END TERM EXAMINATION

THIRD SEMESTER [B.TECH.] DECEMBER-2012

Paper Code: ETMA201 Subject: Applied Mathematics

Time : 3 Hours Maximum Marks : 75

Note: Attempt any five questions including Q.no.1 which is compulsory. Select one question from each unit.

Q1 (a) Find the Laplace Transform of \( \sin t \cos t \).

(b) Find the values of \( \frac{\pi}{2} \) and \( \int_0^\infty \).

(c) Define the unit step function and impulse function.

(d) Show that \( P_n(1) = 1 \).

(e) Construct a first order partial differential equation, if \( z = ax + by + a^2 + b^2 \), where \( a \) and \( b \) are arbitrary constants.

(f) Find the Fourier Sine transform of \( \frac{1}{x} \).

UNIT-I

Q2 (a) Find the Laplace Transform of the periodic function \( f(t) = \begin{cases} t & 0 < t < c \\ 2c-t & c < t < 2c \end{cases} \) then show that \( \mathcal{L}\left\{ f(t)f(t-x)dx \right\} = F(s)F_2(s) \).

(b) If \( \text{Li}_2(t) = \int_0^t \frac{\ln(1-x)}{x} \, dx \) and \( \text{Li}_2(t) = -\frac{\pi^2}{6} + t \), show that \( \text{Li}_2(t) = \frac{\pi^2}{6} - t \).

Q3 (a) Solve the differential equation \( \frac{d^2y}{dx^2} + 4y = u(t - 2) \), where \( u \) is unit step function \( y(0)=0 \) and \( y'(0)=1 \).

(b) Find the Laplace Transform of \( \int e^{-t} \sin^2tdt \).

UNIT-II

Q4 (a) Find the Fourier Series to represent the function \( f(x) = x \sin x \), \( -\pi < x < \pi \).

(b) Express \( f(x) = x \) as a half-range cosine series for \( 0 < x < 2 \).

Q5 (a) Find the Fourier Sine and Cosine transforms of \( f(x) = \begin{cases} 1 & 0 < x < a \\ 0 & x > a \end{cases} \).

(b) Find the Fourier Series for the function \( f(x) \) in the interval \( (-\pi, \pi) \), where \( f(x) = \begin{cases} \pi + x & -\pi < x < 0 \\ \pi - x & 0 < x < \pi \end{cases} \).

UNIT-III

Q6 (a) Find the relation between Beta and Gamma functions.

(b) Show that \( xJ_n = nJ_n \) - \( xJ_{n+1} \).

Q7 (a) Prove that \( \int_0^\infty x^n e^{-x} \, dx = \frac{2}{2n+1} \).

(b) Show that \( \frac{d}{dx} (x \operatorname{Ber}_x) = x \operatorname{Ber}_x \).

UNIT-IV

Q8 (a) Form the partial differential equation by the elimination of \( \phi \) from \( \Phi \) \( + y + nz = \phi(x^2 + y^2 + z^2) \).

(b) Solve \( \frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x \partial y} = \sin x \cos 2y \).

Q9 (a) Solve \( (D^2 - D^2)z = (y - 1)e^z \).

(b) Solve the wave equation \( \frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2} \) under the condition \( u=0 \) when \( x=0 \) and \( u(x,0) = x, \ 0 < x < \pi \).
END TERM EXAMINATION
THIRD SEMESTER [B.TECH.] DECEMBER-2012
Paper Code: ETCS/ETIC203          Subject: Analog Electronics
Time : 3 Hours       Maximum Marks : 75
Note: Attempt five questions including Q.no.1 which is compulsory.
Select one question from each unit.

