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BT-2/M-23 42033

SEMICONDUCTOR PHYSICS

BS-115A

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) What is Bravais lattice ? Explain different types of Brvais lattices in three dimensions. 7

   (b) Discuss the hexagonal closed packed (hcp) structure and determine the c/a ratio for hcp structure. 8

2. (a) What do you mean by point defects in solids ? Derive an expression for concentration of Frankel defects at thermal equilibrium. 8

   (b) Explain the different types of bonding in solids and give one example of each. 7

Unit II

3. (a) Describe the de-Broglie matter waves and establish the correspondence between particle concepts and wave concepts. 7

(b) Explain the group velocity and particle velocity. Prove that group velocity is less than the phase velocity in dispersive medium. 8

4. (a) State Heisenberg's uncertainty principle. Prove the non-existence of the electron inside the nucleus using uncertainty principle. 7

(b) Derive the time independent one-dimensional Schrodinger wave equation for s non-relativistic a free particle. Also give the significance of the wave function. 8

Unit III

5. (a) What are the drawbacks of classical free electron theory ? Discuss the quantum theory of free electron in a one-dimensional box. 8

(b) Discuss the Fermi-Dirac distribution function. Plot this function for various temperatures including 0 K. 7

6. (a) Explain the concept of effective mass of the electron on the basis of band theory of solids. 7

(b) What is Hall effect ? Derive an expression for Hall coefficient and mention some of the applications of this effect. 8

Unit IV

7. (a) What are Semiconductors ? Explain the intrinsic and extrinsic semiconductors. 8

   (b) Derive an expression for carrier concentration in *n*-type semiconductors. What would be the position of Fermi level in the same ? 7

8. (a) What are Bipolar Junction Transistors (BJT)? Explain the characteristics of the bipolar junction transistors. 8

   (b) Describe the principle, construction and working of a semiconductor laser. 7

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BT-2/M-23 42034

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) What are Aromatic compounds ? Describe the conditions an organic compound must fulfill to be an aromatic compound. Give examples also. 4

   (b) Explain pi- molecular orbitals of Benzene on the basis of Molecular orbital theory. 4

   (c) Classify the solids on the basis of band structure. Also explain different types of semiconductors. 7

2. (a) Explain the magnetic behaviour of $[Co(NH_3)_6]^{+3}$ on the basis of Crystal field theory. Also describe the octahederal splitting of d-orbitals with diagram. 6

(b) Write the postulates of Molecular orbital theory. Calculate the bond order for N_2, N_2^+ and N_2^- using Molecular orbital energy level diagram of N_2. 7

(c) Differentiate between Atomic orbitals and molecular orbitals. 2

Unit II

3. (a) What is the principle of IR spectroscopy ? Explain different molecular vibrations feasible in a molecule that are considered in Vibrational spectroscopy. 6

(b) Which radiations are used for electronic spectroscopy ? Also explain various electronic transitions that can occur in an organic molecule with example. 6

(c) What is the difference between Phosphorescence and fluorescence ? 3

4. Write notes on the following : 5+4+6

(a) NMR spectrocopy

(b) Jablonski diagram

(c) Diffraction and scattering of light.

Unit III

5. (a) Define Entropy. Write its units. How entropy changes for an ideal gas when temperature and pressure change at constant volume ? 6

(b) Derive Nernst equation and write its significance. 5

(c) Define the terms-Electrode potential, concentration cell, Gibbs' free energy and electrochemical series. 4

6. (a) Why is there variation in bond angle in NH_3 and NF_3 ? Explain on the basis of VSEPR theory. 3

(b) Define Polarisation and polarisability. Which one is more polar–Sodium chloride or silver chloride and why ? 4

(c) Define Effective nuclear charge. Calculate effective nuclear charge for d-electron of Iron. 4

(d) What is the difference between Ionisation energy and Electronegativity ? Explain with suitable examples. 4

Unit IV

7. (a) Differentiate between E_1 and E_{1cb} mechanism of elimination reactions using proper examples. 6

(b) Describe the synthesis of Paracetamol with mechanism. 5

(c) Define cyclisation reaction and ring opening reaction. Also cite some examples to support your answer. 4

