JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL INFORMATICS AND INNOVATIVE SYSTEMS

UNIVERSITY EXAMINATION FOR THE DEGREE OF SCIENCE

COMPUTER SECURITY & FORENSICS

1ST YEAR 2ND SEMESTER 2013/2014 ACADEMIC YEAR

CENTRE: MAIN

COURSE CODE: IIT 3124

COURSE TITLE: CIRCUIT THEORY & BASIC ELECTRONICS

EXAM VENUE: LR 2 **STREAM: BSc. Computer Security & Forensics**

DATE: 17/12/2013 **EXAM SESSION: 11.30 – 1.30 PM**

TIME: 2 HOURS

Instructions:

1. **Answer question 1 (Compulsory) and ANY other 2 questions.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE

a) Draw energy band diagrams for conductors, insulators and semiconductors. Explain the reasons for the differences between the diagrams (8 Marks)
b) Define the donor doping. Draw a sketch to illustrate and explain the process (6 Marks)
c) A Zener diode with V_z = 4.3V has Z_z equal to 22 ohms when I_z = 20mA. Calculate the upper and lower limits of V_z and I_z changes by +/- 5mA (6 Marks)
d) State Thevenin's theorem, illustrate by use of a diagram (4 Marks)
e) Define the following terms (6 Marks)
    i) Conductance
    ii) Impedance
    iii) Reactance
    iv) Resonace

QUESTION TWO

a) A diode with V_F= 0.7V is connected as a half wave rectifier. The load resistance is 500 ohm, and the rms ac input is 22V. Determine the peak output voltage, the peal current, and the diode peak reverse voltage. (6 Marks)
b) Draw the circuit diagram for a DC power supply that uses a bridge rectifier and a capacitor filter circuit. Sketch the input and output waveforms, and explain the circuit operation and the shape of the waveforms. (9 Marks)
c) By use of sketch diagrams, explain the operation of an NPN transistor (5 Marks)

QUESTION THREE

a) Identify the components that constitute the dc load in a BJT bias circuit. Explain the procedure for drawing the load line on the transistor CE output characteristics (6 Marks)
b) Draw the three basic bias circuit types namely base bias, collector- to- base bias and voltage divider bias; state the stability factor equation for each of the biasing circuit. (12 Marks)
c) State Kirchhoff's current and voltage laws (2 Marks)

QUESTION FOUR

a) State the characteristics of an ideal operational amplifier (4 Marks)
b) Draw a three input summing amplifier circuit diagram using an operational amplifier as a summer for three input voltages v_1, v_2 and v_3. Calculate the output voltage in terms of resistance and voltage. Show your working. (8 Marks)
c) Define Laplace transform of a function f(t). Find the Laplace transforms for the functions $F_1(t) = e^{-at}\sin wt \,.\, u(t)$ (8 Marks)

QUESTION FIVE

a) A series RLC resonant circuit has a resonant frequency admittance of $2x10^{-2}$ S(mohs). The Q of the circuit is 50, and the resonant frequency is 10,000 rad/sec. Calculate the values of R, L, and C. (6 Marks)
b) For the above circuit (Q5 a), find the half-power frequencies and the bandwidth. (4 Marks)
c) From first principles, prove that in a series circuit for three resistors R_1, R_2, and R_3, the effective resistance (R_{eff}) is given by $R_{eff} = R_1 + R_2 + R_3$ (3 Marks)
d) Given a 10 Vrms and 50 Hz power source hooked up in series to a 0.04 H inductor, a 5 Ω resistor, and 0.01 F capacitor. Calculate the impedance of this circuit and the resonance frequency (7 Marks)

COURSE DESCRIPTION

FIRST YEAR 2ND SEM

IIT 3124	**CIRCUIT THEORY AND BASIC ELECTRONICS**
Lecture Hrs	28
Practical Hrs	14
Course Objective	Upon completion of the course, the student must be able to: 1. Know the different dc circuit parameters and components 2. Solve problems in application of the different principles, theorems and laws in dc circuits. 3. Help the students better understanding the basic principles correctly and confidently. 4. Develop analytical skills in electric circuit analysis. 5. Know the different ac circuit parameters and components 6. Help the student understand the differences of passive and active components, their applications in electronic circuits 7. Students to develop analytical skills in semiconductor devices (Diodes, Transistors and OpAmps)
Course Content	Passive circuit: parameters, equilibrium, conditions, Kirchoff's law; representation by differential equations; solutions;

<table>
<tr><td></td><td colspan="2">impedance and reactance. LCR Circuits: frequency domain analysis, resonance and phases. Vector representation, resonance, and circuit diagrams. Network equations, signal flow graphs. Theorems: superposition, reciprocity, Thervnin, Norton, maximum power transfer. Solutions using Laplace transformations: transient and steady state response. Transfer functions: poles and zeros. Physics of semiconductors physics: P-N junction diodes, V-I characteristics; Zener diodes; BJT; FET; MOSFET. Equivalent circuit for diodes, transistors, FETs. Operational amplifier (OPAMP).</td></tr>
<tr><td>Learning & Teaching Methodologies</td><td colspan="2">Lectures and Tutorials</td></tr>
<tr><td>Instructional Materials/Equipments</td><td colspan="2">Classroom and Computer Laboratory</td></tr>
<tr><td rowspan="4">Course Assessment</td><td>Type</td><td>Weighting (%)</td></tr>
<tr><td>Assignments</td><td>10</td></tr>
<tr><td>Continuous Assessment</td><td>20</td></tr>
<tr><td>Examination</td><td>70</td></tr>
<tr><td></td><td>Total</td><td>100</td></tr>
<tr><td>Recommended Reading</td><td colspan="2">[1] R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 10th Edition, Prentice Hall, 2009.
[2] A. S. Sedra and K. C. Smith, Microelectronics Circuits, 5th Edition, Oxford University Press, 2004.
[3] J. D. Irwin, Basic Engineering Circuit Analysis, 7th Edition, Prentice-Hall, 2002.
[4] R. C. Dorf and J. A. Svoboda, Introduction to Electric Circuit, 3rd Edition, John Wiley & Sons, 1996.
[5] N. R. Malik, Electronic Circuit Analysis, Simulation and Design, Prentice-Hall, 1995.
[6] D. Comer and D. Comer, Fundamentals of Electronic Circuit Design, John Wiley & Sons, 2003.
[7] S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, McGraw-Hill, 1988.</td></tr>
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