WEST BENGAL STATE UNIVERSITY

B.Sc. Honours PART-II Examinations, 2018

ELECTRONICS-HONOURS

PAPER-ELTA-III-A

Time Allotted: 2 Hours | Full Marks: 50

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Group-A

1. Answer any ***five*** questions from the following: 2×5 = 10

   (a) Define Array and Pointer in C.
   (b) Explain the necessity of Loops in C.
   (c) What is the difference between actual and formal arguments?
   (d) Explain electron scattering.
   (e) What do you mean by thermoionic work functions of a metal?
   (f) State Bloch's theorem in one dimension.
   (g) Show that the packing fraction for fcc lattice is $\frac{\pi\sqrt{2}}{6}$.
   (h) Why are the effective mass of electron and hole different?
   (i) How can a position be notified in stack?

Group-B

Answer any ***three*** questions from the following 5×3 = 15

2. Write a C-program to produce the following output. 5

```
A B C D E D C B A
A B C D   D C B A
A B C       C B A
A B           B A
A               A
```

3. Write a C-program to find smallest and largest elements from one dimensional array elements. 5

4. Using Runge-Kutta Method write a C-program to solve the following differential equation with initial conditions $x_0 = 0$ and $y_0 = 1$ from x = 0 to x = 0.4 for an interval of h = 0.1 5

$$\frac{dy}{dx} = x + y .$$

5. (a) Define recursive function. 1

(b) Using pointer, write a C-program to print and calculate the sum of the following series. 4

$$S = 1^1 + 2^2 + 3^3 + ... + 100^{100}$$

6. Write a C-program to find the roots of a quadratic equation $ax^2 + bx + c = 0$. 5

7. Write a program to print all Armstrong number from 1 to *N*. Take *N* as an input. 5

Group-C

Answer Question No. **8** and any ***two*** questions from the rest

8. Write a short note on any ***one*** of the following: 5

(a) Concepts of Energy bonds in degenerate semiconductors.

(b) Amorphous solids.

(c) Widemann-Franz Law and its validity.

9. (a) How does the potential energy of an electron vary in an infinite one dimensional crystal? 4+6

(b) Prove that the Fermi Energy of the electron in a metal at 0 K is

$E_F = \frac{h^2}{8m}\left(\frac{3n}{\pi}\right)^{\frac{2}{3}}$, where h = Planck's constant

m = mass of an electron

n = electron concentration

10.(a) What are the assumptions of Drude-Lorentz model to explain classical free electron theory of metals? Discuss the achievements and failures of this model. (3+4)+3

(b) What happens to the Hall voltage if thickness of the specimen is doubled? Justify your answer.

11.(a) Distinguish between a metal, semiconductor and insulator using their bond-diagram. 5+(3+2)

(b) Explain the concept of Brillouin zone with suitable diagram.

12.(a) Differentiate between direct and indirect band-gap semiconductors with examples. 3+4+3

(b) Derive expression for the electron and hole concentration of an intrinsic semiconductor.

(c) How does Fermi level shift with increasing doping and increasing temperature in an extrinsic semiconductor.

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B.Sc. Honours PART-II Examinations, 2018

ELECTRONICS-HONOURS

PAPER-ELTA-IV

Time Allotted: 4 Hours | Full Marks: 100

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.

Group-A

[Active Device]

(Marks-25)

Answer Question No. 1 and any *two* questions from the rest

1. Answer any ***five*** questions from the following: 1×5 = 5
   (a) How does the width of a *p-n* junction depletion region vary with impurity concentration?
   (b) Why is the common collector mode also called emitter follower?
   (c) In the CB mode $I_C < I_E$, although BJT acts an amplifier – Explain.
   (d) Why is an *n*-channel FET preferred over a *p*-channel FET?
   (e) Define reverse saturation current.
   (f) What do you mean by thermal runaway?
   (g) Define firing angle of an SCR.
   (h) Why is a JFET, known as a square-law device?

