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Roll No. ..... Total Pages : 04

BT-1/D-22 41037

CHEMISTRY

BS-101A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Define aromaticity. Write down the requirements for a compound to be aromatic. Explain different types of aromatic compounds citing suitable examples. **5**

(b) Write the postulates of Molecular Orbital theory. Explain the Linear combination of atomic orbitals to form molecular orbitals. Also explain the bond length in CO+ and CO molecules with molecular orbital enegry level diagrams. **10**

2. (a) Explain the splitting of *d*-orbitals in transition metal compounds in the tetrahedral and octahedral ligand field strength. Also explain the magnetic behaviour of any octahedral metal complex using Crysrtal Field theory. **10**

(b) Define doping in semiconductors. Differentiate between *n*-type and *p*-type semiconductors. 5

Unit II

3. Describe the following : 3×5=15

(a) Phosphorescence and Fluorescence

(b) Scattering of light and diffraction

(c) Differentiate types of electronic transitions possible in an organic molecule.

4. (a) Give another name for Vibrational Spectroscopy. Explain the various vibrational transitions occurring in an organic molecule. 6

(b) What the name of compound used as standard for taking NMR spectra of organic compounds. Also explain, why is it used. 4

(c) Define the term Spectroscopy. Explain the basic principle of NMR spectroscopy. 5

Unit III

5. (a) Write the postulates of VSEPR theory. Explain the difference in bond angle of the following using this theory : 6

(i) NH_3 and NF_3

(ii) H_2O and F_2O

(b) Derive Nernst equation and explain its applications. 5

(c) Define free Energy. Write its types and explain the basic different between them. 4

6. (a) Describe Fajan's rule for explaining polarizability of bond in different molecules. 6

(b) Explain using the concept of effective nuclear charge and taking suitable examples, why electrons are filled first in 4*s* in place of 3*d* while writing electronic configuration and also the electron is removed first from 4*s* in place of 3*d* while converting an atom to cation ? 5

(c) Define term Entropy. Justify the statement — "Entropy change for a reversible process is always zero while it is positive for an irreversible process." 4

Unit IV

7. (a) Define the term isomer. Write the difference between structural isomers and seteroisomers with examples. Also explain the different types of structural iosmers using proper examples. 8

(b) Write the general reaction, procedure and mechanism for the synthesis of Paracetamol. 7

8. Differentiate between the following using suitable examples : **3×5=15**

(a) Diastereomers and Enantiomers

(b) E1 and E2 mechanism for elimination reactions

(c) Electrophilic addition reaction and nucleophilic addition reactions.

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BT-1/D-22 41038

PROGRAMMING FOR PROBLEM SOLVING

ES-105A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Solve the following : 9

   (i) $(38)_9 - (378)_9$

   (ii) $(9CD7.BA)_{16} + (EDF5.4D)_{16}$

   (iii) $(ACFF.CD5E)_{16} = (?)_8$.

   (b) What is the difference between an algorithm and pseudocode ? Also write an algorithm and pseudocode for solving a quadratic equation. 6

2. (a) Solve the following :

   (i) $(5437.656)_8 = (?)_{10}$ 4

   (ii) $(577)_{10} - (1063)_{10}$ using 9' complement with proper steps. 5

   (b) Write an algorithm for multiplication of two matrix. 6

Unit II

3. (a) Write a C program to find GCD of two numbers using ternary operator and for loop. 8

   (b) Write a C program to calculate m value using while and do while loop. 7

4. (a) Write a C program to generate and print the numbers between 100 and 200 which are divisible by 3 but not divisible by 4. 7

   (b) Describe the pretest, posttest, counter-controlled and condition-controlled loops with examples. 8

Unit III

5. (a) Write a program to check whether sting is palindrome or not, without using string function. 8

   (b) Write a C program to accept an integer number and print the digits using words (for example 426 is printed as Four Two Six). 7

6. (a) What is Recursion ? Write a program to find the Fibonacci series using recusion. 7

   (b) Write a program to enter some text through keyboard. Insert a dot (.) after every three words in the text. The first character after every dot should be converted to capital. 8

Unit IV

7. (a) How the array can be handled by the pointers in C language ? Explain. 8

   (b) Write a C program to create a text file and read the text from the created file and count the number of vowels and consonants present in the file. 7

8. (a) Write a program that changes every 5th character of data file into uppercase. 8

   (b) Write a program to sort the array using call by reference. 7

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BT-1/D-22 41039

ENGLISH

HM-101A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all. All questions carry equal marks.

