

Q.5(a) If $\theta = t^n e^{-\frac{r^2}{4t}}$, find the value of 'n' which will make $\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial \theta}{\partial r} \right) = \frac{\partial \theta}{\partial t}$. (7)

(b) Using Lagrange's method of multiplier, find the dimension of the rectangular box, open at the top, of maximum capacity whose surface is 432 sq. cm. (8)

Q.6(a) Check the consistency of the system of equations:

$$x + y + z = 3, x + 2y + 3z = 4, x + 4y + 9z = 6 \text{ and find the values of } x, y, z. \quad (7)$$

(b) Show that the matrix, $A = \begin{bmatrix} 3 & 1 & -1 \\ -2 & 1 & 2 \\ 0 & 1 & 2 \end{bmatrix}$ is diagonalizable. Hence find P such that $P^{-1}AP$ is a diagonal matrix. (8)

Q.7(a) Find the half range cosine series for the function $f(x) = (x-1)^2$ in the interval $0 < x < 1$. (7)

(b) Verify Cayley-Hamilton theorem for the given matrix, $A = \begin{bmatrix} 2 & 6 & 1 \\ 0 & 1 & -6 \\ 3 & 4 & -2 \end{bmatrix}$, also find A^{-1} for the same. (8)

Sr. No- 015101

December 2023

B.Tech(ENC/ECE/EEIOT) 1st SEMESTER

Mathematics-I(Calculus and Linear Algebra)(BSC-103D)

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.

PART-A

- Q.1(a) Find the radius of curvature of the given curve $y = 4\sin x - \sin 2x$ at $x = \pi/2$.
- (b) Examine the convergence of the improper integral: $\int_1^{\infty} \frac{dx}{\sqrt{x}}$.
- (c) Define Maclaurin's theorem with Lagrange's form of remainder.
- (d) State Lagrange's and Cauchy's mean value theorem.
- (e) Expand $\log \sin x$ in power of x using Taylor's series up to three terms.
- (f) State Cauchy's root test to check the convergence of the infinite series.
- (g) Prove that $\lim_{(x,y) \rightarrow (0,0)} \frac{x^2 y}{x^4 + y^2}$ does not exist.
- (h) A vector field is given by $\vec{A} = (x^2 + xy^2)\hat{i} + (y^2 + x^2y)\hat{j}$. Show that the field is irrotational.
- (i) Using Rank-Nullity theorem, find the nullity of the given matrix, $A = \begin{bmatrix} 1 & -2 & 0 & 4 \\ 3 & 1 & 1 & 0 \\ -1 & -5 & -1 & 8 \end{bmatrix}$
- (j) Prove that the given matrix $\frac{1}{3} \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ is orthogonal. (1.5*10 = 15)

PART-B

- Q.2(a) Find the coordinates of the centre of curvature for any point (x,y) on the parabola $y^2 = 4ax$. Also find the equation of the evolute of the parabola. (7)
- (b) Find the surface area of the solid generated by the revolution of the ellipse $x^2 + 4y^2 = 16$ about the major axis. (4)
- (c) Using Beta -Gamma function, evaluate $\int_0^{\infty} x^6 e^{-2x} dx$. (4)
- Q3(a) Using L'Hospital rule, evaluate $\lim_{x \rightarrow 0} \frac{e^x \sin x - x - x^2}{x^3}$. (7)
- (b) Examine the applicability of the Rolle's theorem for the given function: (4)
- $f(x) = \log(x^2 + 2) - \log 3$ in $[-1, 1]$.
- (c) Find the maximum and minimum value of the given function: (4)
- $f(x) = x^5 - 5x^4 + 5x^3 + 10, x \in R$
- Q.4(a) Discuss the convergence of the given infinite series: (7)
- $\frac{1^2}{2^2} + \frac{1^2 \cdot 3^2}{2^2 \cdot 4^2} + \frac{1^2 \cdot 3^2 \cdot 5^2}{2^2 \cdot 4^2 \cdot 6^2} + \dots$
- (b) Find the power series solution of the given differential equation (8)
- $(1 + x^2) \frac{d^2 y}{dx^2} + x \frac{dy}{dx} - y = 0$ about the point $x = 0$.

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Q4 (a) Find the values of a and b such that (8)

$$\lim_{x \rightarrow 0} \frac{x(1-a \cos x) + b \sin x}{x^3} = \frac{1}{3}$$

(b) Use mean value theorem to prove that (7)

$$\frac{x}{\sqrt{1-x^2}} \geq \sin^{-1} x \geq 0 \text{ if } 0 \leq x < 1$$

When does the equality hold?

