8. Example of hard matter template is/are

(a) DNA (b) Porous alumina (c) Micelles (d) All of the them

9. Examples of soft matter include,

(a) Soap bubbles (b) Polymers (c) Micelles (d) All of the them

10. The Very First Man-Made Nano Structure -The "Buckyball" contains 60 carbon atoms in the shape of a Soccer ball with a diameter of

(a) 0.3nm (b) 0.7nm (c) 0.9nm (d) 1.4nm

11. Examples of natural colloids are

(a) milk (b) blood (c) fog (d) all of the above

12. Tunneling is the penetration of an electron into an energy region that is classically forbidden. Which important instrument (for imaging nanostructured surfaces) based upon this phenomenon?

(a) AFM (b) STM (c) SEM (d) TEM

13. Metal gold is notably yellow in colour and used for jewellery, if gold is shrunk to a nanoparticle, it changes colour, becoming red if its shape is,

(a)Oval (b) ring (c) spherical (d) rod

14. Contact angle is high at surface of

(a) Hydrophilic (b) hydrophobic (c) both same (d) None of the above

15. Which shape represents the lowest energy configuration of solid materials?

(a) Square (b) disc (c) sphere (d) all are same

16. Addition of atomic or molecular starting materials is a

(a) top-down technique (b) molecular technique
(c) bottom-up technique (d) atomic Technique

17. Which technique is used to fabricate carbon nanomaterials?

(a) Laser Ablation (b) Chemical vapour deposition
(c) Arch discharge (d) All of the above

18. Which of the following technique is the bottom up?

(a) Polishing (b) Grinding (c) Extrusion (d) Chemical vapour deposition

19. How many gold atoms placed in a row equal to 1nm.

(a) 2.5 (b) 3.5 (c) 4.5 (d) 5.5

20. Nanomaterials are those materials whose properties are determined by features between,

(a) 1 and 100 nm in at least 3 dimensions
(b) 1 and 200 nm in at least 2 dimensions
(c) 1 and 150 nm in at least 2 dimensions
(d) 1 and 100 nm in at least 2 dimensions

MA / MSc (ANNUAL) EXAMINA

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Subject:- **PHYSICS** Paper:- **III (Prev)**

Thermal & Statistical Physics

Time Allowed :- 3 Hours Max : Marks : 50

Note :- Attempt any Five Questions in All But Question No. 1- in section –I is compulsory and the time for Section- I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 10 MARKS)

Q.No-1. Attempt any **TEN.**

1. It is possible to convert internal energy to mechanical energy . Explain with examples.
2. Using the first law of thermodynamics , explain why the internal energy of an isolated system is always constant.
3. Does the second law of thermodynamics contradict or correct the first law ? argue for your answer.
4. Give an example of an irreversible process that occurs in nature.
5. Discuss three common examples of natural process that involve an increase in entropy.
6. Differentiate between micro and macro states.
7. Define thermodynamic probability.
8. Energy equation is also called as _____ equation.
9. Write down Tds equations.
10. What is enthalpy?
11. Free energy is also called as _____ energy
12. Define entropy.

SECTION –II(SUBJECTIVE PORTION 40 MARKS) TIME ALLOWED 2:20

Note:- Attempt any Four Questions from this section.

Q. No-2. What is meant by thermodynamical equilibrium? Discuss the equilibrium between a liquid and its vapour state and hence deduce Clausius – Clapeyron's equation.

Q. No-3 (a) Deduce the following Maxwell's relations.

(i) $(\partial S/\partial V)T = (\partial P/\partial T)V$ (ii) $(\partial S/\partial P)T = (\partial V/\partial T)P$.

(b) Show that for homogenous fluid

$$Cp - Cv = T(\partial P/\partial T)V \ (\partial V/\partial T)P$$

Q.No-4. What is Black Body radiation? State Stefan's law of radiation and prove it from thermodynamical considerations.

Q.No-5. Under suitable conditions the Joule Thompson effect results in cooling and so does an adiabatic expansion of a gas. Distinguish between these two types of cooling.

Q.No-6. Distinguish between Classical Statistics , Fermi -Dirac Statistics and Bose Einstein Statistics.