8. (a) What are optically active compounds ? Describe enantiomers, meso compounds and diastereomers. 7

(b) Explain chair and boat conformation of cyclohexane. Which one is more stable and why ? 5

(c) Write Fischer projection of the following compounds :

(i) (S)- 2-Bromopropanoic acid

(ii) (R)- 2-Chloro-2-hydroxyethanal. 3

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BT-2/M-23 42035

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) What is an Algorithm ? Write an algorithm to check whether a person is eligible for a vote or note. 5
   (b) Draw a flowchart of the factorial of numbers. 5
   (c) Discuss block diagram of a computer system. 5

2. (a) Convert the following : 10
   (i) $(8FDA.2C)_{16} = (?)_8$
   (ii) $(65327.472)_8 = (?)_{10}$.
   (b) Differentiate between compiler and interpreter. 5

Unit II

3. (a) Explain the different types of operators in C. 7
   (b) What are storage classes ? How many types of storage classes are used in C ? Explain them. 8

4. (a) Write a C program to print area of circle. 5

(b) Write a C program to check number is even or odd. 5

(c) Write a C program to swap two number without third variable. 5

Unit III

5. (a) Define 2-dimensional array. How are these arrays represented in memory ? Write a C program to print the transpose of a given 2-dimensional array. 8

(b) Differentiate between formal and actual parameters with example. 7

6. (a) What is function ? Write short note on built-in function. Write a C program to print factorial of number. 8

(b) What are parameter passing techniques ? Explain with example. 7

Unit IV

7. (a) What do you understand by dynamic memory allocation ? Differentiate between malloc and calloc. 7

(b) Define Pointers. Why are they important ? Write a C program using pointers to read an array of integers. 8

8. (a) Differentiate between union and structure. Write a C program to implement unions. 8

(b) Write a program that counts the number of characters and number of lines in a text file. 7

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BT-2/M-23 42036

ENGLISH

HM-101A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt any *Five* questions. All questions carry equal marks.

1. (a) Write two synonyms for the following words given (any *eight*) : **8×1=8**

(i) Beautiful

(ii) Guile

(iii) Anger

(iv) Sad

(v) Magnificent

(vi) Hard

(vii) Brave

(viii) Hope

(ix) Captivating.

(b) Write one appropriate antonym for the following words given (any *seven*) : **7×1=7**

(i) Black

(ii) Blunt

(iii) Marvelous

(iv) Opaque

(v) Partial

(vi) Cautious

(vii) Cool

(viii) Easy.

2. Form two suitable words from the following prefix and suffix given : **15**

(i) an.....

(ii) ante.....

(iii) a.....

(iv) ab.....

(v) an.....

(vi) eu.....

(vii) un.....

(viii) en.....

(ix) .....ies

(x) .....ess

(xi) .....ward

(xii) .....ed

(xiii) .....ware

(xiv) .....esque

(xv) .....ism

3. (a) Make sentences from the following phrases : **8×1=8**

(i) Turn a blind eye

(ii) Under the weather

(iii) No pain no gain

(iv) Hit the sack

(v) Once in a blue moon

(vi) Bite the bullet

(vii) Stabbed in back

(viii) pull off.

(b) Punctuate the following sentences : **7×1=7**

(i) he said listen to the music with eyes closed

(ii) Shut the window

(iii) We visited her this morning the nurse told

(iv) She came to see her

(v) The following colors are primary colors red blue and green

(vi) I want to leave said Meera

(vii) you can wait said Roma.

4. Discuss in brief the organizing principles of paragraph writing with valid examples. 14

5. (a) Fill in the blanks with most appropriate word given in the parenthesis : **10**

(i) They went.....(to/was) meet me, but I.....(was/were) out of town at that time.

(ii) Handle with care as you.....(may/could) break the crockery.

(iii) .....(a/an) apple.....(a/an) keeps the doctor away.

(iv) Why.....(is/are) she waiting in the lobby ?

(v) Can you please solve.....(this/those) problem ?

(vi) You can.....(see/saw) her provided he.....(agrees/agreed).

(vii) Close the door as it.....(seems/seemed) to rain.