Q5 (a) A rectangular box open at the top, is to have a volume of 32 c.c. (8)

Find the dimensions of the box requiring least material for its construction.

(b) Find out the directional derivative of the function (7)

$f(x, y, z) = xy^2 + yz^3$ at the point (2, -1, 1) in the direction of the vector $\hat{i} + 2\hat{j} + 2\hat{k}$

Q6 (a) Evaluate $\int_0^a \int_{x^2/a}^{2a-x} xy \, dy \, dx$ (8)

by changing the order of integration.

(b) Find the volume of solid bounded by the surface (7)

$$(x/a)^{2/3} + (y/b)^{2/3} + (z/c)^{2/3} = 1$$

Q7 (a) Using Gauss Jordan method find out the solution of (8)

$$3x + 3y + 2z = 1,$$

$$x + 2y = 4,$$

$$10y + 3z = -2,$$

$$2x - 3y - z = 5$$

(b) Find out the inverse of the matrix by elementary row operations (7)

$$\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$$

December 2023

B. Tech(CIVIL/ENV/FAE)- 1st SEMESTER

Mathematics-I (Calculus, Multivariable Calculus and Linear Algebra) (BSC-103B)

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.

PART -A

- Q1 (a) Define Gamma function and write down the value of $\Gamma\left(\frac{1}{2}\right)$ (1.5)
- (b) Evaluate $\lim_{x \rightarrow 0} \left(\frac{1}{x} - \frac{1}{\sin x}\right)$ (1.5)
- (c) Explain the physical significance of divergence. (1.5)
- (d) Write down the Dirichlet's conditions for the convergence of Fourier series. (1.5)
- (e) Check the convergence of the sequence $\left\{\frac{1}{n}\right\}$ and the series $\sum \frac{1}{n}$ (1.5)
- (f) Expand $\sin x$ in powers of x (1.5)
- (g) Define Critical point and the Saddle point. (1.5)
- (h) Show that $\text{grad } r = \frac{\vec{r}}{r}$ (1.5)
- (i) Explain Taylor theorem with Cauchy's form of remainder. (1.5)
- (j) Define Rank of the matrix with appropriate example. (1.5)

PART -B

- Q2 (a) Find the coordinates of the centre of curvature for any point (x, y) on the parabola $y^2 = 4ax$. Also find the equation of the evolutes of the parabola. (8)
- (b) Evaluate $\int_0^{\pi/2} \sqrt{\sin x} dx$ X $\int_0^{\pi/2} \frac{dx}{\sqrt{\sin x}}$ (7)
- Q3 (a) Discuss the convergence of $\frac{x}{1.2} + \frac{x^2}{3.4} + \frac{x^3}{5.6} + \frac{x^4}{7.8} + \dots$ (8)
- (b) Expand $\pi x - x^2$ in a half range sine series in the interval $(0, \pi)$ (7)

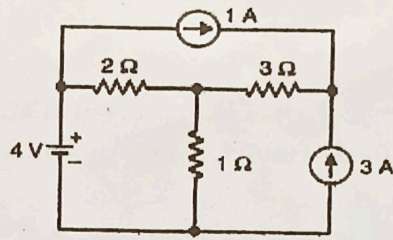


Figure (1)

- Q5 (a) What is series resonance? Derive the expression for resonant frequency in R-L-C series circuit. (7.5)
- (b) Explain working of auto transformer. What are the advantages of auto transformer over two winding transformers? (7.5)
- Q6 (a) A 3-phase, 400 V, 50 Hz a.c. supply is feeding a 3-phase delta-connected load with each phase having a resistance of 25Ω , an inductance of 0.15 H and a capacitor of $120 \mu\text{F}$ in series. Find line current, volt-amp, active power and reactive volt-amp. (7.5)
- (b) Explain the principle of operation and constructional features of synchronous generator. (7.5)
- Q7 (a) A resistance of 20Ω and a coil of inductance 31.8 mH and negligible resistance are connected in parallel across 230 V, 50 Hz supply. Find (i) the line current (ii) power factor and power consumed by the circuit (7.5)
- (b) Write the name of starting method of Induction motor and explain any one with suitable circuit diagram (7.5)

December 2023

B.Tech (AE/FAE) - I SEMESTER

Basic Electrical Engineering (EE-101C)

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.
 4. Any other specific instructions