1. Make two words using the following suffixes and prefixes : **15**

1.	.....ic,	2.	.....al,
3.	.....ee,	4.	.....ward,
5.	.....logy,	6.	homo.....,
7.	socio.....,	8.	hyper.....,
9.	bene.....,	10.	ab.....,
11.	an.....	12.	ante.....
13.	.....ity	14.	.....fy
15.	para.....		

2. Make sentences out of the following phrases given : **15**

1.	Knock out	2.	Fait accompli
3.	Couch potato	4.	Faux pas
5.	Go Dutch	6.	Fender-bender
7.	Hang out	8.	Out of the blue

9. Modus operandi
10. Double minded
11. Pie in the sky
12. Herculean Task
13. De Facto
14. Status Quo
15. Per se

3. Correct the following sentences : **15**

1. Every student like the teacher.
2. I must to call him immediately.
3. His family members are coming by this train.
4. Neither he nor I is going to do the work.
5. I enjoyed from the movie.
6. Jean Paul Sartre is French philosopher who wrote the book *Being and Nothingness.*
7. When I entered the bedroom, I saw a snake crawling on the ground.
8. My sister and myself are pleased to accept your invitation.
9. In three weeks time we are going to complete the work.
10. He is twenty years old, isn't it ?
11. She can to drive.
12. There are numerous complains; late coming is one among them.
13. The ongoing battle of words between Radha, Shyam and their father hampers the peace of the house.
14. Will you kindly open this knot ?
15. You speak English good.

4. Punctuate the following sentences : **15**

1. Hey close the door
2. May I come in
3. Understand you are not allowed in here
4. Go and place it on the table
5. Sorry said Leela after a long pause
6. Claim the prize
7. Stop it
8. They are to send letters to the leaders of charitable organisation
9. Engineers require an advanced knowledge of algebra trigonometry and geometry
10. We have paid our dues we expect all the privileges listed in the contract
11. I need the following articles a glass a cup a jug and a napkin
12. Oh I missed by one mark said Rehan
13. Great we are going out for shopping said Anuradha
14. I want you to see the dress said Ramesh excitedly
15. Bravo you have won the match

5. Write an essay on any *one* of the following topics : **15**

1. Racial Discrimination
2. Global Warming
3. Cyber culture
4. Digital India

6. Write a precise of the following passage and suggest a suitable title : **15**

Democracy would have been impossible without the printing press. The modern media of mass communication are another fruitful source of education, are being spent on manufacturing weapons of mass annihilation and space exploration, the affluent nations are not prepared to help developing nations on a scale which would make a significant impact on their lives. Many civilizations in the past perished because the people recklessly exploited natural resources, exhausted the soil and turned the land into a desert. Impelled by the profit-motive, nations are still recklessly exploiting world resources without giving any serious thought to what would happen a few hundred years hence. When we know that man has to live on this planet for millions of years, this policy of exploiting natural resources and not judiciously conserving them is, to put it mildly, extremely short-sighted. The same short-sightedness is being displayed over population growth. Science has rendered great service to humanity by finding a cure for most diseases, by preventing the outbreak of epidemics which formerly used to kill millions of persons, and by curtailing the death rate in other ways. But unless

men learn to curtail the birth rate as well, we will, before long, be faced with a population explosion. Science has not proved that Malthus was wrong. It has only proved that for some time natural restraints on population in the form of wars, pestilences and famines can be held back. This planet can be made a decent place to live in only if man is wise. Science gives knowledge and power, but not necessarily wisdom.

7. Read the following passage and answer the questions that follow : 15

Philosophy of Education is a label applied to the study of the purpose, process, nature and ideals of education. It can be considered a branch of both philosophy and education. Education can be defined as the teaching and learning of specific skills, and the imparting of knowledge, judgement and wisdom, and is something broader than the societal institution of education we often speak of many educationalists consider it a weak and woolly field, too far removed from the practical applications of the real world to be useful. But philosophers dating back to Plato and the Ancient Greeks have given the area much thought and emphasis, and there is little doubt that their

work has helped shape the practice of education over the millennia.

