

I PUC ELECTRONICS
MODEL QUESTION PAPER -1 (For new syllabus 2013)

Max Mark: 70]

[Max Time : 3 hrs 15 min

Note: i. Question paper contains four parts.

ii. Part-A is compulsory, Part-D contains two sub parts (a) problems (b) essay type questions.

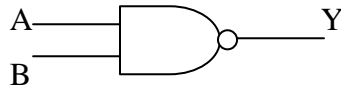
iii. Explanation without circuit diagram, wherever necessary, does not carry mark.

PART – A

Answer **ALL** questions. Each question carries one mark.

1 x 10 = 10

1. How many electrons supplied to a neutral conductor makes it to be charged to $-1C$?
2. Write an equation for specific resistance of cylindrical conductor in terms of radius.
3. What is the significance of time constant of LR series circuit?
4. What type of extrinsic semiconductor will be obtained when Indium impurity is added to Germanium semiconductor?
5. What is the reason for choosing Silicon over Germanium semiconductor?
6. Which region of transistor is moderately doped?
7. Draw the circuit symbol of photo transistor.
8. What is an OR gate?
9. Write the Boolean expression for the output Y of the gate shown.



10. What makes the charge to move from one conductor to another?

PART – B

Answer any **FIVE** questions. Each question carries two mark.

2 x 5 = 10

11. Mention the uses Sphygmomanometer, Glucometer, Pulse oximeter and Digital Thermometer.
12. Briefly explain the determination of frequency of an AC using CRO.
13. Draw the circuit diagram of RC high pass filter. Write an expression for its cut off frequency.
14. What are the factors on which width of depletion layer depend?
15. Current gain β of a transistor is 100. Its base current is $20\mu A$. Calculate α and I_E of the transistor.
16. What is an optocoupler? Draw its circuit.
17. What is the need of 2's compliment method of subtraction? Mention any two advantages of digital technology.
18. Convert $(317)_{10}$ into equivalent hexadecimal number.

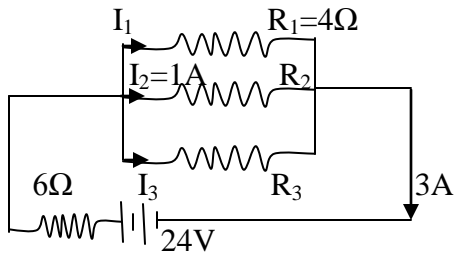
PART – C

Answer any **FIVE** questions. Each question carries three mark.

3 x 5 = 15

19. Explain the role of Electronics in the day to day life.
20. State and explain Kirchoff's voltage law.

21.



Calculate I_3 and R_3 in the following circuit.

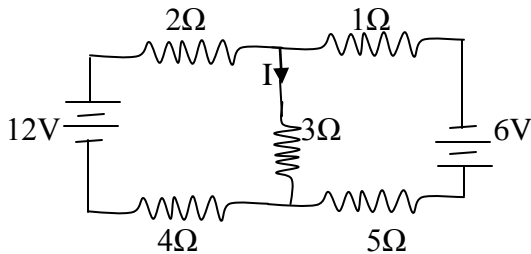
22. What is the principle of parallel plate capacitor? Briefly explain the construction of electrolytic capacitor.
23. Explain the formation of PN-junction and its working under forward biased condition.
24. What is a ripple? With a circuit diagram explain the working of capacitor shunt filter.
25. With a circuit diagram explain the working of series positive clipper.
26. Mention the steps involved in developing PCB. On SMD resistor it is printed as 222. What is its resistance?

PART – D

(a) Answer any **THREE** questions. Each question carries five mark.

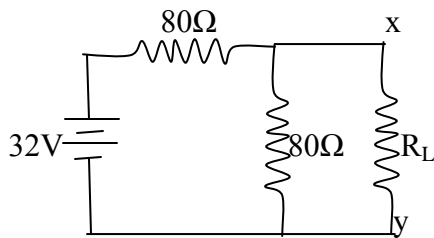
5 x 3 = 15

27.