PART -A

- Q1 (a) Define dependent voltage source and draw the voltage dependent voltage source. (1.5)
- (b) Discuss the Lenz's law. (1.5)
- (c) Define coefficient of coupling in a magnetic circuit. (1.5)
- (d) State the application of superposition theorem. (1.5)
- (e) Describe the Millman's theorems. (1.5)
- (f) Define the term bandwidth and selectivity. (1.5)
- (g) Differentiate between balanced and unbalanced load (1.5)
- (h) Write the application of DC motor. (1.5)
- (i) Define the efficiency. (1.5)
- (j) Write the relation between line current and phase current in delta connected load. (1.5)

PART -B

- Q2 (a) State the faraday law of electromagnetic induction and explain the statically and dynamically induced emf with suitable example. (7.5)
- (b) State and explain the Maximum power transfer theorem. (7.5)
- Q3 (a) Explain the Kirchoff s voltage and current law with some suitable example. (7.5)
- (b) State and explain the reciprocity theorem with suitable example. (7.5)
- Q4 (a) A resistance R is connected in series with a parallel circuit comprising two resistances of $12\ \Omega$ and $8\ \Omega$ respectively. The total power dissipated in the circuit is 70 W when the applied voltage is 20V. Calculate R. (7.5)
- (b) Find the current following through $1\ \Omega$ resistance using Thevenin,s theorem in figure(1) (7.5)

P.T.O.

(b) What are strings? Explain various built-in functions used with strings. (5)

Q7 Write short notes on: (15)

- (a) while vs do-while
- (b) file handling
- (c) pointers and double pointers

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December 2023

B.Tech. (EL/CSE(AI ML)/CIVIL/ENV/FAE) - I ~~SEMESTER~~ SEMESTER

Programming for Problem solving (ESC-103)

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.

PART -A

- Q1 (a) What is a compiler? (1.5)
- (b) What are the features of a good algorithm? (1.5)
- (c) Explain the difference between break and continue statement. (1.5)
- (d) Differentiate between RAM and ROM. (1.5)
- (e) Explain the idea of structures in brief. (1.5)
- (f) What is a header file? (1.5)
- (g) What do you mean by time complexity? (1.5)
- (h) What are strings? How are they different from arrays? (1.5)
- (i) Differentiate between local and global variables. (1.5)
- (j) What are unary operators? (1.5)

PART -B

- Q2 (a) Draw a flowchart to find the largest of three numbers. Also write the algorithm for the same. (10)
- (b) What is operating system? Write some important functions of an operating system. (5)
- Q3 (a) Write a program to find the grades of a student using switch-case. (5)
- (b) What is recursion? Write a program to print the Fibonacci series up to nth term using recursion. (10)
- Q4 Differentiate between arrays and structures. Write a program to store the information of students using structures. (15)
- Q5 (a) Explain the steps for sorting the given array using bubble sort: (5)
- 5, 7, 10, 2, 13, 9, 18, 15
- (b) Explain the concept of call by reference and call by value using an example of swapping two variables. (10)
- Q6 (a) What are 2-D arrays? Write a program to calculate the sum of two matrices. (10)

- Q5 (a) Write an equivalent integral for $\int_0^2 \int_{x^2}^{2x} (4x + 2) dy dx$ with the order of integration reversed by sketching the region of integration. Hence, evaluate the integral. (5)
- (b) Find the equation of normal line and tangent plane at the point $(2, -3, 18)$ to the surface $x^2 + y^2 - 2xy - x + 3y - z = -4$. (5)
- (b) Solve ODE $(y^2 + 2x^2y)dx + (2x^3 - xy)dy = 0$. (5)
- Q6 (a) Find general and singular solutions of ODE $y + px - x^4p^2 = 0$ with $p = \frac{dy}{dx}$. (8)
- (b) Solve ODE $(1 + 2x)^2 \frac{d^2y}{dx^2} - 6(1 + 2x) \frac{dy}{dx} + 16y = 8(1 + 2x)^2$. (7)
- Q7 (a) Solve $\frac{d^2y}{dx^2} + y = \frac{\cos x}{\sin^2 x}$ by using method of variation of parameters. (7)
- (b) Solve the PDE $x(y - z) \frac{\partial z}{\partial x} + y(z - x) \frac{\partial z}{\partial y} = z(x - y)$. (8)

December 2023

BSC-103C **B.Tech. (Electrical Engineering) - I SEMESTER**
Mathematics-I (Calculus and Differential Equations)

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.