Q.No-7. Discuss Fermi -Dirac distribution law and show that

$$n_i = \frac{g_i}{\left[e^{(\alpha + \beta E_i)}\right] + 1}$$

Q.No-8. Derive and discuss the Vander Waals equation of state of a gas ,mention its defects.

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Subject:- **(PHYSICS).** Paper:- **IV (Prev)**

Electromagnetic Theory.

Time Allowed :- 3 Hours Max : Marks : 100

Note :- Attempt any Five Questions in Alf But Question No. 1- in section –I is compulsory and the time for Section- I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 20 MARKS)

Q.No.1 Write short answers of the 10 following Questions.

1. Write down the Mathematical expression of coulomb's law.
2. Write the differential form of electric field intensity.
3. What is charge intensity?
4. What is flux?
5. Write down the four Maxwell's equation in differential form.
6. What is pointing theorem.
7. Write down the Mathematical expression for the potential energy of moving charge.
8. Express the Mathematical from of Laplace equation.
9. What is reflection?
10. Through which medium, the higher frequency electromagnetic waves at the range of meter or less are generated and transmitted.
11. Write the mathematical expression for surface current in case of field at the surface of a conductor.
12. What is power loss in a resonant cavity?
13. Write the formula for oscillating charge density.
14. Write the formula for oscillating charge current density.
15. What is group velocity?
16. What is special theory of relativity?
17. What is inertial frame of reference?
18. Who proposed the postulates of special theory of relativity.
19. State the Einstein postulate of the speed of Light.
20. State the Einstein postulate of the universal limiting speed.

SECTION –II(SUBJECTIVE PORTION 80 MARKS) TIME ALLOWED 2:20

Attempt any Four (04) questions.

Q.No.2 (a) What is electric field? Find the electric field of two point charges q_1 and q_2 separated by a distance $\mathscr{r}$.

(b) Find the electrostatic force for two point charges q_1 and q_2.

Q.No.3 (a) What is pointin theorem? Derive the expression for power flow and show that the pointing vectors s is $S = E \times H$

(b) Derive the charge conservation law $\frac{\partial e}{\partial t} + \nabla J = o$ from.

Amper's law by using Mawell equations.

Q.No.4 Solve the laplace equations in spherical coordinates.

Q.No.5 Write in detail the energy flow and attenuation in wave guide.

Q.No.6 How the attenuation take place in wave guide explain in detail.

Q.No.7 Express the integral and differential from of Maxwell's equations alo write in detail the physical Signifance of it.

Q.No.8 Write in detail the special theory of relativity based on the Einstein postulates.

Q.No.9 What is lorentz's transformation derive the expression for it.

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SUBJECT:- **PHYSICS** PAPER-V (Prev) **ELECTRONICS** (*New course*)

TIME ALLOWED: 3 HOURS MAX. MARKS:-100

Note:- ***Attempt any five Questions in all, including Question No.1,which is compulsory. Time for question No. 1 is 40 minutes. After 40 minutes paper must be returned to the centre superintendent or the invigilator.***

SECTION - I (20 MARKS)

Q. No.1 Select the most appropriate option from each of the following.

1. For a Germanium diode, the typical value of forward biased voltage
(a) Must be greater than 0.7 V
(b) Must be greater than 0.3 V
(c) Depends on the width of depletion region
(d) Depends on the concentration of majority carrier

2. The dynamic resistance can be important when a diode is
(a) reverse-biased (b) forward-biased
(c) In reverse breakdown (d) unbiased

3. Although current is blocked in reverse bias
(a) There is some current due to majority carrier (b) There is small current due to minority carrier (c) There is an avalanche current (d)a, b, c all are correct

4. The average value of half wave rectified voltage with a peak of 100V
(a) 31.8 V (b) 0 V (c) 63.7 V (d) 70.5 V

5. The total secondary voltage in a centre taped full wave rectifier is 125 V. Neglecting the diode drop, the output voltage is
(a) 125 V (b) 177 V (c) 100 V (d) 62.5 V

6. The common emitter amplifier is unique because the input and output voltages are out of phase by
(a) 120^0 (b) 180^0 (c) 90^0 (d) 150^0

