

N.B.

- i) Answer **SIX** questions, taking any **THREE** from each section.
- ii) All questions are of equal values.
- iii) Use separate answer script for each section.

Section A

1. (a) What is a projectile? Derive the expression for maximum range of a projectile. Find the angle at which the height and range of a projectile would be same. 1+3+3
- (b) State & explain Kepler's law of planetary motion. Show that the force of attraction between two bodies is inversely proportional to the square of the distance between them. $4\frac{2}{3}$
2. (a) Derive an expression for angular velocity of a Damped vibration. $5\frac{2}{3}$
- (b) Discuss the characteristics of simple harmonic motion. 2
- (c) Explain the term conservation of momentum and conservation of energy. 4
3. (a) What are the differences between mechanical waves and electromagnetic waves? 2
- (b) Define Simple Harmonic Motion. Derive a Differential equation of Simple Harmonic Motion and derive expression for velocity and acceleration from that equation. 1+5
- (c) Derive the following expression ~~a moving object~~. $3\frac{2}{3}$
$$f_o = f_s \left(\frac{v \pm v_o}{v} \right)$$
4. (a) State Zeroth law of the thermodynamics and Second law of the thermodynamics. $4\frac{2}{3}$
- (b) Explain the basic four postulates of the kinetic theory of gases. 4
- (c) Write about Black body radiation. 3

Section B

5. (a) Discuss condition for interference. Derive expression for (i) intensity at a point on the screen and (ii) fringe width 2+3+3
- (b) In a Newton's ring experiment, the diameter of the 15th ring was found to be 0.590cm and that of the 5th ring was 0.336cm. If the radius of the Plano convex lens is 100cm, calculate the wavelength of the light used. $3\frac{2}{3}$
6. (a) What is diffraction of light and polarization of light? 3
- (b) Write a short note on diffraction grating. 3
- (c) Differentiate between Fraunhofer Diffraction and Fresnel Diffraction. What are the conditions for Fraunhofer Diffraction and Fresnel Diffraction 4+1 $\frac{2}{3}$
7. (a) A parallel plate capacitor with a plate separation t has a capacitance C_0 in absence of a dielectric. What will be the capacitance in times of C_0 if a slab of dielectric material of dielectric constant K and thickness $\frac{2}{5}d$ inserted between the plates. $4\frac{2}{3}$
- (b) Derive an expression for the torque on a complete current loop. 7
8. (a) What is Hall Effect? Explain how the nature of charge carrier can be determined by Hall experiment? 1+3
- (b) What do understand by total internal reflection? 2
- (c) Derive the wave equation for a homogeneous medium. $5\frac{2}{3}$

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Department of Computer Science and Engineering
1st Year 2nd Semester B.Sc. Engineering Examination-2014
Course No. : EEE156, Title: Electronic Devices & Circuits

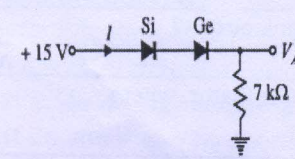
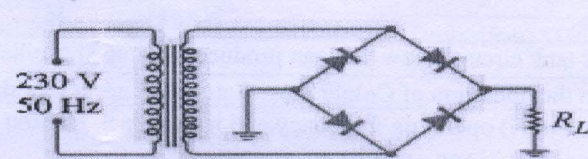
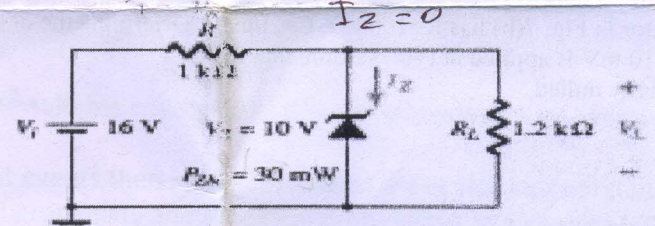
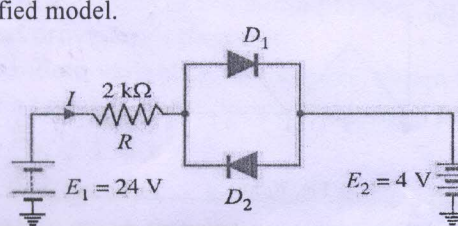
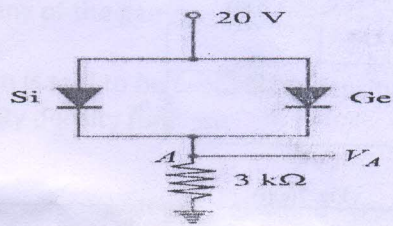
Full Marks: 70