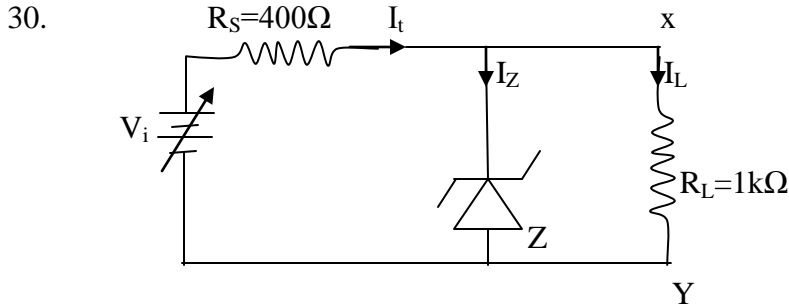
Calculate current through 3Ω resistor using superposition theorem.

Convert the following circuit into Thevenin's equivalent circuit.



28. An AC of 125V is applied to the primary of an ordinary transformer of power efficiency $\eta=60\%$ so that secondary current is 500mA. If the loss of power in the core & coil of it is 10W, calculate primary current, secondary voltage, output power and input power.

29. The following components are used in the LRC series circuit. $R=100\Omega$, $L=1\text{mH}$ & $C=1000\mu\text{F}$. An AC, $v = 200 \sin 100\pi t$ is applied to it. Calculate impedance, power factor and resonant frequency of the LRC circuit.



Where Z – zener diode of $V_Z=10\text{V}$, $P_Z=2\text{W}$; $I_{Z \text{ min}}$ for voltage regulation is 5mA .

Calculate $I_{Z \text{ max}}$, I_L , $V_{i \text{ min}}$ & $V_{i \text{ max}}$ for voltage regulation. Suppose in the above circuit if $V_i = 20\text{V}$, what should be the minimum load resistance(R_L) required for voltage regulation?

31. Convert $(A1F)_{16}$ into equivalent binary number. Subtract $(101)_2$ from $(1010)_2$ using 2's compliment method.

(b) Answer any **FOUR** questions. Each question carries five mark. 5 x 4 = 20

32. a) With a circuit diagram derive an expression for effective resistance of parallel combination of resistors.

b) When do we prefer this combination? 4+1

33. a) What are active and apparent powers? Give the relation between them.

b) Explain charging and discharging of a capacitor in RC circuit when DC is applied. 2+3

34. a) Derive an expression for effective capacitance of parallel combination of capacitors.

b) What happens to capacitance when a dielectric medium is introduced between plates of a capacitor? 3+2

35. a) What is an active component?

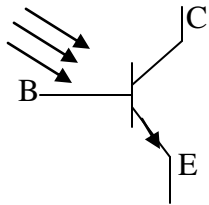
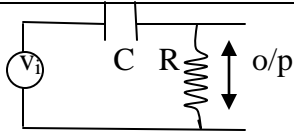
b) With a diagram explain the working of dynamic(moving coil) loudspeaker. 1+4

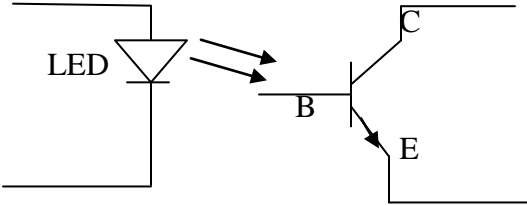
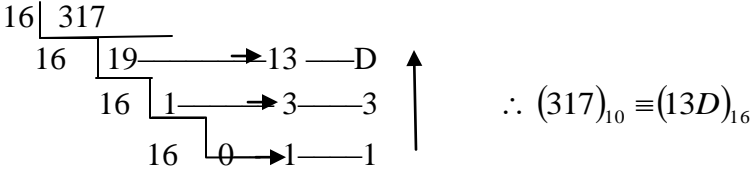
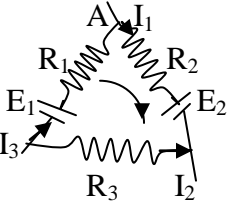
36. What is a rectifier? Draw the circuit diagram of full wave rectifier, explain its working. Draw the input and output wave forms.