7. A thyristor has
(a) two pn junctions (b) three pn junctions
(c) four pn junctions (d) only two terminals

8. An LED
(a) Emits light when reverse biased (b) Sense light when reverse biased
(c) Act as a variable resistance (d) Emits light when forward biased

9. The SCS differs from the SCR because
(a) it does not have a gate terminal (b) its holding current is less
(c) it has two gate terminals (d) it can handle much higher currents

10. The internal resistance of photo diode
(a) Increases with light intensity when reverse biased (b) Decreases with light intensity when reverse biased (c) Increases with light intensity when forward biased (d) Decreases with light intensity when forward biased

11. In cut off region, V_{CE} is
(a) 0 V (b) Minimum (c) a and b (d) Equal to V_{cc}

12. In saturation region, V_{CE} is
(a) 0.7 V (b) Equal to V_{cc} (c) Minimum (d) Maximum

13. Once in saturation, a further increase in base current will
(a) Cause the collector current to increase (b) Not affect the collector current
(c) Cause the collector current to decrease (d) Turn the transistor off

14. The voltage divider biased NPN transistor consists of two resistors. if the lower resistor is open
(a) The transistor is not affected (b) The transistor may be into cut off region
(c) The transistor may be driven into saturation (d) The collector current will decrease

15. The parameter h_{fe} corresponds to
(a) β_{DC} (b) β_{ac} (c) r_e' (d) r_i

16. A certain common emitter amplifier has a voltage gain of 100. If the emitter bypass capacitor is removed
(a) The current will become unstable (b) The voltage gain will decrease (c) The voltage gain will increase (d) Q point will shift

17. An n-channel D-MOSFET with a positive V_{GS} is operating in
(a) The depletion mode (b) The Enhancement mode
(c) Cut off (d). Saturation

18. In differential mode
(a) Opposite polarity signals are applied to the input (b) The gain is one
(c) The outputs have different amplitude (d) Only one supply voltage is applied

19. Voltage follower
(a) has gain of one. (b) is non-inverting (c) has no feedback resistor (d) has all of these

20. Instrumentation amplifiers are used primarily in
(a) High noise environment (b) Medical equipment
(c) Test instruments (d) Filter circuit

SECTION- II (MARKS-80)

Note: Attempt any four questions from this section. All question carry equal marks.

Q.2. (i) Explain Intrinsic and Extrinsic semiconductors. How P-type and N-type semiconductors are formed? Compare the depletion region in forward and reverse biasing (10)

(ii) What is the necessity of using the filter circuits in rectifier? Explain π-type and T-type filters with circuit diagram. (10)

Q. 3. (i) Explain collector feedback bias and base bias with circuit diagram. (14)

(ii) Calculate the value of V_{CE} and I_C for collector feedback biasing if V_{CC}= 10V, R_C =10KΩ, R_B=100KΩ, β_{DC}=100 (06)

Q. 4. (i) Explain the operation of emitter follower with the help of circuit diagram. Derive the relations for input impedance, output impedance, and voltage gain. (12)

(ii) Explain the function of common collector circuit as Darlington pair (08)

Q. 5. (i) What is positive feedback? Draw the diagram of phase shift oscillator and explain its operation. (10)

(ii) What is Barkhausen criterion? Draw only the circuit diagrams of Hartley oscillator and Colpitts oscillator. (10)

Q. 6. (i) What is JFET? Explain its construction. Draw and explain its drain characteristic curve and transfer characteristic curve (12)

(ii) Give at least four differences of BJTs and FETs (08)

Q. 7. (i) What do you mean by four layer diode? Explain the construction and operation of four layer diode. Briefly explain any one application of four layer diode. (12)

(ii) What is Diac? Briefly explain the operation of Diac. (08)

Q. 8. (i) Explain the function of non-inverting amplifier and find out the equation for its closed loop gain. (12)

(ii) What is voltage follower circuit? (04)

(iii) Define the term CMRR. (04)

Q. 9. Explain any two of the following. (10+10)

(i) Clippers

(ii) Transistor as a switch

(iii) Op-Amp as summing amplifier

---------THE END ----------

SECTION- II (MARKS-40)

Note: Attempt any four questions from this section. All question carry equal marks.