Plato is the earliest important educational thinker, and education is an essential element in "The Republic" (his most important work on philosophy and political theory, written around 360 B.C,). In it, he advocates some rather extreme methods : removing children from their mothers' care and raising them as wards of the state, and differentiating children suitable to the various castes, the highest receiving the most education, so that they could act as guardians of the city and care for the less able. He believed that education should be holistic, including facts, skills, physical discipline, music and art. Plato believed that talent and intelligence is not distributed genetically and thus is be found in children born to all classes, although his proposed system of selective public education for an educated minority of the population does not really follow a democratic model. Aristotle considered human nature, habit and reason to be equally important forces to be cultivated in education, the ultimate aim of which should be to produce good and virtuous citizens. He proposed that teachers lead their students systematically, and that repetition be used as a key tool to develop good

habits, unlike Socrates' emphasis on questioning his listeners to bring out their own ideas. He emphasized the balancing of the theoretical and practical aspects of subjects taught, among which he explicitly mentions reading, writing, mathematics, music, physical education, literature, history, and a wide range of sciences, as well as play, which he also considered important.

Questions :

1. What is philosophy of education ? **3**
2. What is the difference between the approaches of Socrates and Aristotle ? **3**
3. Why do educationists consider philosophy a 'weak and woolly' field ? **3**
4. Were Plato's beliefs about education democratic ? **3**
5. Suggest a suitable title to the above given passage. **3**

8. What are the factors that contribute to clear, fluent and effective composition/writing ? Discuss any *three* factors in detail. **15**

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BT-1/D-22 **41040**

MULTI-VARIABLE CALCULUS AND LINEAR ALGEBRA

BS-135A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. (a) Prove the following : **7.5**

$$\int_0^\infty \frac{e^{-x^2}}{\sqrt{x}}dx \times \int_0^\infty x^2 e^{-x^4}dx = \frac{\pi}{4\sqrt{2}}.$$

(b) Find the volume of the solid generated by revolution of the plane area bounded by $y^2 = 16x$ and $y = 4x$ about the x-axis. **7.5**

2. (a) Discuss the applicability of Rolle's theorem to the function $f(x) = |x|$ in $[-1, 1]$. **7.5**

(b) Evaluate the limit of the function : **7.5**

$$\lim_{x \to 0} (\operatorname{cosec} x)^{\frac{1}{\log x}}.$$

Unit II

3. (a) Test the convergence of the $\sum \frac{n^3 + a}{2^n + a}$. 7.5

(b) Discuss the convergence of the series : 7.5

$$\frac{1^2}{2^2} + \frac{1^2}{2^2}\cdot\frac{3^2}{4^2} + \frac{1^2}{2^2}\cdot\frac{3^2}{4^2}\cdot\frac{5^2}{6^2} + \ldots.$$

4. (a) Find the Fourier series to represent : 7.5

$$f(x) = \begin{cases} 1 + \frac{2x}{\pi}, & -\pi \le x \le 0 \\ 1 - \frac{2x}{\pi}, & 0 \le x \le \pi \end{cases}$$

(b) Obtain the Fourier series of the function : 7.5

$$f(x) = \begin{cases} \pi x, & 0 \le x \le 1 \\ \pi(2 - x), & 1 \le x \le 2. \end{cases}$$

Unit III

5. (a) Expand cos x in powers of $\left(x - \frac{\pi}{2}\right)$, and hence find the value of cos 91° corrected up to four decimal places. 7.5

(b) If $u = f(r)$ where $r^2 = x^2 + y^2$, prove that : 7.5

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f''(r) + \frac{1}{r} f'(r).$$

6. (a) If $(\cos x)^y = (\sin y)^x$, find $\frac{dy}{dx}$. 7.5

(b) A thin closed rectangular box is to have one edge equal to twice the other, and a constant volume 72 m^3. Find the least surface area of the box. 7.5

Unit IV

7. (a) By applying the Gauss Jordan Method, find the inverse of the matrix $\begin{bmatrix} -1 & 0 & 6 \\ 3 & 6 & 1 \\ -5 & 1 & 3 \end{bmatrix}$. 7.5

(b) If matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$, find the matrix represented by : 7.5

$A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 6A^2 - 3A + 2I$.

8. Find the eigen values and the corresponding eigen vectors of the matrix given by $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$. 15

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BT-1/D-22 41041

ENGINEERING GRAPHICS AND DESIGN

ES-109-A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. Assume any missing data.

