Roll No. | | | | | | | | | | | |

Total No. of Pages : 02

Total No. of Questions : 09

B.Tech. (ECE/CSE) (Sem.–1,2)

SEMI-CONDUCTOR AND OPTOELECTRONICS PHYSICS

Subject Code : BTPH-105-18

M.Code : 75363

Date of Examination: 23-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C. have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

1. Write briefly:

a) Define Density of state.

b) Out of direct and indirect band gap materials, which are used for the production of light?

c) At what temperature we can expect a 5% probability that electrons in silver have an energy which is 1% above the Fermi energy? The Fermi energy of silver is 4.0 eV.

d) Write a note on metal-semiconductor junctions.

e) Highlight the importance of extrinsic semiconductor.

f) Calculate the wavelength of light emitted from LED made using semiconductor material with band gap 1 eV.

g) Discuss radiative recombination mechanism.

h) A 10 mW laser has a beam diameter of 3.2 mm. What is the intensity of the light assuming that it is uniform across the beam?

i) What information can be obtained from capacitance-voltage measurement?

j) What are the necessary conditions for applying Van der Pauw method?

SECTION-B

2. Explain the classical free electron theory of metals. Discuss its assumptions, successes, and limitations in explaining the electrical conductivity of metals.

3. What is Kronig-penny model? Solve Schrödinger wave equation for periodic potential and explain the origin of energy bands in solids.

4. Explain the working of a p-n junction. Discuss the formation of the depletion region, built- in potential and the effect of forward and reverse bias on the junction.

5. Obtain the expression for electron density in an intrinsic semiconductor. Estimate the fraction of electron in conduction band at room temperature in Ge with band gap 1.0 eV.

SECTION-C

6. What is a photo-detector? Explain the principle, construction and working of an Avalanche photodiode. Discuss its advantages.

7. What is stimulated absorption, Spontaneous emission and Stimulated emission? Obtain the relation between different Einstein's coefficients and discuss the result.

8. Explain any method to measure the wavelength of laser light. Can the same method be used for measuring wavelength of white light?

9. a) What is Four-point probe method? Explain the measurement of resistivity using it.

   b) The resistivity of an intrinsic semiconductor is 5.5 Ωm at 30°C and 3.0 Ωm at 42°C. Find the band gap.

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Roll No. | | | | | | | | | | |

Total No. of Pages : 02

Total No. of Questions : 09

B.Tech. (AI & ML/CSE/DS/IT/Internet of Things and Cyber Security including Block Chain Technology) (Sem.–1,2)

SEMI-CONDUCTOR PHYSICS

Subject Code : BTPH-104-18

M.Code : 75360

Date of Examination:23-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C. have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

1. Write briefly:

a) Why are electrons in metals often considered to have free-electron behavior?

b) Out of direct and indirect band gap materials, which is used to fabricate LED and why?

c) In a solid, consider the energy level lying 0.01 eV above Fermi level. What is the probability of this level being occupied by an electron at 200 K?

d) How does doping affect the electrical properties of an intrinsic semiconductor?

e) Describe the depletion region in a p-n junction.

f) Explain the term "population inversion" and its importance in lasers.

g) What is optical loss, and how does it impact the performance of optoelectronic devices?

h) What is the difference between spontaneous and stimulated emission in semiconductors?

i) What are the necessary conditions for applying Van der Pauw method?

j) Can we determine the type of extrinsic semiconductor (n-type or p-type), using hot-point probe?

SECTION-B

2. What are the special features of Classical free electron theory of metals? Derive an expression for the electrical conductivity of a metal.

3. What is Kronig-Penny model? Solve Schrödinger wave equation for periodic potential and explain the origin of energy bands in solids.

4. Obtain the expression for electron density in n-type extrinsic semiconductor.

5. What is the need of extrinsic semiconductors? Discuss the effect of temperature on the Fermi level in extrinsic semiconductors.

SECTION-C

6. What is Fermi's golden rule? Derive the expression for joint density of states.

7. Define the Einstein coefficients for spontaneous and stimulated emission and absorption. Derive the relationships among these coefficients and explain their importance.

8. Define beam spot and divergence for laser beam. Explain the procedure to measure the divergence of laser beam.

9. What is Four-point probe method? How four probe is better than two probe method? Explain the measurement of resistivity using it.