PART -A

- Q1 (a) Evaluate $\int_{-\infty}^0 x \sin x \, dx$ if it exists. (1.5)
- (b) Prove that $\Gamma(1) = 1$. (1.5)
- (c) Evaluate $\lim_{x \rightarrow \infty} \frac{x^n}{e^x}, n > 0$. (1.5)
- (d) Check the convergence of the series $\sum_{n=1}^{\infty} e^n$. (1.5)
- (e) Find the *grad* ψ for the function $\psi = \log(x^2 + y^2 + z^2)$ at the point (1, 2, 1). (1.5)
- (f) Evaluate $\int_0^1 \int_0^1 \int_0^1 (x^2 + y^2 + z^2) \, dx \, dy \, dz$ (1.5)
- (g) Write the expansions of Bessel's functions $J_0(x)$ and $J_1(x)$ (1.5)
- (h) Define ordinary point and singular point of a differential equation. (1.5)
- (i) Find the singular solution of PDE $z = px + qy + p^2 - q^2$. (1.5)
- (j) Form a PDE by eliminating the arbitrary constants λ and μ from
 $x + \lambda y + \mu = \log_e(az - 1)$. (1.5)

PART -B

- Q2 (a) Find the equation of circle of curvature of $\sqrt{x} + \sqrt{y} = 1$ at the point $(\frac{1}{4}, \frac{1}{4})$. (5)
- (b) Evaluate the area of the surface generated by revolving the portion of the curve
 $y^2 = 4 + x$ cut off by the straight line $x = 2$ about x -axis. (6)
- (c) Find the Taylor's series expansion of $\cos x$ about $x = \frac{\pi}{4}$. (4)
- Q3 (a) Determine the values of x for which the series $\frac{1}{2\sqrt{1}} + \frac{x^2}{3\sqrt{2}} + \frac{x^4}{4\sqrt{3}} + \frac{x^6}{5\sqrt{4}} + \dots \infty$ is (8)
convergent.
- (b) Find the half-range series for $f(x) = (x - 1)^2$ in $0 < x < 1$. Hence, find the sum (7)
of the series $\sum_{n=1}^{\infty} \frac{1}{n^4}$.
- Q4 (a) Using the Method of Lagrange Multipliers, find the greatest and smallest values that (7)
the function $f(x, y) = xy$ takes on the ellipse $\frac{x^2}{8} + \frac{y^2}{2} = 1$.
- (b) State Green's Theorem. Use it to evaluate $\oint_C e^{-x} (\sin y \, dx + \cos y \, dy)$, where C is (8)
rectangular curve with vertices $(0,0), (\pi, 0), (\pi, \frac{\pi}{2}), (0, \frac{\pi}{2})$.

- (c) Obtained the expression for the coefficients of reflection and transmission amplitudes of transverse waves at the boundary of two stretch strings and describe their effects on the phase of waves at the boundary. (6)
- Q4 (a) Drive an expression relating the distances of the object and its image, and the focal length of a concave spherical mirror (7)
- (b) Prove that in case of a thin lens $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = (\mu - 1) \left(\frac{1}{r_1} - \frac{1}{r_2} \right)$, where, symbols have their usual meanings. (8)
- Q5 (a) In a Newton ring experiment, the diameters of 10th ring changes from 2.0 cm to 1.75 cm, when a liquid is filled in between the plano-convex lens and the glass plate. Calculate the refractive index of the liquid. (5)
- (b) Drive an expression for Intensity of Fraunhofer diffraction produced by single slit. Draw the intensity pattern and discuss it. (10)
- Q6 (a) Explain the working of He-Ne laser with the help of neat diagram (6)
- (b) What are the Einstein Coefficients. Drive relation between them. (7)
- (c) Calculate the coherence length for a laser beam for which the bandwidth ($\Delta\nu$) is 2500 Hz. (2)
- Q7 (a) Describe the Stock's treatment of reflection and refraction of waves from a transparent dielectric medium (5)
- (b) State the Fermat principle and prove the law of refraction using it. (5)
- (c) Describe any two (a) monochromaticity of a laser source (b) Why the circular fringes are formed in newton ring experiment and centre remains dark (c) Group velocity and phase velocity in dispersive and non-dispersive mediums. (5)

December 2023
 B.Tech.(EI)- 1st SEMESTER
 Physics (Waves and Optics) (BSC-101C)

Max. Marks:75

Time: 3 Hours

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.
 4. Non-Programmable calculator is allowed