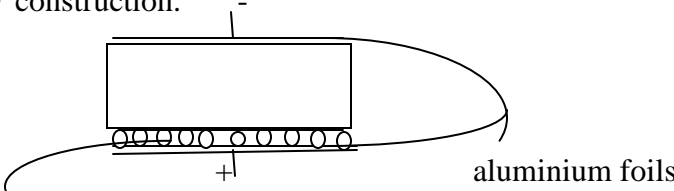
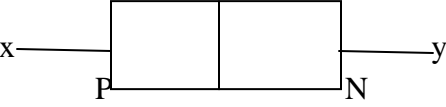
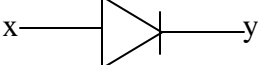
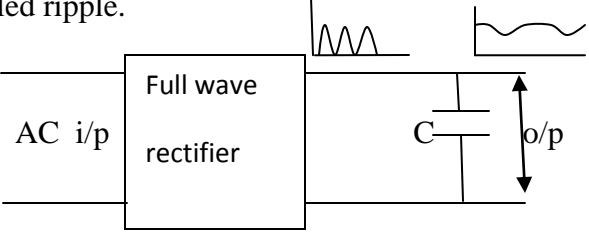
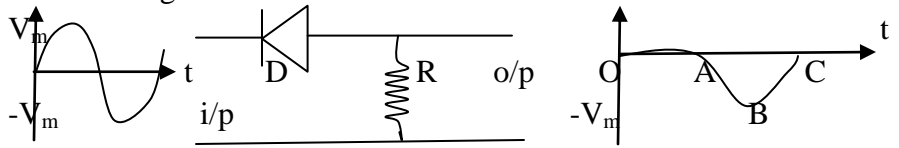
37. a) Show that $\overline{A + A B} = A + B$ using Boolean laws. Draw the circuit diagram and output waveform

b) Draw the circuit diagram and output waveform of monostable multivibrator using IC 555. What is the significance of duty cycle? 2+3

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SCHEME OF EVALUATION(&MODEL ANSWER) FOR
MODEL QUESTION PAPER – 1

PART – A		
Q. No.	Answer	Mark
1.	$n = 6.25 \times 10^{18}$ electrons.	1
2.	$\rho = \frac{\pi r^2 R}{4L}$	1
3.	Its significance is about 63.3% of the maximum current will be reached in the circuit in this time during growth. Or 63.3% current will be decreased in this time during decay.	1
4.	p-type	1
5.	Leakage current is less or more abundant or less costly or temperature withstanding capacity is more.	1
6.	Collector	1
7.		1
8.	OR gate is a logic gate which can have two or more inputs one output, output will be in high state when one or more inputs are in high state . Or OR gate is a logic gate which can have two or more inputs one output, output will be in low state when all the inputs are in low state .	1
9.	$Y = \overline{AB}$	1
10.	The potential difference	1
PART – B		
11.	Sphygmomanometer – used to measure blood pressure, Glucometer – to measure glucose level in blood, Pulse oxymeter – to measure hemoglobin content in human body, Digital thermometer – to measure temperature of human body. } ½ mark each	2
12.	*Display an AC signal on the screen. The length of one wave or distance between two consecutive crests(peaks) or troughs is measured in terms of main division by displaying one complete wave on the screen using time/div control unit. *Then time period of the wave(T) = length of one wave x (time/div) Frequency (f)= 1/T	1 1
13.	*Circuit diagram. <div style="text-align: center;">  </div>	1 1
	* $f_c = \frac{1}{2\pi RC}$	1