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Roll No. | | | | | | | | | | | |

Total No. of Pages :03

Total No. of Questions : 09

B.Tech.(AI&ML/DS/Block Chain/CE/CSE/Cyber Security/Computer Science and Design)/EE/ECE/ETE/IT/ME/(Robotics & Artificial Intelligence/Internet of Things and Cyber Security including Block Chain Technolog) (Sem.–1, 2)

ENGLISH

Subject Code : BTHU-101-18

M.Code : 93806

Date of Examination :23-12-2024

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

l. **Do as directed :**

a. Give synonym and antonym of fast.

b. Write full form of USSR and UNO

c. He is worried _____ his son's well being, (fill in preposition)

d _____ honest critics is better than _____ fake admirer. (Fill in articles)

e. The book that I borrowed was fascinating. (identify clause)

f. Create antonyms of any two words using prefix "un-".

g. Change any two words into adverb using suffix "-ly"

h. The dog waged _____tail as soon as _____ saw her. (use pronouns)

i. People was discussing the matter in an outrageous manner. (identify the error and correct it)

j. She almost drove her kids to school every day. (place the modifier at correct place)

SECTION-B

2. What strategies can you use to improve the flow of your writing?.

3. How does the use of headings and sub-headings improve document organization?

4. What are the essential elements of a strong introduction?

5. Draft an introduction to a paper on "Environmental Degradation".

SECTION-C

6. Write an email to your client apologising him/her for the delivery of wrong assignment.

7. Write an essay on any of the following: The Impact of Technology on Communication, The Role of Education in Personal Development, or Social Media: A Double-Edged Sword.

8. **Make a precise of the following and give a suitable title :**

In recent years, the importance of mental health awareness has gained significant traction in society. Mental health issues affect millions of people globally, yet they often remain stigmatized and misunderstood. Raising awareness about mental health is crucial for promoting understanding and compassion among individuals. Educational campaigns and public discussions can help dismantle the stereotypes surrounding mental illness, allowing those affected to seek help without fear of judgment. Additionally, workplaces are increasingly recognizing the need for mental health resources, such as counseling services and employee support programs. By fostering a culture that prioritizes mental well-being, organizations not only enhance productivity but also contribute to a healthier workforce. Schools, too play a pivotal role in this movement by integrating mental health education into their curricula, equipping students with the knowledge and tools to support their peers. Moreover, promoting self-care practices, such as mindfulness and stress management techniques can empower individuals to take charge of their mental health. Ultimately, the goal of increasing mental health awareness is to create a supportive environment where everyone feels safe to express their struggles and seek assistance. By breaking down barriers and encouraging open conversations, society can work towards a future where mental health is treated with the same importance as physical health, benefiting individuals and communities as a whole.

9. **Read the following paragraph and answer the questions that follows:**

Renewable energy sources such as solar, wind, and hydropower have become increasingly important in the fight against climate change. Unlike fossil fuels, which release greenhouse gases when burned, renewable energy is considered sustainable and

environmentally friendly. The adoption of these energy sources can significantly reduce our carbon footprint and reliance on non-renewable resources. Many countries are investing in renewable technologies to create jobs, boost their economies, and promote energy independence. Additionally, advancements in technology have made renewable energy more efficient and cost-effective, allowing it to compete with traditional energy sources. Transitioning to renewable energy not only helps combat climate change but also contributes to a cleaner environment and healthier communities.

Comprehension Questions :

a. What are the three types of renewable energy sources mentioned in the paragraph?

b. How do renewable energy sources differ from fossil fuels in terms of environmental impact?

c. What are two benefits of adopting renewable energy mentioned in the text?

d. Why is investing in renewable technologies important for countries?

e. How have advancements in technology affected the competitiveness of renewable energy?