PART -A

- Q1 (a) What do you mean by forced and damped oscillations? (1.5)
- (b) Define the term quality factor. Write expression for it. (1.5)
- (c) What do you understand by simple harmonic motion? Given two examples. (1.5)
- (d) Differentiate between transverse and standing waves with examples (1.5)
- (e) Explain the term impedance matching for wave motion? (1.5)
- (f) Define the term total internal reflection. (1.5)
- (g) What are mission order in diffraction pattern produced by grating? (1.5)
- (h) Describe the term resolving power of an optical instrument. Write the Rayleigh's criterion for resolving power. (1.5)
- (i) A parallel beam of monochromatic light is allowed to fall normally on a plane transmission grating having 15000 line/inch and second order spectral line is observed at an angle of 30°. Calculate the wavelength of light. (1.5)
- (j) What are basic conditions for obtaining the sustainable interference pattern. Write atleast one similarity between interference and diffraction. (1.5)

PART -B

- Q2 (a) Show that the average power supplied to the oscillator during one cycle of the driving force is given by (8)
- $$P = \frac{1}{2} F_0 \omega A_{ab}$$
- Where, A_{ab} is the amplitude of that part of the steady state displacement which is 90° out of phases with the driving force.
- (b) What do you mean by damped oscillations? Drive the expression for the energy of a weakly damped harmonic oscillator and show that it decreases exponentially with time. (7)
- Q3 (a) Obtain the classical wave equation for transverse wave on a stretched string. (6)
- (b) Calculate the speed of sound waves in (a) water and (b) steel, when the density of steel is 7500 kg/m³, Young modulus of steel is 15x10¹⁰ Nm⁻² and bulk modulus of water is 15x10⁸ Nm⁻². (3)

- (g) What are the advantages for using Four probe methods? (1.5)
- (h) How DLTS can be used for detection of electrical active defect? (1.5)
- (i) Draw the density of state of 2D, 1D and 0D nanomaterials. (1.5)
- (j) What are the different approaches for the fabrication of nanomaterials? (1.5)

PART-B

- 2. (a) Discuss the origin of band gap by Kronig-Penny Model (10)
- (b) Differentiate between direct and indirect band gap. (5)
- 3. (a) Define density of state. How these vary with energy in case of extrinsic semiconductor? (5)
- (b) Derive an expression for concentration of charge carrier in extrinsic semiconductor. How Fermi level varies with temperature? (10)
- 4. (a) What do you mean by Optical Joint density of state? Derive an expression for it. (10)
- (b) What is Photovoltaic effect? Discuss its applications. (5)

- 5. (a) How the band gap of a material can be determined using UV-Vis spectroscopy? (5)
- (b) Explain in detail the difference between Four-point probe and van der Pauw measurements for measurement of resistivity of semiconductor. (10)
- 6. (a) How I-V measurement can be carried out? How activation energy for conduction can be determined by I-V measurements. (10)
- (b) What are Quantum Dots? Discuss the method of synthesis of it. (5)
- 7. Discuss the Principle and working of Scanning Electron Microscope. (15)

Roll No.

Total Pages : 3

018101

December 2023
B.Tech. 1st SEMESTER
Semiconductor Physics (BSC101D)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

- 1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
- 2. Answer any four questions from Part-B in detail.*
- 3. Different sub-parts of a question are to be attempted adjacent to each other.*

PART-A

- 1. (a) Discuss E-K diagram for free electron and under periodic potential. (1.5)**
- (b) Define effective mass. How it varies at the boundary of Brillouin zone? (1.5)**
- (c) Differentiate between Intrinsic and extrinsic semiconductors. (1.5)**
- (d) What is Schottky Junction? Give some example. (1.5)**
- (e) What is exciton? How it is formed? (1.5)**
- (f) Explain the term absorption, spontaneous and stimulated emission. (1.5)**

018101/810/111/710

32 [P.T.O.]

07/02/2

7. Write an essay in about 300 words on any *one*. (15)
Importance of English language.

OR

Importance of Sports. (15)

- (h) Caught up in adverse circumstances, he is (fighting with/fighting for) his survival. (1.5)
- (i) They tried their best (complete the sentence with a clause) (1.5)
- (j) One of our employees (is/are) retiring today. (1.5)

PART B

- 2. (a) Give antonyms for the words: ancient, hollow, amateur, understand, beneficial. (5)
- (b) Give synonyms for the words: abandon, ignorant, intention, evidence, desire. (5)
- (c) Write the process of making ice-cream at home. (5)
- 3. (a) Define and describe any product that you want to sell. (5)
- (b) Define all the stages of word formation by giving suitable examples. (10)
- 4. Some people say that women and men are equal in every way, so they should be given equal rights. To what extent do you agree or disagree with this opinion? You should write at least 300 words. Give reasons for your answer and include any relevant examples from your own knowledge or experience. (15)
- 5. (a) Describe any *one* favorite characters of movie or book. (5)
- (b) Explain the do's and don'ts of Précis writing. (10)