Q1 (a) Explain the difference in Zener and Avalanche breakdown.  (3)
(b) Define DC and AC resistance of a diode. How these are computed from the V-I characteristics?  (3)
(c) Explain the difference in dc load and ac load, in transistor amplifiers. (3)
(d) Discuss the causes of instability of 'Q' point in a transistor amplifier. (3)
(e) Draw the hybrid-h parameter model of a transistor for CE configuration. Define all the parameters and give their approximate values. (3)
(f) Draw the circuit of an Emitter Follower and discuss its salient features. (4)
(g) Draw the transfer characteristics of an op-amp and explain the various regions of operation. (3)
(h) Discuss any two applications of op-amp when used as a comparator. (3)

UNIT-I
Q2 (a) Derive an expression for the transition capacitance \( C_T \) for a reverse-based p-n junction. Assume \( N_A \gg N_D \). (6.5)
(b) Explain construction, working and applications of (i) photodiode (ii) LED. (6)

Q3 (a) For a diode circuit shown in fig.1. Assume \( V_y = 0.6V \), \( R_f = 10\Omega \) and \( \eta = 2 \). Determine the total voltage \( u(t) \) across \( R_L \). (6.5)

(b) A silicon p-n junction diode is forward-biased. Find the diode voltage \( V_D \) at which the diode current \( I_D \) assumes 290% of the maximum reverse saturation current at room temperature. (6)

UNIT-II
Q4 (a) Draw the output characteristics of a transistor in CB, CE and CC configuration. Label and show the various regions of operation. Explain why the slope of CE curves is more than in CB configuration. (6)
(b) Determine the region of operation of the transistor shown in fig.2. Given: \( V_{BE,\text{active}} = 0.7V \), \( V_{BE,\text{sat}} = 0.8V \), \( V_{CE,\text{sat}} = 0.2V \). (6.5)

P.T.O.
Q5  (a) Derive an expression for the stability factor $S(I_{CO})$ for a self-bias circuit. Show its variation with the ratio $R_B/R_E$.  
(b) For the circuit shown in Fig. 3, determine (i) $R_B$ (ii) $S(I_{CO})$. Given $\beta = 50$.  

\[ \text{Fig. 3} \]

\[ V_{CC} (24V) \]

\[ V_{BE} = 0.5V \]

\[ 0.5k\Omega \]

\[ R_E = 10k\Omega \]

\[ V_{CE} = 5V \]

UNIT-III

Q6  (a) The h-parameters of a transistor used in CE-amplifier are given as $h_{ie}=1K\Omega$, $h_{fe}=100$, $h_{re}=2\times10^{-4}$ and $h_{oe}=20\mu A/V$. If $R_C=5K\Omega$ and $R_S=1K\Omega$, determine $A_I$, $R_i$, $A_v$, $A_{fs}$, $A_{ds}$, $R_0$ and $R_0'$.  
(b) Explain the structure, working, output and transfer characteristics of an n-channel depletion type MOSFET.  

\[ \text{UNIT-IV} \]

Q7  (a) Draw the circuit diagram and frequency response of an RC-coupled amplifier. Explain why gain falls-off at low and high frequencies.  
(b) Discuss the various biasing techniques used for JFET's.  

Q8  (a) Discuss the following applications of op-amp:-  
   (i) Integrator  (ii) Instrumentation amplifier  
(b) Draw the circuit of an op-amp Astable multivibrator. Derive the expression for its frequency of oscillation.  

Q9  (a) Draw the circuit of a 2nd order HPF using op-amp and derive an expression for its transfer function.  
(b) Using op-amp, discuss any two circuit:-  
   (i) op-amp rectifier  
   (ii) clamper  
   (iii) log amplifier  

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Q. No. 1(a) Find the \( z \)-parameters of the T-network shown in Fig.1 (all resistances are in ohms) (5)

\[ \text{Fig.1} \]

(b) The transfer function of a network is given by \( M(s) = \frac{V(s)}{I(s)} = \frac{s + 3}{(s + 2)} \). When \( i(t) \) is the unit step function, find the value of \( v(t) \) in the steady state. (5)

(c) In a two terminal network, the open circuit voltage at the load terminal is 100V and the short circuit at the same terminal gives 5A current. Find the load current, if a load of 80 ohm resistance is connected at the load terminal. (5)

(d) Find the current \( i_x \) in the network (5)

\[ \text{Fig.2} \]

(e) For the network shown in Fig.3, the switch is closed at \( t = 0 \). If the current in \( L \) and voltage across \( C \) are 0 for \( t < 0 \), find \( i(0^+) \), \( \frac{di(t)}{dt} \bigg|_{t=0^+} \) and \( \frac{d^2i(t)}{dt^2} \bigg|_{t=0^+} \). (5)

\[ \text{Fig.3} \]

Q. No. 2(a) Write the equation for the waveforms shown in Fig.4(a) and (b) (6)

\[ \text{Fig.4} \]

(b) What do you understand by Tree and Co-Tree of a graph? Explain the method to develop incidence matrix for a graph with the help of a suitable example. (6.5)
Q. No. 3(a) Find whether the continuous time system described by $y(t) = x(t^2)$ is casual, time-varying and linear or not?