(b) Fill in the blanks in the following sentences with appropriate forms of the verb given in the brackets : **5**

(i) We.....for the station. (leave)

(ii) Although they tried hard, yet they..... not fix the machine. (can)

(iii) It..... since morning. (rain)

(iv) My aunt.....me a shirt for my birthday. (give)

(v) What.....you do then ? (are)

6. Correct the following sentences : 15

(i) I have went Manali last weekend.

(ii) They is going to regret.

(iii) I lives in Italy.

(iv) Herself doesn't listen me.

(v) My flight departs in 5 : 00 am.

(vi) They is coming.

(vii) Every must bring their own boxes.

(viii) Its a cold day.

(ix) These recipes is good for beginners.

(x) What reason did he come for ?

(xi) There father went to the school.

(xii) I am doing good in science.

(xiii) My hair is smoother and softer.

(xiv) She gave me a real nice bouquet of flowers.

(xv) Around a world in 80 days.

7. Write an essay on any *one* of the following topics given (**500** words) : 15

(i) Cybercrimes

(ii) Climate Change Crisis

(iii) Artificial Intelligence

(iv) Moral Values

8. Read the following passage and write a precis : 15

According to Russell, it is the philosopher's job to discover a logically ideal language–a language capable of describing the world in such a way that we will not be misled by the accidental, imprecise surface structure of natural language. As Russell writes, "Ordinary language is totally unsuited for expressing what physics really asserts, since the words of everyday life are not sufficiently abstract. Only mathematics and mathematical logic can say as little as the physicist means to say". Just as atomic facts (the association of properties and relations with individuals) combine to form molecular facts in the world itself, such a language will allow for the description of such combinations using logical connectives such as "and" and "or." In addition to the existence of atomic and molecular facts, Russell also held that general facts (facts about "all" of something) are needed to complete our picture of the world. Famously, he vacillated on whether negative facts are also required.

The reason Russell believes many ordinarily accepted statements are open to doubt is that they appear to refer

to entities that may be known only through inference. Thus, underlying Russell's various projects was not only his use of logical analysis, but also his long-standing aim of discovering whether, and to what extent, knowledge is possible. "There is one great question," he writes in 1911. "Can human beings know anything, and if so, what and how ? This question is really the most essentially philosophical of all questions" (quoted in Slater 1994, 67).

Motivating this question was the traditional problem of the external world. If our knowledge of the external world comes through inferences to the best explanation, and if such inferences are always fallible, what guarantee do we have that our beliefs are true? Russell's response to this question was partly metaphysical and partly epistemological. On the metaphysical side, Russell developed his famous theory of logical atomism, in which the world is said to consist of a complex of logical atoms (such as "little patches of colour") and their properties and relations. (The theory was crucial for influencing Wittgenstein's theory of the same name.) Together these

atoms and their properties form the facts which, in turn, combine to form logically complex objects. What we normally take to be inferred entities (for example, enduring physical objects) are then understood as logical constructions formed from the immediately given entities of sensation ?

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BT-2/M-23 42037

PROBABILITY AND STATISTICS

BS-134A

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) In a bolt factory, machines A, B and C manufacture 25%, 35% and 40% of the total product respectively, of their outputs 5%, 4% and 2% respectively are defective bolts. A bolt is drawn at random from the product and is found to be defective. What are the probabilities that it was manufactured by machines A, B or C ? 8

   (b) Three students A, B and C write an entrance examination. Their chances of passing are 1/2, 1/3 and 1/4 respectively. Find the probability that at least one of them passes. 7

2. (a) A random variable X has the following probability function :

X	P(x)
0	0
1	k
2	$2k$
3	$3k$
4	$3k$
5	k^2
6	$2k^2$
7	$k + 7k^2$

(i) Find the value of the k

(ii) Evaluate P (X < 6), P (X ≥ 6)

(iii) P(0 < X < 5). 8

(b) A die is tossed thrice. A success is 'getting 1 or 6' on a toss. Find the mean and variance of the number of successes. 7

Unit II

3. (a) X is continuous random variable with a probability density function given by :