6. Do as directed :

- (a) The animal spun round suddenly and hissed violently me. (preposition)
- (b) Do you know anyone which/who can repair my speakers?
- (c) Politicians have to believe in, if they expect the people to believe in (pronoun)
- (d) Muhammad Ali is greatest heavy-weight boxer ever. (article)
- (e) Let's distribute the chocolates between you and (I/me).
- (f) The slower you drive safer it is for you. (article)
- (g) I expressed my gratitude their assistance. (preposition)
- (h) Leave it, this bag is our/ours.
- (i) His attitude to say the least was really horrible (punctuate)
- (j) They were asked to wait till they fainted in the sun. (indicate and name the clause)
- (k) Are we going to fly the Alps? (preposition)
- (l) Either the student or the teachers (is/are) to blame for his bad performance.
- (m) Multiple crises (seem/seems) to have ruffled them up.
- (n) Be careful! There (is/are) scissors in the drawer.
- (o) Someone (has/have) left the letter for you. (15)

Roll No.

Total Pages : 4

013104

December 2023

B. Tech. Ist SEMESTER

English (HSMC-101)

Time : 3 Hours]

[Max. Marks : 75


Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART-A

1. (a) Provide words by adding given prefix: anti-, non-, dis- (1.5)
- (b) Provide words by adding suffix: -less, -ness, -ment (1.5)
- (c) He is (sick with/sick of) his neighbours. (1.5)
- (d) He neither smiled spoke nor looked at me (punctuate) (1.5)
- (e) Explain Clichés with an example. (1.5)
- (f) Explain the difference between phrase and clause. (1.5)
- (g) I saw the child trembling with (fear/fears). (1.5)

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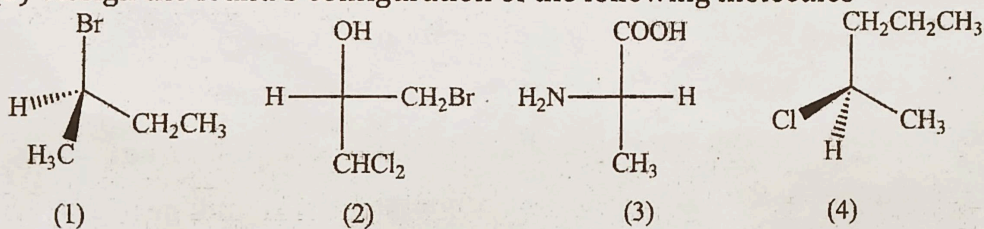
07/02/2

- Q5 (a) Explain the Ellingham Diagram, its applications and limitations. (5)
 (b) Define Polarizability and what are the factors that affect the polarization. (7)
 Explain the trend of polarizability along a group and across a period. Discuss the Fajan's rule for ionic and covalent nature of a bond.
 (c) Write short note on PES Diagrams. Elaborate saddle point and mountain pass (3)
 in a potential energy surface diagram.

- Q6 (a) What do you mean by 'critical state of a gas'? Discuss the formula of T_c , V_c and P_c . (5)
 (b) What is real gas? State the Vander Walls equation for real gases and its (5)
 different for low and very low pressures.
 (b) Write the synthetic steps of any two drug molecules of your own choice. (5)

- Q7 (a) Write the difference between the following along with examples (6)
 (i) Enantiomers and Diastereomers
 (ii) Cis isomers and trans isomers
 (iii) D/L and d/l notation

- (b) Assign the R and S configuration of the following molecules (4)



- (c) Discuss in detail the various types of isomerism in transition metal compounds. (5)

December 2023

B.Tech. (ME/ME(Hindi Medium)/RAI) 1 SEMESTER

Chemistry (BSC-102/BSCH-102)

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub parts of a question are to be attempted adjacent to each other.