(b) Using Laplace transform, find the forced and natural responses of the system described by $\frac{d^2y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 6y(t) = \frac{dx(t)}{dt} + 6x(t)$, when the input is a unit step function and the initial conditions of the system are $y(0^+) = 1$ and $y'(0^+) = 2$.

Q. No. 4(a)

The switch $k$ (Fig.5) is in the steady state in position $a$ for $-\infty < t < 0$. At $t = 0$, it is connected to position $b$. Find the expression for current $i_L(t)$, for $t > 0$.

(b) Allowing transients to die out with switch $S$ in position 'a', the switch is then moved to position 'b' at $t=0$, as shown in Fig.6. Find expressions for $v_e(t)$ and $v_R(t)$ for $t > 0$.

Q. No. 5(a) Determine the $\gamma$-parameters for the network shown in Fig.7.

(b) Determine the $\delta$-parameters of the network shown in Fig.8.

Q. No. 6(a)

A voltage source $V_1$ whose internal resistance is $R_1$ delivers power to a load $R_2 + jX_2$ in which $X_2$ is fixed but $R_2$ is variable. Find the value of $R_2$ at which the power delivered to the load is a maximum.

(b) State Thevenin's theorem. Obtain the Thevenin equivalent of the network across the terminal AB as shown in Fig.9. (all element values are in ohm).

Q. No. 7(a)

Test whether

(i) the polynomial $F(s) = s^4 + s^3 + 2s^2 + 3s + 2$ is Hurwitz; and

(ii) the function $F(s) = \frac{Ks}{s^2 + \alpha}$ is positive real, where and $K \& \alpha$ are positive constants.

(b) For the network function $Y(s) = \frac{2(s+1)(s+3)}{(s+2)(s+4)}$ synthesize in Foster-I and Cauer-I form.
END TERM EXAMINATION
THIRD SEMESTER [B.TECH.] DECEMBER-2012
Paper Code: ETCS207 Subject: Foundation of Computer Science
Time : 3 Hours Maximum Marks : 75

Note: Attempt five questions including Q.no.1 which is compulsory.
Select one question from each unit.

Q1: (5*3=15)

a. State the binomial theorem.
b. List the differences between BFS and DFS
c. Define Boolean Matrices with an example
d. Explain the principal of Mathematical Induction with the help of an example
e. Define the concept of Pascal’s Triangle.

UNIT A

Q2: Solve simultaneous recurrence relations: (7.5+7.5)

(a) \(a_n = 3a_n + 2b_{n-1}\)
(b) \(b_n = a_{n-1} + 2b_{n-1}\).

Q3: (a) Let \(X = \{1, 2, 3, 4, 5, 6, 7\}\) and \(R = \{(x, y) | x - y \text{ is divisible by 3}\}\) in \(X\). Show that \(R\) is an equivalence relation.

(b) Let \(A = \{1, 2, 3, 4\}\) and \(\mathcal{P} = \{\{1, 2, 3\}, \{4\}\}\) be a partition of \(A\). Find the Equivalence relation determined by \(\mathcal{P}\).

UNIT B

Q4:

(a) Explain BFS with an example.
(b) Explain Hamiltonian Circuit with an example.

Q5:

(a) Obtain the canonical product of sums of the propositional formulas:
\[-x \land (\neg y \land z)\]

(b) Determine the validity of the following arguments using propositional logic:
“Smoking is healthy. If smoking is healthy, then cigarettes are prescribed by physicians. Therefore, cigarettes are prescribed by physicians”.

UNIT C

Q6:

(a) Give an example of a graph with ten edges that has a bridge as well as an Euler path.