$F(x) = k\,x \; (0 \leq x < 2)$

$= 2\,k \; (2 \leq x < 4)$

$= -k\,x + 6\,k \; (4 \leq x < 6)$

Find k and the mean value of X. 8

(b) A variate X has the probability distribution

x	-3	6	9
$P(X = x)$	$1/6$	$1/2$	$1/3$

Find $E(X)$ and $E(X^2)$. Hence evaluate $E(2X + 1)^2$ 7

4. (a) Fit a binomial distribution to the following frequency distribution : 8

x	f
0	13
1	25
2	52
3	58
4	32
5	16
6	4

(b) Fit a Poisson distribution to the set of observations : 7

x	f
0	122
1	60
2	15
3	2
4	1

Unit III

5. The distribution of age of males at the time of marriage is as follows :

Age (in years)	No. of males
18-20	5
20-22	18
22-24	28
24-26	37
26-28	24
28-30	22

Find at the time of marriage

(i) The average age

(ii) The Model age

(iii) The Median age. **15**

6. Find out the correlation between the 'height of the father' and the 'height of the son', from the following data : **15**

Height of father (in inches)	Height of son (in inches)
65	67
66	68
67	65

67	68
68	72
69	72
70	69
72	71

Unit IV

7. Use the method of least square, and fit a relation of the form $y = ab^x$ to the following data : **15**

x	:	2	3	4	5	6
y	:	144	172.8	207.4	248.8	298.5

8. (a) A random sample of 10 students' marks in Mathematics, and Statistics are given below. Test whether the correlation exists between the marks of the two subjects at a 5% level of significance. ($t_{0.05}$ = 2.36 for 08 degrees of freedom). **8**

Mark in Mathematics	Marks in Statistics
68	59
54	68
78	72
75	67
76	72

85	78
54	64
68	58
87	68
75	74

(b) A sample analysis of the examination results of 200 M.A. students was made. It was found that 46 students had failed, 68 secured third division, 62 secured second division and the rest were placed in the first division. Are these figues, commensurate with the general examination result which is in the ratio of 4 : 3 : 2 : 1 for various categories respectively ? $P(x^2 < 7.815) = 0.05$. 7

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BT-2/M-23 42038

ENGINEERING GRAPHICS AND DESIGN

ES-109A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt any *Five* questions.

1. (a) Describe the principles of Engineering Graphics. **5**

(b) Construct a diagonal scale of 1 : 50, to show metres, decimetres and centimetres and long enough to measure up to 6 metres. Also indicate on this scale a distance of 4 m, 5 dm and 4 cm. **10**

2. (a) Explain the principles of isometric projection. **5**

(b) Discuss the general methods for generating Hyperbola. **6**

(c) Define the following : **2×2=4**

(i) Epicycloid

(ii) Hypocycloid.

3. Draw the projections of the following points on a common reference line keeping the distance between their projectors 40 mm apart : **15**

(a) Point A is 25 mm below the H.P. and in the V.P.

(b) Point B is 35 mm in front of the V.P. and 25 mm below the H.P.

(c) Point C is 40 mm above the H.P. and 20 mm behind the V.P.

(d) Point D is 20 mm below the H.P. and 4O mm behind the V.P.

(e) Point E is both in H.P. and V.P.

4. A hexagonal prism has one of its rectangular faces parallel to the H.P. Its axis is perpendicular to the V.P. and 3.5 cm above the ground. Draw its projections when the nearer end is 2 cm in front of the V.P. Side of base is 2.5 cm long; axis 5 cm long. **15**

5. A pentagonal prism, base 28 mm side and height 65 mm has an edge of its base on the H.P. and axis parallel to the V.P. and inclined at 60° to the H.P. A section plane, H.T. having its H.T. perpendicular to *xy*, and the V.T. inclined at 60° to *xy* and passing through the highest corner, cuts the prism. Draw the sectional to view and true shape of the section. **15**

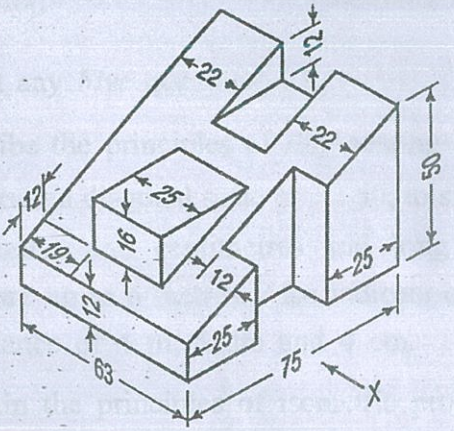
6. A right rectangular pentagonal pyramid, edge of base 40 mm and height 80 mm resting on its base on H.P. is cut by a section plane inclined to H.P. at 45° and meeting the axis at a distance of 20 mm from its top end. Develop the frustum of the prism. **15**

7. (a) What is the use of isometric scale in isometric views ?