PART -A

- Q1 (a) Write a short note on p-type semiconductor. (1.5)
- (b) State the basic difference between the London dispersive forces and dipole-dipole forces. (1.5)
- (c) What are the essential conditions for molecule to be chiral and optically active? (1.5)
- (d) S_N^2 Reactions occur with inversion of configuration. Justify. (1.5)
- (e) Arrange N^3 , O^{2-} , F^- , Na^+ , Mg^{2+} , Al^{3+} in increasing order of ionic radii. (1.5)
- (f) Write the relationship between Helmholtz free energy and Gibbs's free energy. (1.5)
- (g) Predict the number of NMR signals in 3-chlorobutane and isobutane. (1.5)
- (h) What is the Arrhenius definition of an acid and a base? (1.5)
- (i) Write in brief about two methods of protection from corrosion? (1.5)
- (j) Write the electrophiles in the Friedel-Crafts nitration and sulphonation reactions. (1.5)

PART -B

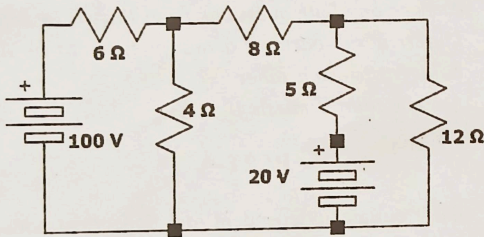
- Q2 (a) (i) Derive the expression for the total energy and normalized wave function for the particle of mass (m) in 1-D box with length L moving with potential $V(x)=0$, $0 < x < L$, otherwise $V(x)$ is infinite. (6)
- (b) On the basis of molecular orbital theory, draw the molecular energy diagram for N_2 molecule. (4)
- (c) Define Electronegativity and write the Pauling and Mulliken's electronegativity equation. (5)
- Q3 (a) Discuss the Nernst equation and write its applications. (5)
- (b) Explain Markovnikov's and Anti Markovnikov's rule along with mechanism in detail with suitable example. Based on the above rules explain ozonolysis-demercuration reaction along with mechanism. (7)
- (c) Discuss Diels-Alder reaction with two examples. (3)
- Q4 (a) Discuss the principle and selection rules for the electronic spectroscopy. Also discuss the various electronic transitions in UV-Visible spectroscopy. Explain the following terms (10)
- (b) Bathochromic Shift, MRI, fluorescence, hyperchromic shift, Bragg's Law (5)

- (b) Explain the working principle of a transformer. What are the properties of an ideal transformer? Draw and explain the phasor diagram of the single-phase transformer at no load condition. CO3 (7.5)
6. (a) Why is a synchronous motor not self-starting? What are the starting methods of synchronous motor? CO3 (7.5)
- (b) Explain the construction and working of the miniature circuit breaker (MCB) with suitable diagram. CO4 (7.5)
7. (a) Define the term power factor. What are the effects of the low power factor? What are the methods of power factor improvement? CO4 (7.5)
- (b) Define the maximum power transfer theorem. Derive the condition for maximum power transfer. CO1 (7.5)
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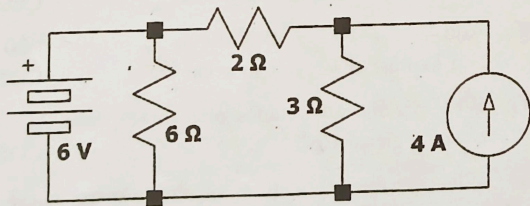
- (h) Why brushes are made of carbon in a DC machine?
CO3 (1.5)
- (i) What is the function of a fuse in electrical installation?
CO4 (1.5)
- (j) Why earthing is necessary for electrical installations?
CO3 (1.5)

PART-B

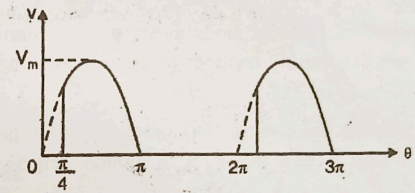
2. (a) Using node analysis determine the current in each resistor for the given circuit. CO1 (7.5)



- (b) In the circuit shown in the figure, find the current in 2Ω resistor using the principle of superposition. CO1 (7.5)



3. (a) Find the average and effective values of the sinusoidal waveform shown in Figure. The maximum value is 100 V. CO2 (7.5)



- (b) A 230V, 50 Hz a.c. supply is applied to a coil of 0.06 H inductance and 6-ohm resistance connected in series with a 6.8 μ F capacitor. Calculate (i) impedance (ii) current (iii) phase angle between current and voltage (iv) power factor and (v) power consumed. CO2 (7.5)
4. (a) Derive the relationship between line and phase voltage and line and phase current for a star-connected three-phase system with suitable connection and phasor diagrams. CO2 (7.5)
- (b) The power input to a 400 V, 3-phase, 50 Hz induction motor is measured by the two-wattmeter method. The readings of the two wattmeters are 40 kW and -10 kW. Calculate (i) the input power (ii) the power factor and (iii) line current. CO2 (7.5)
5. (a) Define the term magnetic circuit. What are the similarities and dissimilarities between magnetic and electric circuits? CO3 (7.5)

Roll No.

