-x^2} dx$ in detail.

42. Find an expression for a volume element in spherical polar coordinates, and hence calculate the moment of inertia about a diameter of a uniform sphere of radius a and mass M.

43. (a) Prove that $B(p,q) = \dfrac{\Gamma(p)\Gamma(q)}{\Gamma(p+q)}$.

(b) Evaluate $\int_0^\infty \dfrac{y^2 dy}{(1+y)^6}$ using above expression.

44. Derive $B(p, q) = \int_0^\infty \dfrac{y^{p-1} dy}{(1+y)^{p+q}}$.

(2 × 15 = 30 Marks)

(Pages : 3) **M – 2403**

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme Under CBCSS

Statistics

Foundation Course – II

ST 1221 — STATISTICAL METHODS – II

(2018 – 2019 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions each carry **1** mark.

1. Define correlation.
2. What is meant by perfect correlation?
3. What are the demerits of scatter diagram?
4. What are the merits of Rank Correlation?
5. Define data mining.
6. Where will the regression line meet?
7. State two properties of Regression.
8. When the regressions lines are parallel?
9. What is the output of R command rep (1, 4)?
10. What do you mean by data warehousing?

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

Answer **any eight** questions. **Each** carries **2** marks.

11. What are the properties of regression coefficients?
12. What do you mean by coefficient of determination?
13. What do you mean by Link Analysis?
14. Describe R as a statistical software.
15. How to enter a data in R console?
16. How do you install R in your computer?
17. What do you mean by work space? Explain how to save the work space.
18. What is partial and multiple correlation?
19. What is a Decision tree?
20. How do you fit an exponential curve by the method of least squares?
21. What is predictive data mining?
22. What is Logistic Regression?

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six** questions each carries **4** marks.

23. Define Correlation ratio. When Correlation ratio a more suitable measure than the correlation coefficient?
24. Explain what are regression lines. Why are there two regression lines?
25. Derive the expression for the angle between two regression lines.
26. Explain some methods of data input in R.
27. Write the build in functions for :
    (a) Finding Mode
    (b) Sorting a raw data in ascending and descending order.
28. Write down important functions in excel.

29. Fit a curve of the form $Y = ab^X$

X	40	65	90	5	30	10	80	88	70	25
Y	30	20	10	80	40	65	15	15	20	50

30. Derive the expression for the rank correlation coefficient.

31. (a) Explain classification in data mining.

(b) Give the usage of time series in data mining.

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions each carries **15** marks.

32. Following data gives the marks in 2 subjects in an examination. Mean mark in A = 52, Mean mark in B = 48, Standard deviation of marks in A = 15, Standard deviation of marks in B = 13, Correlation coefficient between marks in A and marks in B is 0.6

(a) Draw the two lines of Regression

(b) Give the estimate of marks in B for candidate who secured 50 marks in A.

(c) How you identify the regression lines?

33. (a) Prove that the correlation coefficient lies between – 1 and +1

(b) Calculate the correlation coefficient for the following data

X	5	6	7	9	12	15	14	16
Y	10	15	16	20	22	25	24	26

34. (a) Explain the arguments of a plot( ) function.

(b) Explain how will you import data in R from excel?

(c) Write a short note on data accessing and indexing.

35. (a) What is artificial neural network?

(b) Explain different datamining tools.

(c) Discriminant analysis.

(2 × 15 = 30 Marks)

(Pages : 4) **M – 2409**

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme Under CBCSS

Physics

Complementary Course for Statistics

PY 1231.3 – THERMAL PHYSICS AND STATISTICAL MECHANICS

(2020 Admission Regular)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in a sentences or two, each carries **1** mark.

1. Define thermal conductivity.

2. Define Lorentz number.

3. Define adiabatic process.

4. What is adiabatic elasticity?

5. Define the Clausius statement of the second law of Thermodynamics.

6. What is the value of entropy in a reversible cycle?

7. What is latent heat?

8. What are bosons?

9. Write the Plank's quantization condition.

10. What is fermi energy?

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions in paragraph, each carries **2** marks.