(b) In the definition of Euler circuit discuss the requirement that the Euler circuit Intersects with every vertex at least once.

P.T.O.
Q7:
(a) Define spanning tree. What are its characteristics? (6)
(b) Derive all possible spanning trees for the graph shown in Figure 1. (9)

UNIT D

Q8: Write short Notes on any three
   a. POST ORDER Tree Traversal Procedure
   b. Pigeon hole principle
   c. Isomorphic Binary operations
   d. Warshall’s algorithm (5*3=15)

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Q1  (a) What are mutable variables?  
(b) What are nameless objects?  
(c) What is general purpose pointer?  
(d) When is scope resolution operator used?  
(e) Differentiate between pointer and reference variable.  
(f) What is the role of destructors in C++ program?  
(g) What is static function?  
(h) What is the difference between function overloading and function overriding?  
(i) Explain the concept of this pointer.  
(j) Which operators cannot be overloaded?  

(2.5x10=25)

Q2  (a) What is meant by a constant member function? Explain with an example.  
(b) What is role of an inline function? How does it differ from macro? Explain with examples.  
(c) Explain dynamic memory management for C++.  

(4)  
(4)  
(4.5)

Q3  (a) Write a program to overload ++ operator for prefix and postfix use.  
(b) What are default arguments?  
(c) Why argument passed to a copy constructor is a reference variable?  

(6)  
(3)  
(3.5)

Q4  (a) Write a program to overload operator + to concatenate two strings using friend function.  
(b) Differentiate among private, public and protected access modifiers. Also, explain their meaning when a derived class inherits from a base class using public, protected or private keywords.  

(6.5)  
(6)

Q5  (a) What is the difference between a virtual function and a pure virtual function? Explain with example.  
(b) What is a function template? Write a function template to find a maximum value from an array.  

(6.5)  
(6)

Q6  (a) Write a C++ program to copy one file to another file after converting the lower case characters to upper case characters.  
(b) What is exception handling? Discuss try, catch and throw with the help of suitable example.  

(7.5)  
(5)

Q7  (a) Write a program to implement stack using class template.  
(b) What is a standard template library (STL)? Briefly explain sequence containers and associative containers.  

(6.5)  
(6)

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Q1 (a) Time complexity to solve a problem P by four different algorithms given as
   \( A = O(2^N), B = O(N^{3/2}), C = O(N \log N) \) and \( D = O(N \log \log N) \). Arrange them in
   increasing order.
   (b) Briefly discuss about any two strategies for memory representation of sparse matrix.
   (c) How doubly link list solves the problem associated with single link list?
   (d) What is the minimum number of stacks of size ‘N’ required to implement a queue of
       size ‘N’? Justify your answer.
   (e) What is the maximum height of any AVL-tree with 11 nodes? Assume that the
       height of a tree with a single node is 0.
   (f) Numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 inserted into a initially empty binary search tree
       in given order. What will be the in-order traversal sequence of the resultant tree?
   (g) Let G be a complete undirected graph on 5 vertices. If vertices of G are unique then
       what is the number of distinct cycles of length 3 in G?
   (h) Differentiate between external and internal sorting.
   (i) What is the number of swaps required to sort N elements using selection sort, in the
       worst case?
   (j) B-tree of order 4 is built by 10 successive insertions. What is the maximum number
       of node splitting operations that may take place?
Q2 (a) What is recursion and how it is implemented? (2.5)
   (b) Write an algorithm to reverse a given single link list. (5)
   (c) Write an algorithm to convert infix notation into postfix notation by using stack. (5)
Q3 (a) Briefly discuss about storage implementation of two dimensional array. (2.5)
   (b) Write an algorithm to implement circular queue using array. (5)
   (c) Write an algorithm to delete a node situated at mid position in a given doubly link
       list. (5)
Q4 (a) Does the minimum spanning tree of a graph give the shortest distance between any
       two specified nodes? Why or why not? (2.5)
   (b) Write an algorithm to return height of a given binary tree. (5)
   (c) For any binary tree if in-order traversal is: M B F D K I J C G A N and post-order
       traversal is: M F K D B J G C N A I. Write pre-order traversal for this tree. (5)
Q5 (a) To perform search over a graph which strategy is better breadth first search or
       depth first search? Justify. (2.5)
   (b) Explain single source shortest path algorithm by using a suitable example. Derive
       its runtime complexity. (5)
   (c) For a given undirected graph \( G = (V, E) \), if nodes are \( V_1, V_2, \ldots, V_{10} \). Two nodes \( V_1 \) and
       \( V_2 \) are connected if and only if \( 0 < |i - j| < 3 \). Each edge \( (V_i, V_j) \) is assigned a weight
       \( (i + j) \). What will be the cost of the minimum spanning tree (MST) of \( G \)? (5)
Q6 (a) For a given set of N distinct elements how many binary search trees are possible? (2.5)
   (b) Perform heap sort for following given data in order: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15. (5)
   (c) Write an algorithm to find a cycle in a given graph by using depth-first or breadth
       first search. (5)
Q7 (a) What is the number of comparisons required in merging two ordered files A and B of
       sizes M and N respectively? Prove your answer. (2.5)
   (b) Create AVL tree using following data given in order: 3, 2, 1, 4, 5, 6, 16, 15, 14. (5)
   (c) Write quick sort algorithm and also derive its run time complexity. (5)
Q8 (a) Construct 2-3-4 tree (B-tree with a minimum degree of two) in which each data item
       is a letter. The alphabetical ordering of letters used in constructing the tree are B, H, I, L, N, P, Q, T, U, V, X, Z, G. (2.5)
   (b) Write short notes on any two of the following:-
       (i) Hashing
       (ii) File organization Techniques
       (iii) Topological Sorting
       (iv) Threaded binary Tree
       *****************
Q. 1. (a) If \( f(t) \) has a Laplace transform and if \( F(t+w) = F(t) \), then show that