Total Pages : 4

013102

December 2023
B.Tech. 1st SEMESTER
Basic Electrical Technology (ESC-101-A)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

- 1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
- 2. Answer any four questions from Part-B in detail.*
- 3. Different sub-parts of a question are to be attempted adjacent to each other.*
- 4. Assume data if missing.*

PART-A

1. (a) Differentiate independent and dependent sources. CO1 (1.5)
- (b) What are the limitations of Ohm's law? CO1 (1.5)
- (c) Define unilateral and bilateral circuits. CO1 (1.5)
- (d) Define resonance in series RLC circuit. CO2 (1.5)
- (e) Add $V_1 = (-10 + j 50)$ volts to $V_2 = (30 + j 20)$ volts and express the result in polar form. CO2 (1.5)
- (f) What are the advantages of a three-phase AC system over single-phase? CO2 (1.5)
- (g) What are the applications of auto-transformers? CO2 (1.5)

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6. (a) Discuss the maxima and minima of

$$f(x, y) = x^3y^2(1 - x - y). \quad (8)$$

- (b) Find the directional derivative of $\phi(x, y, z) = x^2yz + 4xz^2$ at the point $(1, -2, -1)$. In the direction of the vector $2\vec{i} - \vec{j} - 2\vec{k}$. (7)

7. (a) For what values of k , the equations (7)

$$x + y + z = 1,$$

$$2x + y + 4z = k,$$

and $4x + y + 10z = k^2$

have (i) Unique solution (ii) Infinite number of solutions
(iii) No solution and solve them completely.

- (b) If $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$, then find A^n in terms of A and I .

(8)

- (f) Test the convergence of the following infinite sequence :
(1.5)

$$\{\sqrt{n+1} - \sqrt{n}\}.$$

- (g) Find grad ϕ for the function $\phi(x, y, z) = 3xy + y^3z$ at the point (1, -2, 1). (1.5)

- (h) State Cayley-Hamilton Theorem. (1.5)

- (i) Find the Eigenvalues of the matrix $\begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$. Hence,

find the matrix whose Eigenvalues are $\frac{1}{6}$ and -1 . (1.5)

- (j) Prove that a square matrix A and its transpose A^T have the same eigenvalues. (1.5)

PART-B

2. (a) Find the evolute of the rectangular hyperbola $xy = c^2$. (8)

- (b) The portion of the curve $y = \frac{x^2}{2}$ cut off by the straight

line $y = \frac{3}{2}$ is revolved about the y-axis. Find the surface area of revolution. (7)

3. (a) Evaluate $\int_0^{x/2} \sin^8 \theta \cos^2 \theta d\theta$. (5)

- (b) Using Taylor's theorem, prove that

$$x - \frac{x^3}{6} < \sin x - \frac{x^3}{6} + \frac{x^5}{120}, \text{ for } x > 0. \quad (10)$$

4. (a) Evaluate $\lim_{x \rightarrow 0} \frac{\tan x - x}{x^2 \tan x}$. (5)

- (b) Discuss the nature of the series (10)

$$\frac{1}{2} + \frac{2}{3}x + \left(\frac{3}{4}\right)^2 x^2 + \left(\frac{4}{5}\right)^2 x^3 + \dots \infty, \text{ for } x > 0.$$

5. (a) If $a_0, a_1, a_2, \dots, a_n$ are real numbers such that (5)

$$\frac{a_0}{n+1} + \frac{a_1}{n} + \frac{a_2}{n-1} + \dots + \frac{a_{n-1}}{2} + a_n = 0,$$

then there exists at least one x in (0, 1) such that

$$a_0 x^n + a_1 x^{n-1} + a_2 x^{n-2} + \dots + a_{n-1} x + a_n = 0.$$

- (b) Find the Fourier series for (10)

$$f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x & 0 < x < \pi \end{cases}$$

$$\text{Deduce that } \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}.$$

Roll No.

Total Pages : 4

013101

December 2023

**B.Tech. (Mechanical Engineering) 1st SEMESTER
Mathematics-I (Calculus and Linear Algebra) (BSC-103A)**

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART-A

1. (a) Test the convergence of the improper integral $\int_{-1}^1 \frac{dx}{x^2}$.
(1.5)
- (b) What is relation between Beta and Gamma functions?
(1.5)
- (c) State Mean value theorems. (1.5)
- (d) Explain "ALTERNATING SERIES" with example.
(1.5)
- (e) Evaluate (1.5)

$$\lim_{x \rightarrow \infty} \frac{x^n}{e^x}$$

07/02/2024