11. Explain thermometric conductivity.

12. Explain Weidman-Franz law.

13. What is ultraviolet catastrophe?

14. Explain any one application of Wien's displacement law.

15. Explain an isothermal process.

16. Explain the efficiency of a heat engine.

17. What are the parts of a heat engine?

18. Explain the second law of thermodynamics.

19. What do you mean by the heat death of Universe?

20. Define a TS diagram.

21. Explain the change in entropy when ice is converted to steam.

22. Entropy of the universe is always increasing. Justify this statement.

23. What is phase-space?

24. Define ensemble.

25. Explain how Planck 'law corrected the Rayleigh-jeans theory of radiation.

26. What are the theories of specific head of solids?

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six** questions, each carries **4** marks.

27. Given that the thermal conductivity of the material of a slab is 10×10^{-2} Wm^{-1} K^{-1} Calculate the amount of heat flows through the slab per second when the difference in temperature between the slab is 10 K. Given that the thickness of the slab is 1 cm and its area of cross section is 2×10^{-2} m^2.

28. The surface temperature of the Sun is 6000 K. Calculate the maximum wavelength which can be emitted from the Sun. Given that Wein's constant is 0.292×10^{-2} metre K.

29. Calculate the energy radiated by a blackbody at 1200K. Given that the Stefan's constant is 5.67×10^{-8} W/m^2 K^4.

30. Prove that the work done in an adiabatic change is equal to its change in internal energy.

31. Calculate the decrease in efficiency of a Carnot's engine works between 1000K and 300K changes it working temperature to 600 K and 300 K.

32. Calculate the entropy change when 2 kg of water at 373 K is converted to water vapour at the same temperature. Given that the latent heat of vaporization of water is 2.26×10^6 JKg^{-1}.

33. Draw and explain the T-S diagram of a Carnot's cycle.

34. Calculate the energy of a radiation of wavelength 400 mm using Planck's distribution law.

35. Draw the black body spectrum and explain the energy density distribution as a function of temperature and frequency/wavelength,

36. Distinguish between *canonical*, *micro canonical and grand canonical* ensembles.

37. Calculate the velocity of a free electron at a temperature of 10 K. Given that the Boltzmann constant is 1.38×10^{-23} K^{-1}. Mass of the electron is 9.1×10^{-31} kg.

38. Derive the Einstein formula for the specific heat of solid.

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions, each carries **15** marks.

39. With the help of a neat diagram and necessary theory explain the method of determination of Heat conductivity of a bad conductor by Lees' disc.

40. Derive the equation for work done in an isothermal process.

41. Explain the processes involving in a Carnot' s cycle. Derive the efficiency of a Carnot's engine.

42. (a) Derive the equation for the change in entropy in a irreversible process.

    (b) Derive the expression for entropy in a reversible isothermal process,

43. Compare Maxwell-Boltzmann, Fermi Dirac and B.E. Distribution laws.

44. Explain the theory of a blackbody. Derive the Rayleigh–Jeans law and the correction of Rayleigh law by –Planck's distribution law.

(2 × 15 = 30 Marks)

(Pages : 3) **M – 2405**

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme Under CBCSS

Physics

Complementary Course for Statistics

PY 1231.3 : THERMAL PHYSICS AND STATISTICAL MECHANICS

(2018 and 2019 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A (very short answer type)

Answer **all** questions in **one** word or maximum of **two** sentences. **Each** question carries **1** mark.

1. Explain isothermal process.

2. State Dulong – petit law.

3. Write down the expression for work done by an ideal gas in an isothermal process.

4. Explain thermometric conductivity.

5. Write down the expression for adiabatic elasticity.

6. State Clausius statement of the second law of thermodynamics.

7. Write the expression for Planck's radiation formula.

8. Is a proton a Fermion?

9. Define efficiency of an engine.

10. What is Pauli's exclusion principle?

(10 × 1 = 10 Marks)

SECTION – B (Short Answer)

Answer any **eight** questions in about one paragraph. **Each** question carries **2** marks.