14.	<p>* Type of material, doping level, temperature and type of biasing.</p> <p>*The phenomenon of abrupt increase in the current through pn junction under reverse bias due to increase in the kinetic energy of minority charge carriers is called avalanche break down.</p>	1 1
15.	<p>* $\alpha = \frac{\beta}{1 + \beta} = \frac{100}{1 + 100} = 0.990099 \approx 0.99$</p> <p>$I_C = \beta I_B = 100 \times 20 \times 10^{-6} = 2\text{mA}$; $I_E = I_C + I_B = 2\text{mA} + 20\mu\text{A} = 2.02\text{mA}$</p>	1 1
16.	<p>Optocoupler is an electronic device that interconnects two electrical circuits by means of an optical interface.</p> 	1 1
17.	<p>* The necessity of using 2's compliment method is to reduce circuit complexity.</p> <p>* Advantages of digital technology: It is cheap, easily replaceable, requires less space, less affected by noise & temperature, It has memory. It has greater accuracy & precision. It can be programmed.</p> <p style="text-align: right;">Any two are to be written.</p>	1 1
18.	 <p style="text-align: right;">$\therefore (317)_{10} \equiv (13D)_{16}$</p>	2
PART – C		
19.	Explanation of role of electronics.	3
20.	<p>*KVL : Algebraic sum of voltages in a loop of an electrical network is zero. Or In a loop of an electrical network algebraic sum emfs in different branches is equal to algebraic sum of IR drops in different branches of the same loop.</p> <p>*</p>  <p>Applying KVL - $E_1 + E_2 = I_1 R_1 - I_2 R_2 + I_3 R_3$</p>	1 1 1
21.	<p>*Main current, $I=3\text{A}$ & supplied voltage, $V=24\text{V}$.</p> <p>Voltage across 6Ω is $V_1=3 \times 6=24\text{V}$. Voltage across parallel combination, $V_2=V-V_1=6\text{V}$</p> <p>*$V_2=I_1 R_1=I_2 R_2=I_3 R_3$ So $I_1=V_2/R_1=1.5\text{A}$</p> <p>*$I=I_1+I_2+I_3$ So $I_3=I- I_1 - I_2 = 0.5\text{A}$; $R_3= V_2/I_3 = 12\Omega$</p>	1 1 1

22.	<p>* Bringing an uncharged identical plate parallel to a charged plate, potential between the plates decreases. Decrease in potential increases capacitance of the arrangement.</p> <p>* construction.</p>  <p>Aluminium oxide film(dielectric medium)</p> <p>It consists of two thin aluminium foils. On one of the foils borax or phosphate or carbonate(electrolyte) is coated. On which absorbent paper or plastic gauge is placed. Over which second Al foil is placed. Then rolled into cylinder. It is then placed in a Al cylinder with wax in between. Terminal connected to foil on which electrolyte coated is positive terminal, the other one is negative. Positive terminal is to be connected to higher potential.</p>	<p>1</p> <p>2</p>
23.	<p>*Two different type extrinsic semiconductors of same size and doping level fused together to pn-junction. But diffusion technic or different technics are used to form pn-junction.</p> <p>* Construction</p>  <p>circuit symbol</p>  <p>*When the junction is forward biased width of the depletion layer formed due to recombination of electron hole pair at the junction decreases. Resistance offered by the depletion layer decreases so flow of majority carriers increases hence the current.</p>	<p>1</p> <p>1/2</p> <p>1 1/2</p>
24.	<p>*An undesirable ac component present at the output of a rectifier or any circuit is called ripple.</p> <p>* Working</p> 	<p>1</p> <p>1</p> <p>1</p>
25.	<p>*Circuit diagram</p>  <p>*During positive half cycle of the input, diode is reverse biased so no current flows through R. Hence out is zero(OA). During negative half cycle of the input, diode is forward biased. Hence there will be negative half cycle appears at the output(ABC).</p>	<p>1</p> <p>2</p>
26.	<p>PCB Layout preparation, photo resist, PCB etching process, PCB drilling, conductor plating & PCB assembling.</p> <p>*222 $\equiv R=22 \times 10^2 \Omega = 2.2k\Omega$</p>	<p>1</p> <p>1</p> <p>1</p>