(b) What are the principles of isometric projection ?

(c) Explain the projections of solids inclined with both the planes. **3×5=15**

8. Draw the front view, top view and side view in first angle projections of figure given below : **15**



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BT-2/M-23 42039

ENGINEERING GRAPHICS AND DESIGN
ES-109A

Time : Three Hours] [Maximum Marks : 75

Note : Attempt any *Five* questions.

1. (a) Describe the significance of Engineering graphics. 5

(b) Draw a scale of 1 : 50 or of R.F. 1/50 to show metres and decimetres and long enough to measure up to 6 metres. 5

(c) Explain the usage of Drawing Instruments in Engineering Graphics and Design. 5

2. (a) What is the difference between first angle projection and third angle projection ? 4

(b) Discuss the general methods for generating ellipse. 5

(c) Brief the following with drawing : 3×2=6

(i) Involute

(ii) Cycloid.

3. Draw the projections of the following points on a common XY line keeping the distance between their projectors 20 mm apart : 15

(a) Point A is 30 mm above HP and 40 mm in front of VP.

(b) Point B is 80 mm above HP and 40 mm behind the VP.

(c) Point C is 30 mm below HP and 40 mm behind the VP.

(d) Point D is 30 mm below the HP and 40 mm in front of VP.

(e) Point E is in both HP and VP.

4. A square pyramid, base 40 mm side and axis 65 mm long has its base in the V.P. One edge of the base is inclined at 30° to the H.P. and a corner contained by that edge is on the H.P. Draw its projections. **15**

5. A triangular prism, base 30 cm side and axis 50 cm long, is lying on the H.P. on one of its rectangular faces with its axis inclined at 30° to the V.P. It is cut by a horizontal section plane, at a distance of 12 mm above the ground. Draw its front view and sectional top view. **15**

6. A cylinder of base diameter 60 mm and axis 80 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**

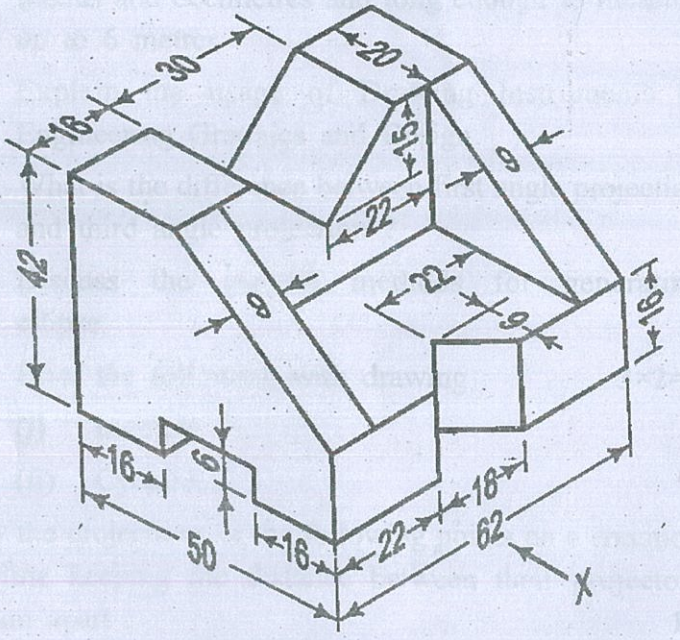
7. (a) What is an isometric scale ? Describe its constructional details.

(b) Explain the principles of isometric projection in detail.

(c) Explain the importance of Development of Surfaces.