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Total No. of Questions : 09

Total No. of Pages : 02

B.Tech.(AI & ML/Block Chain/CE/CSE/CS/DS/CSD/EE/ECE/IT/ME/ /Internet of Things and Cyber Security including Block Chain Technology) (Sem.–1,2)

PROGRAMMING FOR PROBLEM SOLVING

Subject Code : BTPS101/18

M.Code : 93803

Date of Examination : 20-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

1. **Answer Briefly :**

   a. What is conditional operator? Give an example on how to use it.

   b. Explain different types of computer memory.

   c. What is pseudocode? Give an example.

   d. Give an example of logical error in C.

   e. Write the syntax of (if- else if) control statement.

   f. What is an array? How to initialize each element of the array?

   g. What is a function? Differentiate between user-defined and library function.

   h. Differentiate between array and structure.

   i. What is pointer? How can we access a variable using pointer?

   j. Differentiate between while and do-while loop.

SECTION-B

2. What is recursion? Write a program to find the factorial of a number using recursion.
3. Write a program to find the sum of all elements of an array.
4. Explain in detail various type of operators in C.
5. Explain various data types in C.

SECTION-C

6. Write a program or algorithm to implement bubble sort.
7. Explain in detail various string library functions with the help of proper syntax.
8. What is an operating system? List various features or characteristics of operating system.
9. Write a program to check if the given number is prime or not?

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Total No. of Pages : 03

Total No. of Questions : 09

B.Tech. (AI & ML / AI & DS / AE / CE / CSE / DS / IOT / EE / ECE / IT / ME / Internet of Things and Cyber Security including Block Chain Technology) (Sem.–1,2)

CHEMISTRY-I

Subject Code : BTCH-101-18

M.Code : 75343

Date of Examination : 20-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

1. **Write short notes on:**

   a) What are the criteria for the molecule to be aromatic?

   b) What is role of doping on band structure?

   c) What is magnetic resonance imaging(MRI)?

   d) What is dry corrosion?

   e) Differentiate between ion dipole and dipole-dipole interaction.

   f) What is cell potential?

   g) What are the differences between diastereoisomer and enantiomer?

   h) What are possible geometries for a metal complex with four coordination, number?

   i) What is polarizability?

   j) What is Chirality? Explain with examples.

SECTION-B

2. a) Derive the Schrodinger wave equation for a particle in one dimension box.

   b) Draw the molecular orbital diagram of NO molecule.

3. a) Discuss the crystal field splitting in octahedral complexes.

   b) What is the principle of electronic spectroscopy?

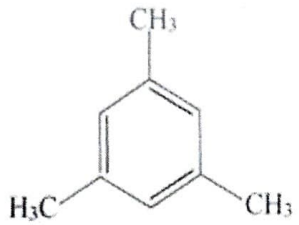
4. a) What is Entropy?

   b) What is Ellingham diagram? How can it be constructed? Discuss its important characteristics.

5. a) How many signals are present in following compounds in PROTON NMR SPECTROSCOPY?

   1. CH_3-NH_2

   2. CH_3-CH_2-O-CH_3

   3. 

   4. CH_3-CH_2-CH_2-OH

   b) Explain the mechanism of fluorescence and phosphorescence by Jablonski diagram.

SECTION-C

6. a) What is electrochemical corrosion? Discuss its various types.

   b) Calculate the equilibrium constant for the reaction.

   $Sn^{2+}(aq) + Pb(s) \rightleftharpoons Sn(s) + Pb^{2+}(aq)$

   At 298K given $E^\circ (Sn^{2+}/Sn) = -0.14V$ and $E^\circ (Pb^{2+}/Pb) = -0.13$ V

7. a) Discuss the structure of BCI^3 and NH^3 according to VSEPR theory.

   b) Why ionisation energy of nitrogen is more than oxygen?

   c) Explain why electron affinities of halogens are high?

8. Discuss the potential energy surface diagram of H_3.

9. a) What are addition reaction? Explain with examples.

   b) Discuss the various possible isomerisation in transitional metal complexes.

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Roll No. | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B. Tech. (AE/AI&ML/AI&DS/IOT/A&R/CE/CSE/DS/EEE/EE/ECE/FT/IT/ME/Internet of Things and Cyber Security including Block Chain Technology)(Sem.–1,2)

ENGINEERING GRAPHICS & DESIGN

Subject Code : BTME101-21

M.Code : 91335

Date of Examination : 14-01-2025

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select at least TWO questions from SECTION - B & C.