PART - D		
(a) 27.	<p>*Step 1. Short $V_2=6V$ find current through 3Ω say I_1. It is $I_1= 1A$</p> <p>*Step 2. Short $V_1=12V$ find current through 3Ω say I_2. It is negative with respect to I_1. $I_2=- \frac{1}{2} A$</p> <p>*Find R_{TH}, it is 40Ω. Find V_{TH}, it is $16V$.</p> <p>*</p> <div style="text-align: center;"> </div>	<p>1½</p> <p>2</p> <p>1</p> <p>½</p>
28.	<p>*$P_i=P_O+P_L$; $\eta = \frac{P_o}{P_i} = \frac{P_o}{P_o + P_L}$</p> <p>*$P_O = \frac{P_L}{\frac{1}{\eta} - 1} = 15W$; * $P_O = I_S V_S \rightarrow V_S = 30V$; *$P_i=P_O+P_L=25W$</p> <p>*$P_i=I_P V_P \rightarrow I_P=0.2A$</p>	<p>1</p> <p>3</p> <p>1</p>
29.	<p>*$v=200\sin 100\pi t=V_m \sin 2\pi f t \rightarrow f=50Hz$.</p> <p>*$X_L=2\pi f L \rightarrow X_L=0.3142\Omega$; *$X_C=1/(2\pi f C) \rightarrow X_C=3.142\Omega$;</p> <p>*$Z=\sqrt{R^2 + (X_L - X_C)^2} = 100.041\Omega$</p> <p>*Power factor=$\cos\phi = R/Z = 0.99959$; $f=\frac{1}{2\pi\sqrt{LC}}=159.1Hz$</p>	<p>1</p> <p>2</p> <p>1</p> <p>1</p>
30.	<p>*$I_{Z\max} = \frac{P_Z}{V_Z} = \frac{2}{10} = 200mA$; *$I_L = \frac{V_o}{R_L} = \frac{V_Z}{R_L} = \frac{10}{10^3} = 10mA$</p> <p>*$I_{t\min} = I_{Z\min} + I_L = 15mA$, $V_{i\min} = I_{t\min} R_S + V_Z = 16V$</p> <p>*$I_{t\max} = I_{Z\max} + I_L = 210mA$, $V_{i\max} = I_{t\max} R_S + V_Z = 84V$</p> <p>*For $V_i=20V$, $I_t = \frac{V_i - V_z}{R_S} = 25mA$, $I_{L\max} = I_t - I_{Z\min} = 20mA$, $R_{L\min} = \frac{V_Z}{I_{L\max}} = 500\Omega$.</p>	<p>1+1</p> <p>1</p> <p>1</p> <p>1</p>
31.	<p>*$(A1F)=(101000011111)_2$</p> <p>*2's compliment subtraction.</p> <div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: right; margin-right: 10px;"> $\begin{array}{r} 1010 \\ - 110 \\ \hline \end{array}$ </div> <div style="font-size: 2em; margin-right: 10px;">}</div> <div style="margin-right: 10px;">≡</div> <div style="text-align: left;"> $\begin{array}{r} 1010 \text{ ---minuend} \\ - 0110 \text{ ---subtrahend} \\ \hline \end{array}$ </div> <div style="font-size: 2em; margin-left: 10px;">}</div> </div> <p>*2's compliment of subtrahend $(0110)_2$ ——— $(1010)_2$</p> <p>*2's compliment of subtrahend + minuend = $(1\ 0100)_2$</p> <p style="text-align: center;">↙</p> <p>Extra carry. So answer is positive. Write rest of the bits ignoring carry with a positive sign gives the answer. Ans = $+(0100)_2$</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>
(b) 32.	<p>*Circuit diagram.</p> <p>*Derivation of R_p.</p> <p>*To get lesser resistance from the standard resistors parallel combination is preferred.</p>	<p>1</p> <p>3</p> <p>1</p>

33.	*Average power dissipated in an AC circuit is called active power or real power.	1
	*The power a circuit seems to be drawing from an AC source is called apparent power.	1
	*Circuit diagram.	1
	*Explanation : *charging,	1
	*discharging.	1
34.	*Circuit diagram.	1
	*Derivation of C_P ;	3
	*capacitance increases.	1
35.	*It is an electronic component that supplies energy to the circuit. OR these are the components that can rectify or amplify or change one form of energy into another form	1
	*Diagram.	1
	*Working.	3
36.	*It is an electronic circuit which converts ac into dc.	1
	*Circuit diagram.	1
	*Working.	2
	*Input & output wave forms.	1
37.	*LHS= $A + \overline{A} B$ $= A.1 + \overline{A} B = A(1+B) + \overline{A} B = A + AB + \overline{A} B = A + (A + \overline{A})B = A + 1.B = A + B = RHS$	2
	*Circuit diagram.	1
	*Wave form.	1
	*Duty cycle signifies that how long the multivibrator is in on condition.	1