\[
L\{F(t)\} = \int_{0}^{\infty} \frac{e^{-s\beta} F(\beta) d\beta}{1 - e^{-sw}}.
\]  

(b) If \( L\{F(t)\} = f(s) \), then show that

\[
L\left\{ \frac{F(t)}{t} \right\} = \int_{s}^{\infty} f(s) ds, \text{ provided the integral exists. Use it to find the Laplace transform of } (\sin \alpha t)/t \text{ exist?}
\]  

(c) State and prove Rodrigue’s formula.  

(d) Define Bessel function of first kind of order \( n \). Show that

\[
x J_n(x) = n J_n(x) - x J_{n+1}(x)
\]  

(e) Find the d’Alembert’s solution of a one dimensional wave equation. Use it to find the deflection of a vibrating string of unit length having fixed ends with initial velocity zero and initial deflection

\[
f(x) = k (\sin x - \sin 2x)
\]  

(f) What do you mean by half range series? Expand \( f(x) = x^2 \) in a Fourier sine series in \( 0 < x < 1 \).
UNIT - I

Q. 2.  (a) Find  
(i) \( L\{\sin\sqrt{t}\} \),  
(ii) \( L^{-1}\left\{\frac{s}{s^4 + s^2 + 1}\right\} \)  \( (3, 3) \)

(b) Apply convolution theorem to show that

\[
\begin{align*}
(i) & \ \int_0^t \sin u \cos(t-u) \, du = \frac{1}{2} t \sin t \\
(ii) & \ L^{-1}\left\{\frac{s}{(s^2 + 4)^3}\right\} = \frac{t}{64} (\sin 2t - 2t \cos 2t) \quad (3, 3.5)
\end{align*}
\]

Q. 3.  (a) State and prove first shifting theorem and use it to find 
\( L\{\sinh at \cos at\} \).

(b) Solve \( \frac{\partial^2 y}{\partial x^2} = y + 2 \frac{\partial y}{\partial t}, \ y(x, 0) = 6e^{-3x} \), 
which is bounded for \( x > 0, t > 0 \).  \( (6.5) \)

UNIT - II

Q. 4.  (a) Find the Fourier transform of

\[
\mathcal{F}\{f(x)\} = \begin{cases} 
1 - x^2, & |x| \leq 1 \\
0, & |x| > 1 
\end{cases}
\]

and hence evaluate \( \int_0^\infty \left( \frac{x \cos x - \sin x}{x^3} \right) \cos \frac{x}{2} \, dx \)  \( (3, 3.5) \)