Unit I

1. Draw a hypocycloid of a circle of diameter 50 mm, which rolls inside a circle of diameter 180 mm for one revolution. Also, draw a tangent and a normal to the hypocycloid at a point 50 mm from the centre of the directing circle. 15

2. If 1 cm long line on a map represents a real length of 4 m. Calculate the R.F. and draw a vernier scale long enough to measure up to 50 m. Show a distance of 44.5 m on it. 15

Unit II

3. (a) Draw the projections of the following points on a common reference line keeping the distance between their projectors 30 mm apart.

(i) Point P is 35 mm below the H.P. and in the V.P.

(ii) Point Q is 40 mm in front of the V.P. and 25 mm below the H.P.

(iii) Point R is 45 mm above the H.P. and 20 mm behind the V.P.

(iv) Point S is 30 mm below the H.P. and 45 mm behind the V.P.

(v) Point T is both in H.P. and V.P. **10**

(b) The front view of a line PQ parallel to the V.P. and inclined 60° to the H.P. is 50 mm. One end of the line is 20 mm in front of the V.P. and 25 mm above the H.P. Draw its projections and determine true length of the line. **5**

4. A pentagonal prism of base side 30 mm and axis 70 mm has a corners on the H.P. and the axis is inclined at 45° to the H.P. Draw its projection when the plane containing the resting corner and the axis is parallel to the V.P. **15**

Unit III

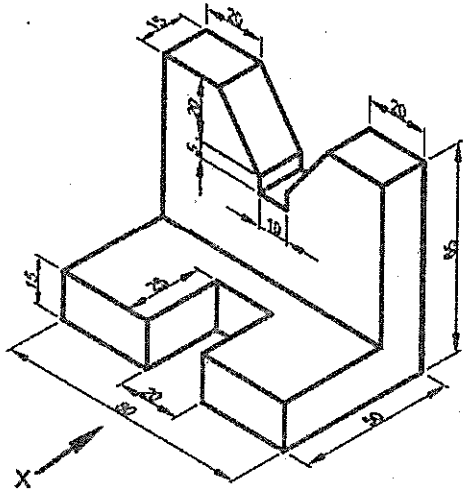
5. A triangular prism, base side 50 mm and axis 50 mm is lying on one of its rectangular faces on the H.P. with its axis perpendicular to the V.P. It is cut by a section plane parallel to and 20 mm above H.P. Draw its front view and sectional top view. **15**

6. A cylinder of base diameter 50 mm and axis 70 mm is resting on ground with its axis vertical. It is cut by a section plane perpendicular to the V.P., inclined at 45° to the H.P., passing through the top of a generator and cuts all the other generators. Draw the development of its lateral surface. **15**

Unit IV

7. Draw the isometric view of a sphere of diameter 60 mm truncated by a horizontal plane at a height of 20 mm from the centre plane. **15**

8. Pictorial view of an object is shown in Figure as given below. Using first angle projection, draw its (a) front view, (b) top view and (c) right-hand side view. **15**



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BT-1/D-22 **41042**

ENGINEERING GRAPHICS AND DESIGN

(EVEN)

ES-109A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. (a) Define R.F. What is the significance of RF in the scales used in Engineering Drawing ? 5

   (b) Define scale and explain plain, vernier and diagonal types of scale. 10

2. Draw the projection of the following points on the same reference line by taking the gap of 30 mm in adjacent projectors : 15

   (a) Point A, 25 mm in front of V.P. & 45 mm above H.P.

   (b) Point B, 30 mm behind V.P. & 40 mm above H.P.

   (c) Point C, 25 mm behind V.P. & 45 mm below H.P.

(d) Point D, 50 mm in front of V.P. & 55 mm below H.P.

(e) Point E, lies in V.P. and H.P.

Unit II

3. A line AB, 90 mm long is inclined at 30° to the H.P. Its end A is 15 mm above the H.P. and 20 mm in front of the V.P. Its front view measures 65 mm. Draw the top view of AB and determine the inclination with the V.P. **15**

4. A square ABCD of 50 mm side has its corner A in the H.P., its diagonal AC inclined at 30° to the H.P. and the diagonal BD inclined at 45° to the V.P. and parallel to the H.P. Draw its projections. **15**

Unit III

5. A pentagonal pyramid, side of base 30 mm and axis 70 mm long, has its base lying on horizontal plane and an edge of the base parallel to the V.P. A horizontal section plane cuts it at a distance of 30 mm above the base. Draw its front view and sectional top view. **15**

6. Develop the surface of a right circular cone 50 mm diameter base and 60 mm axis long with its axis bisected by a plane at an angle 45° with horizontal. **15**