SECTION-A

1. Write short notes on :

a) Write the following statement using single stroke capital vertical letters of 12 mm size: ***"WHOEVER IS HAPPY WILL MAKE OTHERS HAPPY TOO".***

b) Explain any two types Lines used in Engineering Drawing.

c) Explain with the help of an example the unidirectional system of placement of dimensions.

d) What is difference between plane scale and diagonal scale?

e) Draw a regular Hexagonal Lamina of side 65mm.

f) How will you represent Metals and Glass on a drawing sheet?

g) Draw projections of a line inclined to HP and parallel to VP with a suitable freehand drawing. Assume suitable dimensions. Also, show traces.

h) Show by means of traces, a plane perpendicular to HP and inclined to VP.

i) Differentiate between Frustum and Truncated solid.

j) Differentiate Isometric Projections and Isometric Drawing.

SECTION-B

2. Line "KL" 68mm long; has its end "K" both in HP and VP. It is inclined at 42° to the "HP" and 33° to the "VP". Draw its projections when the line is lying in first quadrant.

3. A line CD has its end "C" 10 mm above HP and 15 mm in front of VP. End "D" 42 mm above HP and 58 mm in front of VP. The distance between the end projectors, is 48 mm. Draw the projections of the line and find out its true length, true inclinations with principle planes, HT and VT.

4. A point "M" is 39mm behind VP and 32mm below HP. Draw its projections and find out its shortest distance from the reference line.

5. Construct a Plane Scale of R.F= 1:40 to read meters and decimeters and long enough to measure up to 6m. Indicate 4.4m on the scale.

SECTION-C

6. A hexagonal prism of side of base 28mm and length of axis 65mm lies on one of its rectangular faces on HP with axis Perpendicular to VP and parallel to HP. Draw its projections.

7. A circular lamina of diameter 42mm is inclined to VP at 44° and perpendicular to HP and it is resting on VP on a point on its circumference. Draw its projections. Also show traces.

8. A cone of base rim diameter 45mm and axis 65 mm lying on HP on a point of its circumference such that the generator is perpendicular to HP. Draw its projections assuming the cone lying in first quadrant.

9. Draw the isometric drawing of the Frustum of a right regular hexagonal pyramid, side of the base hexagon is 20 mm, side of top hexagon is 10 mm, and the height of the frustum is 40 mm.

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Roll No. | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(AI&ML/AI&DS/DS/CE/CSE/IOT/EE/ECE/FT/IT/ME/Robotics & Artificial Intelligence/Internet of Things and Cyber Security including Block Chain Technology/) (Sem.–1,2)

PROGRAMMING FOR PROBLEM SOLVING

Subject Code : BTPS-101-18

M.Code : 75346

Date of Examination : 21-01-2025

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C. have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

1. **Write briefly :**

   a) What are the main components of a computer system?

   b) Define syntax and logical errors with examples.

   c) What is operator precedence in arithmetic expressions?

   d) What is an array, and why is it used in programming?

   e) Define linear search in an array.

   f) What are built-in functions and why are they used?

   g) What is recursion?

   h) What is the structure in programming?

   i) What is a pointer in programming?

   j) What is file handling in programming?

SECTION-B

2. Explain the process of converting an algorithm to a program, covering source code, variables, and memory locations.

3. Discuss the concept of loops and explain the differences between for, while, and do-while loops.

4. Discuss character arrays and how they differ from string data types in handling text?

5. Explain parameter passing in functions with examples of call by value and call by reference.

SECTION-C

6. Draw a flowchart to find the maximum of three numbers.

7. Create a program that checks if a number is prime using conditional statements and loops.

8. Explain the process of linear and binary search algorithms with examples.

9. Explain the concept of merge sort and quick sort using recursion, with a step-by-step example.

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Total No. of Questions : 09

Total No. of Pages : 02

B.Tech. (AIDS/AIML/IOT/CSD/ETE/Blockchain/CE/CSE/DS /EE/ECE/FT/IT/ME/Robotics & Artificial Intelligence/Internet of Things and Cyber Security including Block Chain Technology) (Sem.–1,2)

CHEMISTRY-I

Subject Code : BTCH101/23

M.Code : 93800

Date of Examination : 18-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION - B & C have FOUR questions each.**
3. **Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.**
4. **Select atleast TWO questions from SECTION - B & C.**