11. Explain Fermi energy.

12. Describe the Rayleigh-Jeans formula.

13. Describe the TS diagram for Carnot cycle.

14. Explain the concept of ensemble.

15. Describe Stefan's law.

16. Discuss the change in entropy during an irreversible process.

17. What is the connection between entropy and disorder?

18. Compare average velocity, root mean square velocity and most probable velocity.

19. Derive the relation $Cp - Cv = nR$.

20. Explain the specific heat of electrons in metals.

21. Explain Carnot's theorem.

22. Distinguish between reversible and irreversible processes.

(8 × 2 = 16 Marks)

SECTION – C (Short Essay)

Answer any **six** questions. **Each** carries **4** marks.

23. It is claimed that a particular, engine absorbs 200 Joules of heat at 500 K, does 100 Joules of work and rejects 75 Joules of heat into a sink at 212 K. It is possible.

24. Find the change in entropy when three moles of a gas expands isothermally to thrice its initial volume.

25. A gas within a cyclinder with a pressure of 3 atoms at room temperature of 27°C suddenly bursts. Find its resulting temperature. Take $\gamma = 1.4$.

26. State and explain Wiedmann-Franz Law. Also define thermal conductivity.

27. Obtain Stefan-Boltzmann law from Planck's radiation formula.

28. Describe Wein's displacement law.

29. Explain the carnot cycle with suitable diagram.

30. Explain the change in entropy when ice is converted into steam.

31. Describe how the Rayleigh-Jeans law fails to explain the black body spectrum.

(6 × 4 = 24 Marks)

SECTION – D (Long Essay)

Answer any **two** questions. **Each** carries **15** marks.

32. Derive the expression for adiabatic process of an ideal gas. What is the work done by an ideal gas in an adiabatic process?

33. Explain Einstein's theory of specific heat of solids.

34. Describe the working of a Carnot engine and derive the expression for its efficiency.

35. Use Fermi-Dirac statistics to explain the specific heat of electrons in a metal.

(2 × 15 = 30 Marks)

(Pages : 4) **M – 2404**

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme Under CBCSS

Mathematics

Complementary Course for Statistics

MM 1231.4 — MATHEMATICS – II – ADVANCED DIFFERENTIAL AND INTEGRAL CALCULUS

(2018 – 2019 Admission)

Time : 3 Hours Max. Marks : 80

PART – A

Answer **all** questions. Each question carries 1 mark.

1. Check whether the differential $x^2dy + 2xy\,dx$ is exact.

2. Give the Maclurian's series expansion of a function $f(x, y)$ of two variables x and y about the origin.

3. Write condition for which a point (x_1, n_1) to be a critical point of the function $f(x, y)$.

4. Find the value of the double integral $\int_{-1}^{1}\int_{0}^{2} x^3 dy\ dx$.

5. Find the Jacobian of the transformation $x = r\cos\theta$, $y = r\sin\theta$ with respect to r and θ.

6. Find the value of the tripple integral $\int_{0}^{2}\int_{-1}^{1}\int_{0}^{3} x\,y^2 z dx\,dy\,dz$.

7. The value of $\Gamma(3)$ is.

8. The value of $\beta(m,n)\Gamma(m+n)-\Gamma(m)\Gamma(n)$ is.

9. Write the value of $\Gamma\left(\frac{1}{2}\right)$.

10. Write the value of the factorial $n!$ as an integral.

PART – B

Answer **any eight** questions. Each question carries **2** marks.

11. If $f(t)=t$ and $y(t)=1+t$. Find the rate of change of $f(x,y)=xy$ with respect to 't'.

12. Find the total derivative of $f(x,y)=x^3+xy$ with respect to x, given that $y=\sin x$.

13. Check whether the expression $yz\,dx+xz\,dy+xy\,dz$ is exact.

14. Find the extremum value of the function $f(x,y)=x^3y^2(1-x-y)$ for $x\neq 0,\ y\neq 0$.

15. The temperature T at any point (x,y,z) in space is $T=400\,xyz^2$. Find the highest temperature on the surface of the unit sphere $x^2+y^2+z^2=1$.