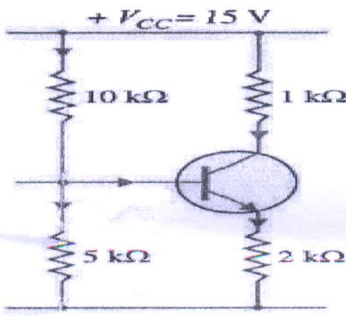
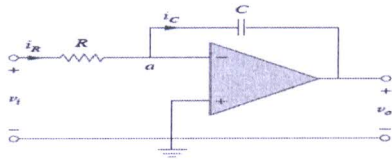
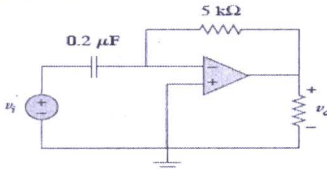
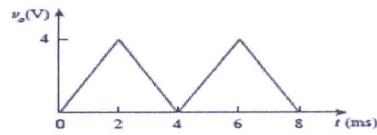
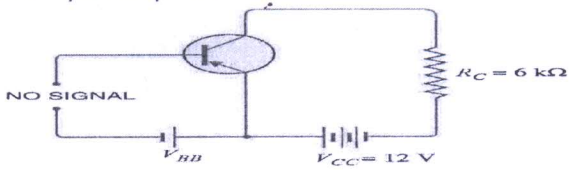
Times: 3 Hours

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Section- A

1.	<p>a) Define: i) PIV ii) Ripple factor</p> <p>b) Derive an expression for the efficiency of a full-wave rectifier.</p> <p>c) i) Find the voltage V_A and current I in the circuit shown in Fig. 1(c)(i). Use simplified model. ii) In Fig. 1(c)(ii), the maximum voltage across secondary winding is 136V. Find i) the d.c. load voltage ii) peak inverse voltage iii) output frequency.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <p>Fig. 1(c)(i)</p> <p>Fig. 1(c)(ii)</p> </div>	<p>3</p> <p>4.67</p> <p>4</p>
2.	<p>a) Describe the basic operation principle of LED with necessary sketch.</p> <p>b) What is zener region? Sketch symbol of zener diode and its ideal characteristics. For the zener diode network of the following figure, determine V_L, V_R, I_Z and P_Z</p>	<p>4</p> <p>4.67</p>
	<div style="text-align: center;">  </div> <p>c) Determine the current I in the circuit shown in Fig. 2(c)(i). Assume the diodes to be of Si and forward resistance of diodes to be zero. ii) Find the voltage V_A in the circuit shown in Fig. 2(c)(ii). Use simplified model.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <p>Fig. 2(c)(i)</p> <p>Fig. 2(c)(ii)</p> </div>	<p>3</p>
3.	<p>a) Define i) Q-point ii) Cut-off & saturation point.</p> <p>b) For transistor CE configuration, prove that $I_C = \beta I_B + I_{C0}$, where symbols have their usual meaning.</p> <p>c) A transistor is connected in CE configuration in which collector supply is 8V and the voltage drop across resistor R_C connected in the collector circuit is 0.5V. The value of $R_C = 800\Omega$. If $\alpha = 0.96$, determine : i) collector-emitter voltage ii) base current.</p>	<p>3</p> <p>4.67</p> <p>4</p>