SECTION-A

1. Write short notes on :

a) What does ψ^2 represent in the context of the Schrodinger wave equation?

b) Explain how n-type and p-type doping modify the band structure of a semiconductor and affect its conductivity?

c) Define chromophores and auxochromes. How do they influence the absorption spectrum of a molecule?

d) Write the expression for the energy levels of a diatomic molecule in rotational spectroscopy.

e) What are Ionic interactions, and how do they differ from dipolar interactions?

f) How does the zeolite process work in softening of hard water?

g) What is the hardness of water? Differentiate between temporary and permanent hardness.

h) What is ionization energy, and how does it vary across periods and groups in the periodic table?

i) What is optical activity and how it can be used to distinguish between enantiomers?

j) How does a free radical addition reaction occur?

SECTION-B

2. a) How can you explain the splitting of d-orbitals in an octahedral crystal field?

   b) Give the solution to the Schrodinger equation for a particle in a one-dimensional box.

3. a) Provide the molecular orbital energy level diagram for nitrogen (N_2). Based on this diagram, determine the bond order, discuss the molecule's stability, and explain whether it is paramagnetic or diamagnetic.

   b) What is fluorescence, and how is it used in medical applications?

4. a) What are the selection rules for vibrational and rotational transitions in diatomic molecules?

   b) List two factors that can affect the wavelength (λ_{max}) and intensity of absorption bands in electronic spectroscopy. Also explain the reason.

5. a) What is the van der Waals equation of state, and how does it describe the behavior of real gases?

   b) Describe Boyle's Law and Charles's Law. Also derive the ideal gas equation.

SECTION-C

6. a) What is electrochemical corrosion, and how does it differ from dry corrosion?

   b) What is the relationship between free energy and the electromotive force (emf) of a cell?

7. a) Explain the concept of Hard and Soft Acids and Bases (HSAB) and give examples of each.

   b) Explain electron affinity and its trend across periods and groups of the periodic table giving suitable reasoning.

8. a) Perform a conformational analysis of Ethane and illustrate the potential energy diagram for its various conformations.

   b) What is chirality and explain why certain molecules are chiral?

9. a) What are the different between E1and E2 elimination reaction?

   b) What is Markovnikov's rule, and how does it apply to addition reactions?

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Total No. of Questions : 05

Total No. of Pages : 02

B.Tech. (AI&ML)/(Civil Engg.)/(CSE/DS) /(EE)/(ECE)/(IOT Cyber Security including Block Chain Technology)/ (IT)/(ME) (Sem.–1,2)

ENGLISH

Subject Code : BTHU/101/18

M.Code : 75349

Date of Examinaton : 18-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES:

1. All Questions are compulsory.
2. Question 1,2,3 carry TEN marks each and question 4,5 carry FIFTEEN marks each.

1. **a) Use the following phrases in sentences:**

Break the ice, Bread and Butter, A piece of cake, A hard nut to crack, All ears

b) State whether the following sentences are compound or complex:

i. It's gone 10pm, and he still hasn't arrived.

ii. Our car broke down, so we took a taxi.

iii. I'll have a week in Rome, or I'll go to Paris for three days.

iv. Whenever it rains, I like to wear my blue coat.

v. Though she loves her job, yet she complains about it a lot.

2. **a) Condense the following passage retaining the main idea and using the minimum number of words:**

Almost every organism has the tendency to react to certain stimuli for survival. This reaction to each and every situation has an evolutionary basis of adaptation. The study of human emotions dates back to the 19th century and psychologists have discovered many reasons for every emotion, yet these are just theories. The arousal of emotions and their assumed structures is said to occur due to repeated encounters with a situation followed by the adaptation of the encounter. Human emotions have been linked to. adaptively regulate emotion gathering mechanisms. The emotion of fear which is associated with ancient parts of the brain has presumably evolved among our pre- mammal ancestors while the emotion of a mother's love called the 'filial emotion' has seen to evolve among early mammals. Various emotions work as manipulative strategies that favour survival.

Feigning emotions by an accused person may help him be saved from the punishment. An exaggerated display of anger is also associated with manipulating or threatening someone.

b) **Use the appropriate preposition in the following sentences:**

i. Matilde lost her ring _____ the beach.

ii. The book belongs _____ Anthony.

iii. They were sitting _____ the tree.

iv. The fish swan _____ the ship.

v. She can't wait until next month _____ treatment.