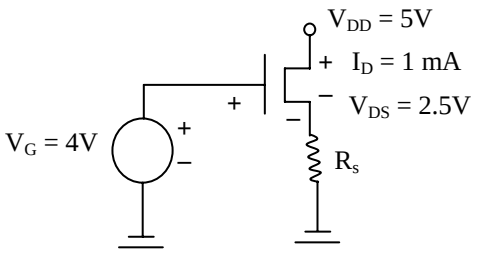
2. (a) Draw the circuit diagram of a full-wave rectifier and explain its working principle. Find out the ripple factor and conversion efficiency of this rectifier. 1+2+2+2
   (b) Explain how a Zener-diode can act as a voltage regulator. 3

3. Starting from Poisson's equation, derive expressions for (a) contact potential, (b) depletion width and (c) junction capacitance of a *p-n* junction diode. 3+3.5+3.5

4. (a) Explain that I-V characteristics of an SCR using two-transistor analogy. 6
   (b) What is meant by pinch-off in a JFET? Explain why complete pinch-off cannot occur. 4

5. (a) With suitable diagrams explain the operation of a MOSFET, as a voltage variable resistor. – Explain how the JFET can be used as an automatic gain control device. 4+2

   (b) For the circuit shown below use the NMOS equation to find R_S & K. Mention the region of operation. Consider $V_T = 1$ V 3+1



Group-B

[Active Circuits]

(Marks-40)

Answer Question No. 6 and any *three* questions from the rest

6. Answer any ***five*** questions from the following: 2×5 = 10

   (a) Define α and β in connection with a transistor.

   (b) What is cross over distortion?

   (c) How is a power transistor different from a normal transistor?

   (d) Define gain margin of an amplifier.

   (e) What is TUF?

   (f) Can the stability factor be less than unity? – Explain.

   (g) State the advantages of SMPS over linear power supply.

   (h) Why is a push-pull amplifier so called?

7. With the help of necessary diagram, explain the working principle of phase-shift oscillator. Derive the expressions for frequency of oscillation and condition of sustained oscillation. 2+3+3+2

8. (a) What is harmonic distortion? How does push-pull amplifier minimize harmonic distortion? 3+4

   (b) The open-loop gain of an amplifier changes by 25% due to changes in the parameters of the device. If a maximum change of 4% in overall gain, what should be the type of feedback employed? If the gain with feedback is 20. Find the minimum value of feedback ratio and open-loop gain. 3

9. (a) State and prove Miller's theorem and write down the dual of it. 3+1

   (b) Draw the schematic block diagram of an SMPS and explain the function of each block. 6

10.(a) Define the following terms and find an inter-relationship between them: 3+2

(i) trans-conductance

(ii) drain resistance

(iii) amplification factor.

(b) An *n*-channel JFET has I_{DSS} = 10 mA and pinch-off voltage V_P = – 4V. Find the drain current for V_{GS} = – 2V. If the transconductance g_m of the JFET with the same I_{DSS} at V_{GS} = 0V is 4 millimho, find the pinch-off voltage. 5

11.(a) What are the advantages of negative feedback? Show how negative feedback (i) stabilizes gain, (ii) improves input impedance of an amplifier. 3+2+3

(b) Show that the CE configuration introduces a 180° shift in the output. 2

Group-C

[Instrumentation]

(Marks-35)

Answer Question No. 12 and any *three* questions from the rest

12. Answer any ***five*** questions from the following: 1×5 = 5

(a) What is the slew rate of an OPAMP?

(b) Define virtual grand of an OPAMP.

(c) What is meant by passive and active probe?

(d) What is the persistence of phosphor?

(e) State two disadvantages of closed loop system.

(f) Define capture range in connection with a V.C.O.

(g) What is the function of delay line in CRO?

13.(a) Draw the block diagram of a general purpose CRO and explain the functions of the following controls: 2+5

(i) Intensity

(ii) Focus

(iii) Horizontal and vertical positioning

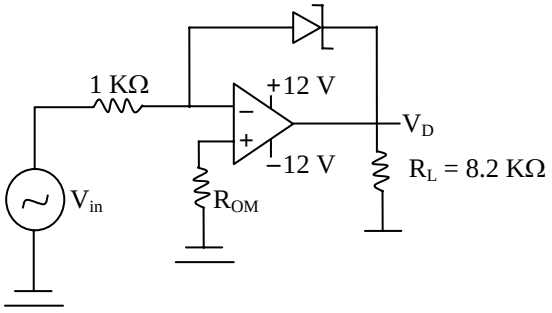
(iv) Synchronization.

(b) Explain the various types of coupling used in CRO. 3

14.(a) Draw the circuit diagram of a monostable multivibrator using 555 timer I.C and obtain the expression for its time period and duty cycle. 7

(b) Draw the circuit and explain the operation of a time-base circuit. 3

15.(a) Determine the output voltage swing and draw the output waveform of the given circuit, if a sine wave of frequency 100 Hz and amplitude 1V is applied at its input. Assume that $V_D = 0.7V$ and $V_Z = 4.7V$. 5



(b) Write a short note on V.C.O. 5

16.(a) Draw a block diagram of the various steps of an OPAMP. 4+3+3

(b) What is the function of level shifter?

(c) Find expression for input impedance of an inverting amplifier.