19P109A (Pages: 2) Name: ……….……………

Reg. No…………………...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2019

(Supplementary/Improvement)

(CUCSS-PG)

CC17P PHY1 C04 – ELECTRONICS

(Physics)

(2017 & 2018 Admissions)

Time: Three Hours Maximum : 36 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. What is the significance of the transconductance parameter g_m of a JFET? Hence show that FET is a voltage controlled device.
2. Draw the structure of a p-channel enhancement type MOSFET. Show its symbol. What are its advantages over JFET?
3. What are the requirements of laser operation in a semiconductor laser?
4. Explain the terms quantum efficiency and response speed of a photodiode.
5. What is the slew rate of an OP-Amp? Explain how it affects the high frequency applications of the Op-Amp.
6. Describe how the input offset voltage of an Op-Amp is measured.
7. Draw the circuit diagram of a CMOS inverter and explain its operation.
8. What is the advantage of an Op-Amp differentiating circuit over a simple RC differentiating circuit?
9. Draw the circuit diagram of an astable multivibrator using Op-Amp and describe its working.
10. Draw the logic diagram, truth table and waveforms for a mod-3 counter using two flip flops and explain how it works.
11. Explain how a glitch appears in a counter output.
12. Write a short note on charge coupled devices.

(12 x 1 = 12 Weightage)

Section B

Answer any ***two*** questions. Each question carries 6 weightage.

13. Discuss with theory the working of a p-n junction solar cell and obtain expressions for maximum output power and conversion efficiency.
14. Explain the working of a mod-10 shift counter. Which are the illegal states? How are the outputs decoded? Using a suitable example explain how the outputs can be utilized to form a clock of any desired form.

15. Draw the circuit diagram of a common source FET amplifier and its AC equivalent. Derive expressions for voltage gain, input impedance and output impedances. Show that gain of the amplifier is reduced when the source bypass capacitor is removed.
16. Distinguish between first order and second order filters. Discuss with theory the operation of a first order low-pass filter using Op-Amp 741 and give its Butterworth response.

(2 x 6 = 12 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

17. A MOSFET has a drain-circuit resistance R_d of 120 K and operates at 10 kHz. Calculate the voltage gain of this device as a single-stage transistor amplifier. The MOSFET parameters are g_m=1.5 mA/V; r_d=47 K; C_{gs} = 3 F; C_{ds} = 1 pF and C_{gd} = 2.4pF
    What is the gain, if the inter-electrode capacitances are negligible?
18. The input resistance of a differential amplifier is measured using 25 kΩ resistor in series with an input voltage of 5V. What is the value of R_i, if the voltage into the amplifier is 1.5 V.
19. Design an Op-Amp scale changer to scale an input signal to 5 times its original value. Draw the circuit diagram and mark the component values in the diagram. Also construct a subtractor circuit.
20. An InGaAsP Fabry-Perot laser operating at a wavevelength of 1.33μm has a cavity length of 300μm. The index of refraction of InGaAsP is 3.39. (a) What is the mirror loss expressed in cm^{-1}? (b) If one of the facets is coated to produce 90% reflectivity, how much threshold current reduction (percentage) can be expected, assuming α =10cm^{-1}.
21. Calculate the gain and current generated when 1μW of optical power with $h\nu$ =3eV is shone onto a photoconductor of η =0.85 and a minority carrier life time of 0.6ns. The material has an electron mobility of 3000cm^2/V-s, the electric field is 5000V/cm and
    L =10μm.
22. Suppose only the inputs 1010 through 1111 appear when there is a trouble in a digital system. Design a logic circuit that detects the presence of any nibble input from 1010 to 1111.

(4 x 3 = 12 Weightage)

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