16. Find the moment of inertia of a uniform triangular lamina of mass M with sides a and b *about one of the sides of length a.*

17. If R is the region bounded by the circle $x^2+y^2=1$ in the first quadrant evaluate $\iint_R \frac{xy}{\sqrt{1-y^2}}\,dy\,dx$.

18. Find the Jacobian of U and V with respect to x and y if $u=x^3y$ and $v=e^x$.

19. Prove that the Beta integral is symmetric in its variables.

20. Prove that $\int_0^{\frac{\pi}{2}} \sin^p\theta\cos^q\theta\,d\theta=\frac{1}{2}\beta\left(\frac{p+1}{2},\frac{q+1}{2}\right)$.

21. Prove that the value of $\beta\left(3,\frac{1}{2}\right)$ is $\frac{16}{15}$.

22. Prove that if n is a positive integer $\Gamma\left(n+\frac{1}{2}\right)=\frac{1.3.5....(2n-1)}{2^n}\sqrt{n}$.

PART – C

Answer **any six** questions. Each questions carries **4** marks.

23. Verify $\frac{\partial^2 f}{\partial x\, dy} = \frac{\partial^2 f}{\partial y\, \partial x}$ for the functions $f(x,y) = 2x^3y^2 + y$.

24. If $xyz = 8$ find (x, y, z) at which the function $f = \frac{5xyz}{x+2y+4z}$ is a maximum.

25. Find the Taylor expansion upto the quadratic term in $(x-2)$ and $(y-3)$ for the function $f(x,y) = ye^x$.

26. Find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

27. Evaluate $\iiint_R xy\, dx\, dy\, dz$ where R is the positive octant of the sphere $x^2 + y^2 + z^2 = a^2$.

28. If R is the region bounded by the planes $x = 0$, $z = 0, z = 0$ and the cylinder $x^2 + y^2 = 1$, evaluate the $\iiint_R xyz\, dx\, dy\, dz$ by changing it to cylindrical coordinates.

29. Prove that $\frac{\beta(m+1,n)}{m} = \frac{\beta(m,n+1)}{n} = \frac{\beta(m,n)}{m+n}$.

30. Show that $\Gamma(n)\Gamma(1-n) = \beta(n,(1-n)) = \int_0^1 \frac{x^n - 1}{1+x} dx$ where $0 < x < 1$.

31. Prove that $\Gamma(n)\Gamma\left(n + \frac{1}{2}\right) = \frac{\sqrt{\pi}}{2^{2n-1}}\Gamma(2n)$ for $n > 0$.

PART – D

Answer **any two** questions. Each questions carries **15** marks.

32. If $x = e^u \cos\theta$, $y = e^u \sin\theta$ show that $\frac{\partial^2 \phi}{\partial u^2} + \frac{\partial^2 \phi}{\partial \theta^2} = \left(x^2 + y^2\right)\left(\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}\right)$ where $f(x,y) = \phi(u,\theta)$.

33. (a) Evaluate $\iint_R (x+y)^2 dx\, dy$ where R is the region bounded by the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.

(b) Evaluate $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y} dy\, dx$ by changing the order of integration.

34. (a) Using tripple integrals find the volume of the tetrahedron bounded by the planes $x=0, y=0, z=0$ and $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.

(b) Find the volume of the sphere $x^2+y^2+z^2=a^2$ using integrals.

35. (a) Prove that $ya \neq b$, $\beta(m,n)=\frac{1}{(b-a)^{m+n-1}}\int_a^b (x-a)^{m-1}(b-x)^{n-1}dx$.

(b) Prove that $\Gamma(n)\Gamma\left(n+\frac{1}{2}\right)=\frac{\sqrt{\pi}}{2^{2n-1}}\Gamma(2n)$.

(Pages : 6) **M – 2407**

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme under CBCSS

Statistics

Foundation Course

ST 1221 – STATISTICAL METHODS II

(2020 Admission Regular)

Time : 3 Hours Max. Marks : 80

Use of calculator is permitted

SECTION – A

(Very short answer)

Answer **all** questions. Each question carries **1** mark.