Q.2. (i) Explain Intrinsic and Extrinsic semiconductors. How P-type and N-type semiconductors are formed? Compare the depletion region in forward and reverse biasing (06)
(ii) Describe the current-voltage characteristics of simple semiconductor diode and Zener diode (04)

Q. 3. (i) What is the necessity of using the filter circuits in rectifier? Explain π-type and T-type filters with circuit diagram. (05)
(ii) What are diode limiters? Explain positive and negative limiters with circuit diagram. (05)

Q. 4. (i) Explain collector feedback bias and base bias with circuit diagram. (07)
(ii) Calculate the value of V_{CE} and I_C for collector feedback biasing if
V_{CC}= 10V, R_C=10KΩ, R_B=100KΩ, β_{DC}=100 (03)

Q. 5. (i) Explain the operation of emitter follower with the help of circuit diagram. Derive the relations for input impedance, output impedance, and voltage gain. (06)
(ii) Explain the function of common collector circuit as Darlington pair (04)

Q. 6. (i) What is positive feedback? Draw the diagram of phase shift oscillator and explain its operation. (05)
(ii) What is Barkhausen criterion? Draw only the circuit diagrams of Hartley oscillator and Colpitts oscillator. (05)

Q. 7. (i) What is JFET? Explain its construction. Draw and explain its drain characteristic curve and transfer characteristic curve (06)
(ii) Give at least four differences of BJTs and FETs (04)

Q. 8. (i) Explain the function of non-inverting amplifier and find out the equation for its closed loop gain. (06)
(ii) What is voltage follower circuit? (02)
(iii) Define the term CMRR. (02)

Q. 9. Explain any two of the following. (5+5)
(i) Clampers
(ii) Transistor as a switch
(iii) Light emitting diode

THE END

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SUBJECT: - **PHYSICS** PAPER-V (Prev)

ELECTRONICS (*old course*)

TIME ALLOWED: **3 HOURS** MAXMARKS:-**50**

Note:- ***Attempt any five Questions in all, including Question No.1,which is compulsory. Time for question No. 1 is 40 minutes. After 40 minutes paper must be returned to the centre superintendent or the invigilator.***

SECTION – I (10 MARKS)

Q. No.1. Select the most appropriate option from each of the following.

1. The band gap energy of Silicon is,
(a) 1.12 eV (b) 0.6 eV (c) 0.7eV (c) 0.3eV

2. For a Silicon diode, the typical value of forward biased voltage
(a) Must be greater than 0.7 V (b) Must be greater than 0.3 V (c) Depends on the width of depletion region (d) Depends on the concentration of majority carrier

3. When PN junction is Reverse biased
(a) The only current is hole current (b) The only current is electron current
(c) The only current is due to minority carrier (d) The current is due to both holes and electron

4. The average value of half wave rectified voltage with a peak of 100V
(a) 31.8 V (b) 0 V (c) 63.7 V (d) 70.5 V

5. The total secondary voltage in a centre taped full wave rectifier is 125 V. Neglecting the diode drop, the output voltage is
(a) 125 V (b) 177 V (c) 100 V (d) 62.5 V

6. The common emitter amplifier is unique because the input and output voltages are out of phase by
(a)120° (b) 180° (c) 90° (d) 150°

7. An LED
(a) Emits light when reverse biased (b) Sense light when reverse biased (c) Act as a variable resistance (d) Emits light when forward biased

8. A diode that act as a variable capacitor is
(a) Schottky diode (b) Tunnel diode (c) Laser diode (d) Varactor diode

9. If a Zener diode has a Zener voltage 3.6V, it operates in
(a) Regulated breakdown (b) Zener breakdown
(c) Forward conduction (d) Avalanche breakdown

10. The internal resistance of photo diode
(a) Increases with light intensity when reverse biased (b) Decreases with light intensity when reverse biased (c) Increases with light intensity when forward biased (d) Decreases with light intensity when forward biased

11. In cut off region, V_{CE} is
(a)0 V (b) Minimum (c) a and b (d) Equal to V_{CC}

12. In saturation region, V_{CE} is
(a) 0.7 V (b) Equal to V_{CC} (c) Minimum (d) Maximum

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15. The parameter h_{fe} corresponds to
(a) β_{DC} (b) β_{ac} (c) r_e' (d) r_c'

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