Unit IV

7. A cylindrical block of base, 60 mm diameter and height 80 mm, standing on the H.P. with its axis perpendicular to the H.P. Draw its isometric view. 15

8. Derive orthographic projection. Describe briefly the method of obtaining an orthographic projection of an object. Also explain conversion of orthographic projection to isometric projection considering any suitable example. 15

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BT-1/D-22 41043

BIOLOGY

BS-141A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Enlist the features of living organisms. 7

   (b) Draw the structure of mitochondria and endoplasmic reticulum. 8

2. Classify the organisms on the basis of energy and carbon utilisation and habitat. 15

Unit II

3. (a) Classify the carbohydrates based on functional group and number of carbons. 10

   (b) Differentiate between plant and animal cell. 5

4. (a) Classify enzymes based on criteria which is most acceptable and as per enzyme commission. 10

   (b) Enlist the importance of kinetic parameters. 5

Unit III

5. Define the process of cell division and with the help of diagrams, discuss the process of mitosis. 15

6. (a) Write down the Mendel's law of inheritance along with concept of central dogma of molecular biology. 10

   (b) Write a short note on Diabetes type I and type II. 5

Unit IV

7. Discuss with an example, the concept of exothermic and endothermic reactions along with significance of Gibbs' free energy in metabolism. 15

8. Write short notes on the following : 5×3=15

   (i) ATP as energy currency of cell

   (ii) Concept of species and strains

   (iii) Role of biology in agriculture and medicine.

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BT-1/D-22 41044

BASIC ELECTRICAL ENGINEERING

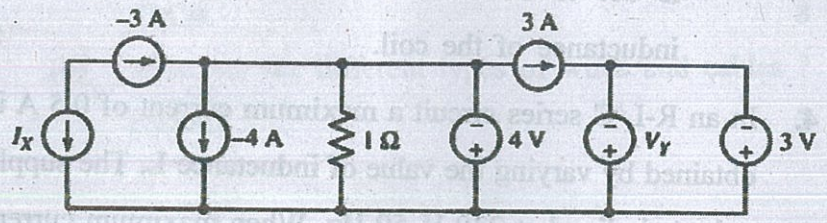
ES-101A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

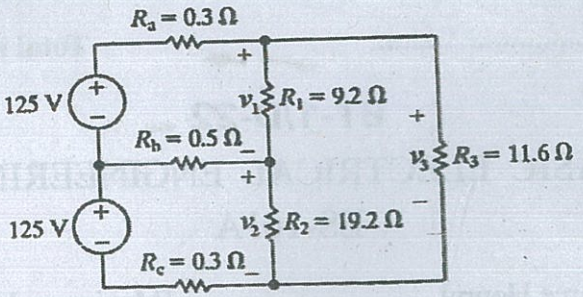
Unit I

1. (a) State KCL and KVL. Determine the values for I_X and V_Y in the circuit shown in figure. 8



(b) State and explain superposition theorem. 7

2. (a) In the circuit shown in figure, calculate (i) v_1, v_2 and v_3 (ii) power delivered to R_1, R_2 and R_3. 10



(b) Explain Star-Delta transformation for resistors. 5

Unit II

3. (a) Explain how is the sinusoidal waveform represented as a phasor quantity with example. 7

(b) A coil is connected in series with a capacitor of 20 μF to a 200 V variable frequency supply. The current is a maximum at 50 A, when the frequency is set to 50 Hz. Determine the resistance and inductance of the coil. 8

4. In an R-L-C series circuit a maximum current of 0.5 A is obtained by varying the value of inductance L. The supply voltage is fixed at 230 V, 50 Hz. When maximum current flows through the circuit; the voltage measured across the capacitor is 350 V. What are the values of the circuit parameters ? 15

Unit III

5. Explain the measurement of 3-phase power by two wattmeter method for a delta connected balanced load with the help of phasor diagram. **15**

6. (a) From the fundamentals, derive the expression for the EMF equation of a single-phase transformer. **7**

   (b) A 50 kVA, single-phase transformer has 500 turns on the primary and 200 turns on the secondary. The primary is connected to 2000 V, 50 Hz supply. Determine : (i) The secondary voltage and (ii) The maximum value of flux. **8**