1. Square of correlation coefficient is known as ————.

2. If the variables X and Y are independent what is the value of regression coefficient?

3. What is the effect of change of origin and scale on regression coefficient?

4. The value of correlation ratio varies from ————.

5. If A and B are two attributes with (AB) =300 and expectation of (AB) = 250, state the nature of association between A and B.

6. Name the function used to group a column in excel.

7. Define data warehouse.

8. Who introduced the term OLAP?

9. What is meant by logistic regression?

10. What is assign function in *R*?

(10 × 1 = 10 Marks)

SECTION – B

(Short answer)

Answer **any eight** questions. Each question carries **2** marks.

11. Define Karl Pearson correlation coefficient.

12. Define partial correlation with an example.

13. Comment on the following :

    For a bivariate distribution, the regression coefficient of Y on X is 4.2 and regression coefficient of X on Y is 0.5

14. Write down the normal equations (adopting principle of least squares) for second degree parabola fitting.

15. Point out the uses of probable error of correlation coefficient.

16. Why there are two regression lines in a bivariate distribution?

17. Write down the formula for multiple correlation coefficient in terms of total correlations.

18. If Karl Pearson correlation coefficient is 0.6 for 64 pairs of observations, find the probable error of correlation coefficient.

19. What is the limitation of data analysis in excel?

20. Write down the plot functions to create bar chart and pie chart in R.

21. How to fit a straight line in R?

22. What is classification in data mining?

23. How can you compare neural network and decision tree?

24. Mention the usage of time series in data mining.

25. What is discriminant analysis in data mining?

26. How to create histogram in R?

(8 × 2 = 16 Marks)

SECTION – C

(Short essay questions)

Answer **any six** questions. Each question carries **4** marks.

27. Show that correlation coefficient is independent of change of origin and scale.

28. What are regression coefficients? Show that coefficient of correlation is the geometric mean between regression coefficients.

29. Describe the scatter diagram method of studying correlation.

30. Comment on the following :

    (a) If the correlation coefficient is 0.8, it implies that 80% of the data are explained

    (b) Probable error of correlation coefficient may be used to determine the limits for population correlation coefficient.

31. In a bivariate distribution, the following values are obtained:

$$\sum X = 30,\ \sum Y = 40,\ \sum XY = 214,\ n = 5,\ \sum X^2 = 220,\ \sum Y^2 = 340.$$

Obtain the regression line of Y on X.

32. Explain the method of fitting of an exponential curve $y = ab^x$ by principle of least squares.

33. The lines of regression of a bivariate distribution are :

$8X - 10Y + 66 = 0$

$40X - 18Y - 214 = 0$

The standard deviation of X is 3. Find the mean values of X and Y. What is the coefficient of correlation between X and Y?

34. How to calculate quartile deviation, mean deviation and variance using R software?

35. Describe the role of link analysis in data mining technique.

36. Write down the R commands to fit lines of regression and to compute regression coefficients.

37. What is clustering? What are the different clustering techniques?

38. Explain briefly different stages of data mining.

(6 × 4 = 24 Marks)

SECTION – D

(Essay questions)

Answer **any two** questions. Each question carries **15** marks.

39. (a) Define rank correlation. State and establish Spearman's rank correlation coefficient.

(b) Calculate Spearman's rank correlation for the following data :

X	115	22	148	251	83	47	325	92	70	164
Y	84	385	200	110	292	152	86	120	301	144

(8 + 7 = 15)

40. (a) Explain different types of correlation with examples. How do you interpret a calculated value of correlation coefficient?

(b) Explain the concept of regression and point out its uses.

(c) Prove that regression line of Y on X intersect at $(\overline{X}, \overline{Y})$ **(6 + 4 + 5 = 15)**

41. (a) What is meant by association of attributes? Define Yule's coefficient of association.

(b) The residents of a village, who were interviewed during a sample survey are classified below according to their smoking and tea drinking habits. Calculate Yule's coefficient of association and comment on its value.