5×3=15

8. Draw the front view, top view and side view in first angle projections of figure given below : **15**



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BT-2/M-23 42040

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. Describe the ultrastructure of a typical eukaryotic cell indicating all the cell organelles with the help of a well-labelled diagram. 15

2. Write short notes on the following : 15
   (i) Differentiate between unicellular and multicellular organisms.
   (ii) Chloroplast and its functions.

Unit II

3. Discuss the general characteristics, nomenclature pattern and classification of enzymes in details with the help of suitable examples. 15

4. Write short notes on the following : 15

(i) Functions and classification of carbohydrates

(ii) Effect of temperature on enzyme activity.

Unit III

5. Differentiate between mitotic and meiotic cell division with the help of well-labelled diagrams and highlight their significance. 15

6. Write short notes on the following : 15

(i) Genetics of blood group

(ii) Fungi as agents of plant and human diseases.

Unit IV

7. Discuss the various applications of biology in forensic sciences and agriculture with the help of suitable examples. 15

8. Write short notes on the following : 15

(i) Light and dark reactions of photosynthesis

(ii) Sterilization and its significance in microbiology laboratory.

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BT-2/M-23 42041

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. Find Norton's equivalent of circuit shown as Fig. 1 (below), w.r.t. load resistor of 32Ω. **15**

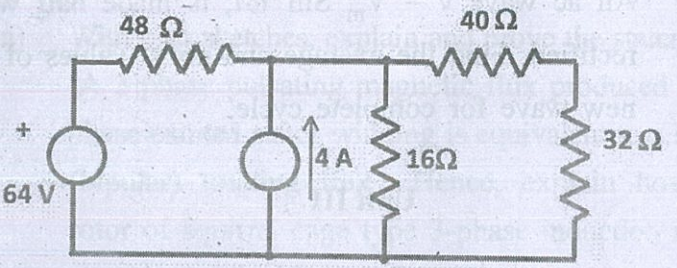

Fig. 1

2. Find Thevenin's equivalent of circuit shown as Fig. 1 (above), w.r.t. load resistor of 16Ω. **15**

Unit II

3. (a) Explain in detail the theory of sinusoidal frequency response of series RLC ckt. including resonance. **10**

(b) The voltage applied to an ac circuit is $500\sqrt{2}\cos(100\pi t)$ V and the ckt. draws current of $100\sqrt{2}\sin(100\pi t - 5\pi/6)$ A. Taking voltage as the reference phasor, find the phasor representation (polar form) of the current in amperes. **5**

4. (a) Given the AC voltages : $V_1 = 20 \sin(\omega t)$ V, $V_2 = 40 \cos(\omega t)$ V and $V_3 = -40 \cos(\omega t + 120°)$ V, find their sum in periodic sine reference. **7**

(b) An ac wave $v = V_m \text{ Sin } \omega t$, is made half wave rectified. Find the average and r.m.s. values of the new wave for complete cycle. **8**

Unit III

5. (a) Explain in detail the two wattmeter method of power measurement for a (star or delta connected) load (any type) with suitable steps containing equations, neat ckt. and phasor diagram. **10**

(b) Taking X-axis intervals of 30 degree each, draw neatly the complete waves on simultaneous axis : $V_1 = V_m \sin \omega t$, $V_2 = V_m \sin (\omega t - 120°)$ and $V_3 = V_m \sin (\omega t - 240°)$. 5

6. (a) Explain in detail the OC and SC test on a single phase transformer. 12

(b) Deduce condition of maximum efficiency of a single phase transformer. 3

Unit IV

7. (a) Explain in detail the construction of a DC motor and working of commutator using neat sketches. 10

(b) Derive generated EMF equation in case of a DC generator. 5

8. (a) With neat sketches, explain and prove the statement : 'A 3 phase pulsating magnetic flux produced by 3-phase excited stator winding is equivalent to a single (bipolar) rotating flux'. Hence, explain how the rotor of squirrel cage type 3-phase induction motor starts rotating. Also explain slip. 12

(b) Give function of an armature coil in an electrical machine. Give examples of motors/generators in which field is stationary/moving with respective armature moving/stationary. 3

Roll No. ..... Total Pages : 03

BT-2/M-23 42042

INTRODUCTION TO ELECTROMAGNETIC THEORY

BS-119A

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 Divergence of a vector field and its physical significance. **5**

   (b) Explain Curl of a vector field and its physical significance. **5**

   (c) Compare between : **5**

   (i) Solenoidal and Non-solenoidal

   (ii) Rotational and Irrotational vector fields.