4.	<p>a) Explain why dc biasing is needed for operation of a transistor. Also identify why stabilization of operating point is needed? 3</p> <p>b) Show the energy level of solid, insulator and semiconductor material. What is p-type and n-type material? Define majority and minority carriers. 3.67</p> <p>c) Fig. 4(c) shows the voltages divider bias method. Draw the d.c. load line and determine the operating point. Assume the transistor to be of S_i. 5</p>	
 <p>Fig. 4(c)</p>		
Section – B		
5.	<p>a) What is tank circuit? How you can produce undamped oscillations from tank circuit? 3</p> <p>b) Explain the operation of Colpitt's oscillator with necessary sketch. 4.67</p> <p>c) Calculate the i) operating frequency and ii) feedback fraction for Hartley Oscillator, where $L_1=1000\mu H$, $L_2=100\mu H$, $M=20\mu H$, $C=20pF$. 4</p>	
6.	<p>a) What is op-amp? Draw its pin configuration. Also identify the characteristics of an ideal op-amp. 3.67</p> <p>b) Explain the circuit operation of inverting & non-inverting amplifier. 4</p> <p>c) Design an op-amp circuit with inputs v_1, v_2 & v_3 such that $v_0 = -5v_1 + 3v_2 - v_3$ 4</p>	
7.	<p>a) How you can design an integrator and differentiator circuit using op-amp. Describe mathematically. 3.67</p> <p>b) The integrator in Fig. 7(b) has $R=100\text{ k}\Omega$, $C=20\mu F$. Determine the output voltage when a dc voltage of 10 mV is applied at $t=0$. Assume that the op-amp is initially nulled. 4</p>	
	 <p>Fig. 7(b)</p>	
	<p>c) Sketch the output voltage for the circuit in fig. 7(c)(i) give the input voltage in Fig. 7(c)(ii). Take $v_0=0$ at $t=0$. 4</p>	
	 <p>Fig. 7(c)(i)</p>  <p>Fig. 7(c)(ii)</p>	
8.	<p>a) Draw the input & output characteristics of a transistor for CE configuration. 2</p> <p>b) Describe the working principle & efficiency of photovoltaic cell. 4.67</p> <p>c) In Fig. 8(c), if $V_{cc}=12V$ and $R_c=6\text{ k}\Omega$, draw the d.c. load line. What will be the Q point if zero signal base current is $20\mu A$ and $\beta=50$? 5</p>	
	 <p>Fig. 8(c)</p>	

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1. a) What do you mean by statistics? Discuss its importance. 2.67
 - b) Define population, sample and variable with suitable examples. 3
 - c) What is stem and leaf plot? From the following raw data, draw a stem and leaf plot. 3
84,17,38,45,47,53,76,54,22,66,65,55,54,51,33,39,54,72
 - d) What do you mean by frequency distribution? Distinguish between histogram and bar diagram. 3
 2. a) Given a frequency distribution in the following: find mean, median and mode 6
- | | | | | | | | |
|----------------|-------|-------|-------|-------|-------|-------|-------|
| Class interval | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 |
| Frequency | 5 | 6 | 8 | 10 | 7 | 5 | 4 |
- b) For two unequal observation, prove that $MD=SD=R/2$, where MD=Mean Deviation, SD=Standard deviation, and R= Range. 3
 - c) Define scatter diagram. Discuss situation when i) $r=+1$ ii) $r=-1$ iii) $r=0$ 2.67
 3. a) What is Skewness? Briefly describe at least three measures of skewness. 4
 - b) What do you mean by coefficient of correlation. Write down the properties of coefficient of correlation. 4
 - c) Show that correlation coefficient lies between -1 to +1. 3.67
 4. a) What do you mean by regression analysis? Write down the simple linear regression model under required assumptions. 3.67
 - b) Discuss the method of ordinary least squares(OLS) for estimating the parameters in a simple regression model. 5
 - c) Write down properties of regression coefficient. 3

SECTION-B

5. a) Define the following terms with suitable examples (i) Random experiment (ii) Sample Space (iii) Events 3.67
 - b) If A and B are two independent events then prove that \bar{A} and \bar{B} are also independent. 3
 - c) What do you mean by classical probability and empirical probability? In a class of 100 students 75 play football, 50 play cricket and 40 play both the game. A student is selected at random from the class. What the probability that the student (i) plays only cricket but not football (ii) plays at least one of the game (iii) does not play any of the games. 5
 6. a) State and prove Bay's theorem. 5
 - b) Define random variable with example. When function is said to be probability density function? 3
 - c) Let x be a continuous random variable with probability density function 3.67

$$f(x) = \begin{cases} \frac{2}{3}x, & \text{if } 1 < x < 2 \\ 0, & \text{otherwise.} \end{cases}$$
 Prove that f(x) is a probability density function and find $P[x \leq 1.2]$, $P[x > 3]$
 7. a) What do you mean by mathematical expectation of a random variable? If x is a discrete random variable with probability following function. Compute the expected value and variance of x. 4
- | | | | | | | |
|------|-----|-----|-----|-----|-----|-----|
| x | 1 | 2 | 3 | 4 | 5 | 6 |
| f(x) | 1/6 | 1/6 | 1/6 | 1/6 | 1/6 | 1/6 |
- b) What is the probability function of binomial distribution? Derive the mean and variance of binomial distribution. 4
 - c) Show that mean and variance of poisson distribution is equal. 3.67
 8. a) Define normal distribution. 2
 - b) Find the moment generating function of normal distribution. Derives its mean and variance. 6
 - c) Define stochastic process with examples. What do you mean by markov chain? 3.67