Unit IV

7. Explain the construction and working principle of a 3-phase Induction motor with Torque-slip characteristic. **15**

8. (a) What is ELCB ? Explain the working principle of ELCB. **8**

   (b) What are the different types of wires and cables ? Explain. **7**

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BT-1/D-22 41045

SEMICONDUCTOR PHYSICS

BS-115-A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. (a) Explain bonding in solids with suitable examples. 7

   (b) What do you mean by point defects in solids ? Derive an expression for concentration of Frenkel defects in a crystal. 8

2. (a) Explain Diamond structure. Calculate its packing fraction. 7

   (b) Explain three-dimensional Bravais lattices. 8

Unit II

3. (a) What is the relation between de-Broglie group velocity associated with the wave packet and velocity of the particle ? 8

(b) Derive Schrödinger time dependent equation for matter waves. Give physical significance of the wave function. 7

4. (a) Define Heisenberg's uncertainty principle. Explain *two* of its applications. 8

(b) Explain the origin of concept of wave particle duality with example. 7

Unit III

5. (a) Explain quantum free electron theory. 8

(b) Explain Fermi-Dirac distribution function. 7

6. (a) Write short notes on the following : 8

(i) E *versus* K diagram

(ii) Brillouin zone.

(b) Explain Hall effect and its applications. 7

Unit IV

7. (a) Explain the working and characteristics of Field Effect Transistor. 8

(b) What do you mean by intrinsic semiconductor ? Derive an expression for carrier concentration in intrinsic semiconductor. 7

8. (a) Describe the formation of p-n junction. Discuss its current-voltage characteristics. 8

(b) Explain the construction and working of Bipolar Junction Transistor. 7

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BT-I/D-22 **41046**

CALCULUS AND LINEAR ALGEBRA

BS-133A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Prove that :

$$\beta\left(m, \frac{1}{2}\right) = 2^{2m-1}\beta(m, m)$$

(b) Verify Rolle's theorem for the function :

$$(x+2)^3(x-3)^4 \text{ in } (-2, 3)$$

2. (a) Evaluate :

$$\lim_{x \to 0} \frac{(1+x)^{1/x} - e - \frac{ex}{2}}{x^2}$$

(b) Find the volume of a sphere of radius a.

Unit II

3. (a) If $A = \begin{bmatrix} 1 & -2 & 3 \\ 2 & 3 & -1 \\ -3 & 1 & 2 \end{bmatrix}$ and I is the unit matrix of order 3, evaluate $A^2 - 3A + 9I$.

(b) Find the rank of the matrix :

$$\begin{bmatrix} 1 & 2 & 1 \\ -3 & -6 & -3 \\ 5 & 10 & 5 \end{bmatrix}$$

4. (a) Solve the following equations by Cramer's rule :

$$x+3y+6z=2$$
$$3x-y+4z=9$$
$$x-4y+2z=7$$

(b) Find the inverse of the matrix $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$ and verify $A^{-1}A = I$, where I is the identity matrix of order 3.

Unit III

5. (a) Show that the set $v_1 = (2, -1, 0)$, $v_2 = (1, 2, 1)$ and $v_3 = (0, 2, -1)$ are linearly independent. Also express the vector (3, 2, 1) and (1, 1, 1) as a linear combination of v_1, v_2 and v_3.

(b) Prove that the set $\{(2, 1, 4), (1, -1, 2), (3, 1, -2)\}$ forms a basis of R^3.

6. (a) If $T : R^3 \rightarrow R^3$ be a linear operator defined by $T(x, y, z) = (2x, 4x - y, 2x + 3y - z)$, show that T is invertible.

(b) For what value of k (if any) the vector $v = (1, -2, k)$ can be expressed as a linear combination of vectors $v_1 = (3, 0, -2)$ and $v_2 = (2, -1, -5)$ in $R^3(R)$?

Unit IV

7. (a) Find the eigenvalues and eigenvectors of the matrix :

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

(b) Define orthogonal matrix and show that the following matrix is orthogonal :

$$\begin{bmatrix} \frac{1}{3} & \frac{2}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{1}{3} & -\frac{2}{3} \\ \frac{1}{3} & -\frac{2}{3} & \frac{1}{3} \end{bmatrix}$$

8. (a) If α and β are vectors in an inner product space, then show that :

$$\|\alpha+\beta\|^2+\|\alpha-\beta\|^2=2\|\alpha\|^2+2\|\beta\|^2$$

(b) Define symmetric and skew-symmetric matrix and prove that every square matrix can be expressed as sum of a symmetric and skew-symmetric matrix.