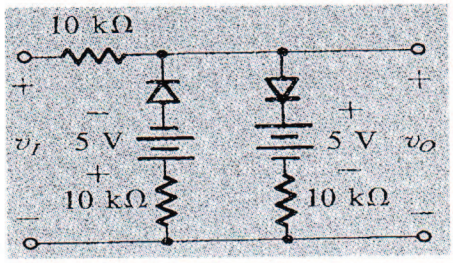
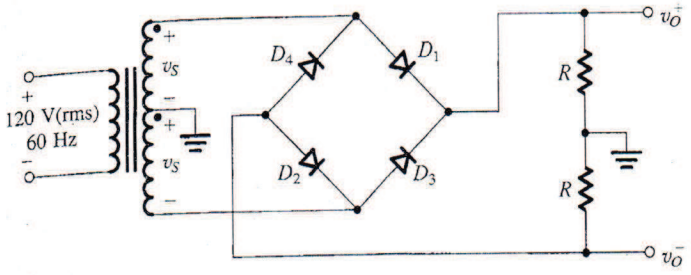
Indian Institute of Technology Patna

End Semester Exam. (Autumn 2016)

Electrical Sciences (EE101)

Time: 3 Hrs MM: 50

There are 8 questions in this paper. Answer all parts of a question at one place.
Figures in the right hand margin indicate marks. In case of a missing parameter value assume a suitable one.

Q No.	Questions	Marks
1.	(a) A cylindrically shaped section of n-type Si has a 1mm length and 0.1 mm^2 cross-sectional area. Calculate its conductivity and resistance (a) when it is purely intrinsic material, and (b) when it has a free electron density of 8×10^{13} /cm^3.	3
	(b) Compare the I-V plots of Si and Ge made diodes.	2
2.	(a) Explain the origin of the barrier voltage at a p-n junction. Discuss the effect of barrier voltage on drift and diffusion currents.	2
	(b) By how much does the built in voltage change if either side of impurity doping concentration is increased by a factor of 10.	1.5
	(c) Why built in voltage of a p-n junction diode can't be measured by a voltmeter?	1.5
3.	(a) Assuming the diodes to be ideal, describe the transfer characteristics of the circuit shown below 	3
	(b) Draw the circuits for positive and negative voltage doublers. Explain the working.	2
4.	(a) Sketch and clearly label the waveforms of v^+_0 and v^-_0. Consider Vs=*5 sin 120πt.* 	3
	(b) A 9.1 V Zener diode exhibits its nominal voltage at a test current of 28mA. At this current the incremental resistance is specified as 5Ω. Find V_{z0} of the zener model. Find the Zener voltage at a current of 10mA and at 100mA.	2

5.	(a) With the help of a neat diagram explain the transistor action of npn BJT.	3
	(b) Draw and explain the input and output characteristics of CE configuration of BJT.	2
	(c) What is early effect?	1
6.	(a) What is the transistor biasing?	2
	(b) The pnp transistor of the circuit given below (Fig 6.1) has β=50. Find the value of R_C to obtain $V_C = 5V$. What happens if the transistor is replaced with another with β=100.	2

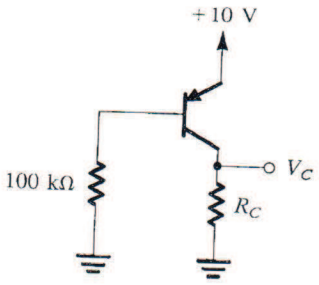


Fig 6.1

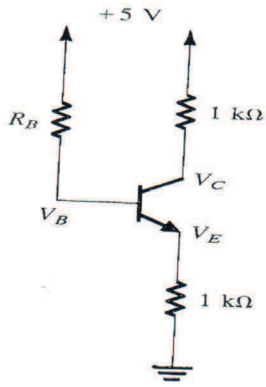
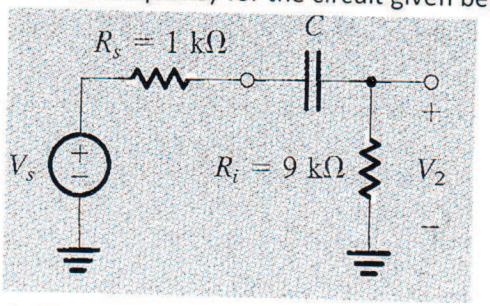


Fig 6.2

	(c) For the circuit of Fig 6.2, find V_B, V_C and V_E for $R_B = 10k\Omega$ and β=100.	2
7.	(a) Draw a neat circuit of Instrumentation amplifier and also explain the working principle? Design an instrumentation amplifier for differential voltage gain of 20.	3
	(b) Using Ideal Op-amps, implement the input output relationship $V_o = 4V_1 + 3V_2 + 5V_3$.	2
	(c) What is the slew rate? Determine the maximum peak output voltage obtainable from an Op-amp circuit with a 100 kHz signal frequency. Slew rate is 0.5V/μs.	2
8.	(a) Derive the expression for 3-dB frequency in a first-order low pass filter circuit.	2
	(b) Draw the gain and phase responses for a first-order high pass filter circuit.	2
	(c) Find the transfer function and 3-dB frequency for the circuit given below.	3



	(d) Using operational amplifier, design a current amplifier with a current gain of 10.	2
	(e) Design an analog circuit which has two inputs (V_1 and V_2) and one output (V_0) with input-out relationship $V_o = V_2/V_1$.	2