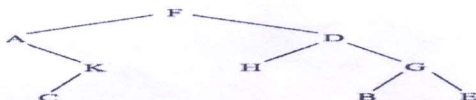
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SECTION-A

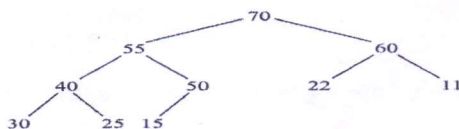
1. a) What do you mean by data structure? Explain the basic operations those are normally performed on a particular data structure. 4
 - b) What are the differences between array and link list? 3
 - c) Describe a situation where storing items in array is clearly better than storing items on a linked list. 4.67
 2. a) Distinguish between stack and queue. 3
 - b) Write pseudo code for implementing QUEUE. 4.67
 - c) Describe stack with link list. 4
 3. a) What do you mean by binary search tree? 3.67
 - b) Suppose the preorder and in-order traversal of a binary tree T yield the following sequences of nodes. 4
- Draw the diagram of the tree T.
 Preorder: P, B, R, D, L, M, E, F, G, H, J, K
 In-order: R, L, M, D, E, B, G, H, F, K, L, P
- c) Consider the binary tree T in the following figure. Find the recursive tree representation of T for pre-order traversal. 4



4. a) Compare linear search and binary search. 2
- b) ~~Compare~~ ^{Apply} binary search technique to the following array, when search item is 112. Array -15, -6, 0, 7, 9, 23, 54, 82, 101, 112, 125. 3.67
- c) Let A be an nxn square matrix array. Write module which 6
- i. Find the number NUM of nonzero elements in A.
- ii. Find the SUM of the elements above the diagonal, i.e. elements $a[i,j]$ where $i < j$.
- iii. Find the product PROD of the diagonal elements

SECTION-B

5. a) What is hashing? What is main advantage that open addressing hashing technique has over chaining? 4
- b) Write down some hash functions with their limitation and advantages. 3
- c) Let H be the heap in the following Figure. Find the final heap H if the numbers 65, 44, and 75 are inserted one after the other into H. 4.67



6. a) What is graph? Give practical use of graph, DFS and BFS. 4
 - b) How do you determine all vertices of a graph are connected or not and write pseudo code for implementation. 4
 - c) What is file and file allocation table. Give example. 3.67
 7. a) Find a minimal spanning tree of the following weighted graph using Prim's algorithm. 3.67
-
- ```

graph LR
 A ---|6| B
 B ---|5| C
 A ---|4| X
 X ---|3| Y
 A ---|1| Y
 B ---|8| Y
 C ---|2| Y

```
- b) Describe single source shortest path problem for figure in question 7(a). 4
  - c) Describe floyd warshall algorithm for figure in question 7(a). 4
  8. a) Describe topological sort with example. 4
  - b) How do you handle hash collisions? 4
  - c) What are the differences between Tree and Graph? 3.67

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### SECTION-A

01. (a) Define function, domain and range of a function with example. Find the domain and range of the following functions: 06

$$(i) f(x) = \begin{cases} 1+x & \text{when } -1 \leq x < 0 \\ 1-x & \text{when } 0 \leq x \leq 1 \\ 0 & \text{when } x > 1 \end{cases} \quad \text{and} \quad (ii) f(x) = \begin{cases} \frac{|x-3|}{x-3}, & \text{when } x \neq 3 \\ 0, & \text{when } x = 3 \end{cases}.$$

Also draw its graph.

- (b) What is limit of a function? What is the difference between  $\lim_{x \rightarrow a} f(x)$  and  $f(a)$ ? Using  $5 \frac{2}{3}$

$(\epsilon, \delta)$  definition of limit to show that  $\lim_{x \rightarrow 0} x^2 \sin \frac{1}{x} = 0$  and also determine the value of  $\delta$

when  $\epsilon = 0.1$ .

02. (a) Define continuity of a function at  $x = a$ . Find  $\lim_{x \rightarrow -1} f(x)$  and  $\lim_{x \rightarrow 3} f(x)$ , where  $f(x)$  06

defined as  $f(x) = |x+1| + |x-3|$ . Does  $f(x)$  continuous at  $x = 3$ ? Also test of the differentiability at  $x = -1$  and  $x = 3$ .