	Smokers	Non-smokers
Tea drinkers	40	33
Non-tea drinkers	3	12

(c) With the usual notations if $r_{12} = 0.59$, $r_{23} = 0.77$, and $r_{13} = 0.46$ find $R_{1.23}$ and $r_{12.3}$. **(4 + 5 + 6 = 15)**

42. (a) How is data mining different from knowledge discovery in data base?

(b) Distinguish between sequence mining and spatial mining.

(c) Describe the role of data mining in data ware house.

(d) Define predictive data mining. How can regression be used as a data mining tool? **(3 + 3 + 4 + 5 = 15)**

43. (a) Describe the essential features of decision trees. How is it useful to classify data?

(b) What is nearest neighbor rule? What are the characteristics of K nearest neighbor algorithm?

(c) What is logistic regression in data mining? Why do we use logistic regression for classification?

(6 + 5 + 4 = 15)

44. (a) Describe the commonly used methods of data input in *R*.

(b) Explain the computations of mean, median for a frequency distribution using *R* software.

(10 + 5 = 15)

(2 × 15 = 30 Marks)

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(Pages : 3) **M – 2405**

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme Under CBCSS

Physics

Complementary Course for Statistics

PY 1231.3 : THERMAL PHYSICS AND STATISTICAL MECHANICS

(2018 and 2019 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A (very short answer type)

Answer **all** questions in **one** word or maximum of **two** sentences. **Each** question carries **1** mark.

1. Explain isothermal process.
2. State Dulong – petit law.
3. Write down the expression for work done by an ideal gas in an isothermal process.
4. Explain thermometric conductivity.
5. Write down the expression for adiabatic elasticity.
6. State Clausius statement of the second law of thermodynamics.
7. Write the expression for Planck's radiation formula.

P.T.O.

8. Is a proton a Fermion?

9. Define efficiency of an engine.

10. What is Pauli's exclusion principle?

(10 × 1 = 10 Marks)

SECTION – B (Short Answer)

Answer any **eight** questions in about one paragraph. **Each** question carries **2** marks.

11. Explain Fermi energy.

12. Describe the Rayleigh-Jeans formula.

13. Describe the TS diagram for Carnot cycle.

14. Explain the concept of ensemble.

15. Describe Stefan's law.

16. Discuss the change in entropy during an irreversible process.

17. What is the connection between entropy and disorder?

18. Compare average velocity, root mean square velocity and most probable velocity.

19. Derive the relation $C_p - C_v = nR$.

20. Explain the specific heat of electrons in metals.

21. Explain Carnot's theorem.

22. Distinguish between reversible and irreversible processes.

(8 × 2 = 16 Marks)

SECTION – C (Short Essay)

Answer any **six** questions. **Each** carries **4** marks.

23. It is claimed that a particular, engine absorbs 200 Joules of heat at 500 K, does 100 Joules of work and rejects 75 Joules of heat into a sink at 212 K. It is possible.

24. Find the change in entropy when three moles of a gas expands isothermally to thrice its initial volume.

25. A gas within a cyclinder with a pressure of 3 atoms at room temperature of 27°C suddenly bursts. Find its resulting temperature. Take $\gamma = 1.4$.

26. State and explain Wiedmann-Franz Law. Also define thermal conductivity.

27. Obtain Stefan-Boltzmann law from Planck's radiation formula.

28. Describe Wein's displacement law.

29. Explain the carnot cycle with suitable diagram.

30. Explain the change in entropy when ice is converted into steam.

31. Describe how the Rayleigh-Jeans law fails to explain the black body spectrum.

(6 × 4 = 24 Marks)

SECTION – D (Long Essay)

Answer any **two** questions. **Each** carries **15** marks.

32. Derive the expression for adiabatic process of an ideal gas. What is the work done by an ideal gas in an adiabatic process?

33. Explain Einstein's theory of specific heat of solids.

34. Describe the working of a Carnot engine and derive the expression for its efficiency.

35. Use Fermi-Dirac statistics to explain the specific heat of electrons in a metal.

(2 × 15 = 30 Marks)