3. **Do as Directed :**

i. Synonym of Start, Big

ii. Antonym of Vague, Choosen

iii _____ zoo has _____ elephant enclosure. (Fill in article)

iv. Punctuate the following sentence: students will acquire basic proficiency in reading listening comprehension writing and speaking skills

v. Full form of AD, c/o

4. Write an essay in about 500 words on "Effect of Pollution on the planet Earth".

5. Being the Convener of Inter-college Athletic Meet, draft your report on the Meet organized by your Institute to be submitted to the University.

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Roll No. | | | | | | | | | | | |

Total No. of Questions : 09

Total No. of Pages : 03

B.Tech. (AE/CE/CSE/ME) (Sem–2)

MATHEMATICS-II

Subject Code : BTAM203/18

M.Code : 91959

Date of Examination : 19-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

1. Solve :

a) For the differential equation $xdy - ydx = e^y(x^2 + y^2)dy$, check whether the equation is exact or not.

b) Find the general solution of the Clairaut's equation $y = xy' + e^{-y'}$.

c) Find a general solution of the differential equation $y'' - 4y' - 12y = 0$.

d) Find the general solution of the homogeneous differential equation $x^2y'' + 4xy' + 2y = 0$, where $x > 0$.

e) Find the regular and singular points of the differential equation $x^2y'' + axy' + by = 0$, a, b are constants.

f) Find $\lim_{z \to \infty} \frac{z}{2 - iz}$

g) Show that if $f(z)$ is analytic and $Im\, f(z)$ = constant, then $f(z)$ is a constant.

h) Determine all the points (if any) at which the Cauchy-Riemann equations are satisfied for the function $f(z) = z(Re\, z)$.

i) Evaluate, $\int_a^b \phi(t)dt$, where $\phi\ t = te^{-it}$, $a = 0, b = \pi$.

j) State Cauchy residue theorem.

SECTION-B

2. a) Find the integrating factor and hence solve the differential equation:

$$(4y + x^3)dx + xdy = 0.$$

b) Find the solution of the Bernoulli equation $y' + y = xy^{5/3}$.

3. a) Find the general solution of the homogeneous differential equation:

$$x^2y'' - 3xy' + 3y = 2 + 3\ln x, \text{where } x > 0.$$

b) Solve $y^2p^2 - 3px + y = 0$, where $p = \frac{dy}{dx}$.

4. Find the power series solutions about the origin of the second order equation: $y'' - 3x^2y' = 0$.

5. Find the general solution of the differential equation $y'' + 4y = \sec 2x$, using the method of variation of parameters.

SECTION-C

6. a) Show that the function $f(z)$ is not continuous at $z = 0$, where

$$f(z) = \begin{cases} \frac{Im(z)}{|z|}, & z \neq 0 \\ 0 & z = 0. \end{cases}$$

b) Compute the limit $\lim_{z \to i} \left[x + \frac{i}{1-x} \right] e^{xy}$.

7. a) Show that the function $v(x, y) = y + 3x^2y - y^3$ is harmonic. Find the corresponding conjugate harmonic function $u(x,y)$ and construct the analytic function $f(z) = u + iv$.

b) Under the mapping $w = f(z) = \sin z$, find the image in the w-plane of the strip $(-\pi/2) < \text{Re}(z) < (\pi/2)$, $\text{Im}(z) > 0$ in the z-plane. Is the mapping conformal?

8. a) Evaluate the integral $\oint_G \frac{dz}{2-\bar{z}}, C:|z|=1.$

b) Obtain the first three non-zero terms in the Taylor's series expansion for the function tan z about the point $z_0 = 0$.

9. a) Compute the residues at the singular points of $f(z)$, where $f(z) = \frac{z^2}{z^2 - 2z + 2}$.

b) Obtain the Laurent series expansion of function $f(z) = cosec\ z$ about the point $z_0 = n\pi$, n is integer.

NOTE : Disclosure of Identity by writing Mobile No. or Marking of passing request on any paper of Answer Sheet will lead to UMC against the Student.