2. (a) A point charge is located at a point P(1,3,5). Convert the co-ordinates from Cartesian to Cylindrical and spherical co-ordinates. **5**

(b) Derive the expression for Electrostatic Energy Density (per unit volume) in a region of uniform Electric field E and permittivity ε in a parallel plate capacitor. 5

(c) Find the gradient of the scalar field $V = 4xz^2 + 3yz$. 5

Unit II

3. (a) Explain qualitatively why a dielectric gets attracted into an electric field. Derive an expression for the force exerted by the field on the dielectric. 10

(b) Briefly explain Polarization in dielectrics and the field of a dielectric object. 5

4. (a) Derive boundary conditions in the presence of dielectrics. 9

(b) Define the following : 6

(i) Electric displacement

(ii) Susceptibility.

Unit III

5. (a) What is Lorentz's force ? Compare among the electric force given by the Lorentz's law and that of given by the Coulomb's law. 10

(b) Explain Ampere's Law in magnetised material. Does this law obey the Newton's third law ? 5

6. (a) Define vector potential in steady magnetic fields. What is its unit ? Explain how, 'though being a potential, it is a vector quantity'. **10**

(b) Give a classification of magnetic materials. Give at least one important feature of each. **5**

Unit IV

7. (a) Derive the expression for Energy Density (per unit volume) in a region of uniform Magnetic field B and Permeability μ. **5**

(b) Draw a neat and labelled diagram of a propagating plane electromagnetic wave with all the associated fields. **5**

(c) Show that the field in the uniform plane wave is independent of two dimensions. **5**

8. Write down the Maxwell's equations in differential and integral forms and and discuss the physical significance/ circuit relations/field theory concept depicted by each of the equations. **15**

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BT-2/M-23 42043

CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS

BS-136A

Time : Three Hours] [Maximum Marks : 75

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

Unit I

1. (a) Solve :

$$(3x^2y^4+2xy)dx+(2x^3y^3-x^2)dy=0.$$

(b) Solve :

$$\frac{dy}{dx}-\frac{1}{x}y=2x^3+3x+4.$$

2. (a) Solve $\frac{d^2y}{dx^2}+4y=\tan 2x$, by using the method of variation of parameters.

(b) Solve :

$$(1+x)^2\frac{d^2y}{dx^2}+(1+x)\frac{dy}{dx}+y=2\sin[\log(1+x)].$$

Unit II

3. (a) Evaluate :

$$\int_0^{2a} \int_{x^2/4a}^{3a-x} xydydx.$$

(b) Evaluate $\int_0^1 \int_{e^x}^{e} \frac{1}{\log y} dydx$ by changing the order of integration.

4. (a) Find the area bounded by the parabola $y^2 = 4ax$ and its latus-rectum.

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

Unit III

5. (a) Find the directional derivative of the function $\phi = (x^2 - y^2 + 2z^2)$ at the point P(1, 2, 3) in the direction of the line PQ, where Q is the point (5, 0, 4).

(b) State and prove the physical meaning of Divergence.

6. (a) Compute $\int_C \vec{F}.\vec{dr}$, where $\vec{F} = (x^2y^2i + yj)$ and the curve C is $y^2 = 4x$ in the xy-plane from (0, 0) to (4, 4).

(b) Evaluate $\oint_C [xydx + xy^2dy]$ by Stokes's theorem, where C is the square in the xy-plane with vertices (1, 1), (–1, 1), (–1, –1), (1, –1).

Unit IV

7. (a) Prove that an analytic function with constant modulus is constant.

(b) If $u - v = \frac{e^y - \cos x + \sin x}{\cosh y - \cos x}$ and $f(z) = u + iv$ is analytic function of z, then find $f(z)$ in terms of z.

8. (a) Evaluate $\oint_C \frac{e^{2z}}{(z-1)(z-2)} dz$, where C is the circle $|z| = 3$.

(b) (b) Determine the poles of the function $f(z) = \frac{z^2}{(z-1)^2(z+2)}$ and the residues at each pole.