- (b) Define differentiability of a function at  $x = a$ . If the function is differentiable at  $x = a$  then show that it is continuous at that point. Also give an example of a function which is continuous at  $x = 0$  but not differentiable at that point and prove it.  $5 \frac{2}{3}$

03. (a) Find the differential coefficients of the following with respect to  $x$ : (ANY THREE) 06

$$(i) y = \log \left\{ e^x \left( \frac{x-1}{x+1} \right)^{\frac{3}{2}} \right\}, (ii) y = (\tan x)^{\cot x} + (\cot x)^{\tan x}, (iii) y = \sin \left[ 2 \tan^{-1} \sqrt{\frac{1-x}{1+x}} \right] \text{ and}$$

$$(iv) x^p y^q = (x+y)^{(p+q)}.$$

- (b) Find the  $n$ th derivative of the function  $y = \sin^2 x + (x^2 - 5x + 6)^{-1}$ . 02

- (c) State the Leibnitz's theorem. Using Leibnitz's theorem, If  $y = e^{\tan^{-1} x}$  then, show that  $3 \frac{2}{3}$   
 $(1+x^2)y_{n+2} + (2nx + 2x - 1)y_{n+1} + n(n+1)y_n = 0$ .

04. (a) What is homogeneous function? If  $f(x, y) = \sin^{-1} \frac{x}{y} + \tan^{-1} \frac{y}{x}$ , show that  $x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y} = 0$ . 04

- (b) State Euler's theorem. Using Euler's theorem prove that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin 2u$ , where  $3 \frac{2}{3}$   
 $u(x, y) = \tan^{-1} \frac{x^3 + y^3}{x - y}$ .

- (c) Define maxima and minima at point  $x = a$ . Find the maximum and minimum values of  $04$   
 $f(x) = 1 + 2 \sin x + 3 \cos^2 x (0 \leq x \leq \frac{\pi}{2})$ .



# SECTION-B

05. (a) Integrate the following integrals: (Any SIX)

11 2/3

(i)  $\int \frac{1}{3-2x-x^2} dx$ , (ii)  $\int \sqrt{\frac{a+x}{x}} dx$ , (iii)  $\int \frac{\cos x}{5-3\cos x} dx$ , (iv)  $\int \frac{xe^x}{(x+1)^2} dx$ ,  
 (v)  $\int \cos\left(2\cot^{-1}\sqrt{\frac{1-x}{1+x}}\right) dx$ , (vi)  $\int \frac{x^2+1}{x^4+1} dx$  and (vii)  $\int \frac{2\cos x+3\sin x}{3\cos x+2\sin x} dx$ .

06. (a) What is integrable function? If  $f(x)$  is integrable in the closed interval  $[a, b]$  and if  $f(x) \geq 0$  for all  $x \in [a, b]$ , then prove that  $\int_a^b f(x) dx \geq 0$ , where  $b > a$ . (3)

3 2/3

(b) Evaluate the following integrals: (Any FOUR)

08

(i)  $\int_0^{\pi/2} \cos^3 \theta \sqrt{\sin \theta} d\theta$ , (ii)  $\int_8^{15} \frac{dx}{(x-3)\sqrt{x+1}}$ , (iii)  $\int_a^\beta \sqrt{(x-a)(\beta-x)} dx$ , (iv)  $\int_0^{\pi/2} \frac{dx}{4+5\sin x}$   
 and (v)  $\int_0^\pi \frac{xdx}{a^2 \sin^2 x + b^2 \cos^2 x} = \frac{\pi^2}{2ab}$ .

07. (a) State and prove the Fundamental theorem of integral calculus. (2)

4

(b) Evaluate:  $\lim_{n \rightarrow \infty} \left[ \frac{1^2}{n^3+1^3} + \frac{2^2}{n^3+2^3} + \dots + \frac{n^2}{2n^3} \right]$ ,  $\lim_{n \rightarrow \infty} \left[ \frac{1}{n} + \frac{n^2}{(n+1)^3} + \frac{n^2}{(n+2)^3} + \dots + \frac{1}{8n} \right]$

2 2/3

(c) Define definite integral as the limit of a sum. Find by the method of summation the values of  $\int_a^b \sin \theta d\theta$ . 05

08. (a) Write down any two Fundamental properties of definite integrals. Using this properties, evaluate the following integrals (Any TWO): (3)

5 2/3

(i)  $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$ , (ii)  $\int_0^{\pi/2} \ln(\sin x) dx$  and (iii)  $\int_0^{\pi/4} \ln(1 + \tan \theta) d\theta$ .

(b)  $I_n = \int_0^{\pi/4} \tan^n \theta d\theta$ , show that  $I_n = \frac{1}{n-1} - I_{n-2}$ . Hence find the value of  $\int_0^{\pi/4} \tan^6 x dx$ .

03

(c) Find the whole area of the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

03

3, 9, 5, 67