(b) What do you mean by even and odd functions? Expand \( f(x) = |\cos x| \) 
as a Fourier series in the interval \( (-\pi, \pi) \).  \( (6) \)
Q. 5. (a) Obtain the constant term and the coefficients of the first sine and cosine terms in the Fourier expansion of y as given in the following table:

\[
\begin{array}{cccccc}
  x & 0 & 1 & 2 & 3 & 4 & 5 \\
  y & 9 & 18 & 24 & 28 & 26 & 20 \\
\end{array}
\]  

(b) Using the Fourier Sine transform, solve

\[
\frac{\partial V}{\partial t} = k \frac{\partial^2 V}{\partial x^2} \quad \text{for} \ x > 0, \ t > 0,
\]

with the boundary conditions: \( V(0, t) = V_0 \)

and initial conditions: \( V(x, 0) = 0. \)  

UNIT - III

Q. 6. (a) Explain Ber and Bei functions and show that

(i) \( \frac{d}{dx} (x \text{Bei} x) = x \text{Ber} x, \)

(ii) \[
\int_0^\infty x (\text{Ber}^2 x + \text{Bei}^2 x) \, dx = \frac{\pi}{2} (\text{Ber}^2 \pi + \text{Bei}^2 \pi).
\]  

(b) Prove that

(i) \( \frac{\Gamma(m+\frac{1}{2})}{\Gamma(m+\frac{1}{2})} = \frac{\sqrt{\pi} \Gamma(2m)}{2^{2m-1}} \)

(ii) \( \frac{\beta(m+1, n)}{m} = \frac{\beta(m, n+1)}{n} = \frac{\beta(m, n)}{m+n} \)

Q. 7. (a) In the usual notations, prove that

\( (n+1) P_{n+1}(x) = (2n+1) x P_n(x) - n P_{n-1}(x) \)

Use this to evaluate \( \int_{-1}^{1} x^2 P_{n-1} P_{n+1} \, dx \)

(b) State and prove orthogonality of Bessel functions.  

P.T.O.
UNIT - IV

Q. 8.  (a) Find differential equation of all spheres whose centres lie on the Z-axis.

(b) Solve \( \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0 \), subject to \( u(0, y) = u(1, y) = u(x, 0) = 0 \) and \( u(x, a) = \sin \frac{n \pi}{\ell} x \) \( (7.5) \)

Q. 9.  (a) A string is stretched and fastened to two points \( l \) apart. Motion is started by displacing the string in the form \( y = a \sin \left( \frac{\pi x}{l} \right) \) from which it is released at time = 0.

Find the displacement of any point at a distance \( x \) from one end at time \( t \).

(b) Form the p. d. e. by eliminating the arbitrary function from

\[ Z = y^2 + 2f \left( \frac{1}{x} + \log y \right) \] \( (4) \)
END TERM EXAMINATION
THIRD SEMESTER (B.TECH.) - DECEMBER 2010

Paper Code : ETCS - 203
Paper ID : 27203
Subject : Analog Electronics

Time : 3 Hours
Maximum Marks : 75

Note : (1) Question No. 1 is compulsory.
(2) In addition attempt any One question from each unit.

Q. 1. (a) Explain the significance of the existence of
(i) transition capacitance
(ii) diffusion capacitance
in a PN junction diode. (3)
(b) Draw the Eber-Moll's model of BJT and write necessary equations. (3)
(c) Give the circuit diagrams of:
(i) log amplifier
(ii) antilog amplifier
(4)
(d) Explain the difference between:
(i) drift current
(ii) diffusion current
Draw necessary neat diagrams. (3)
(e) Give the basic principle of LED. (3)
(f) Explain the need for stabilization of any BJT. List the types of stability factors. (3)
(g) Give various characteristics of an ideal OP - AMP. (3)
(h) Explain the difference between zener breakdown and avalanche breakdown. (3)

UNIT - 1

Q. 2. (a) Derive an expression for the transition capacitance of a linearly
graded PN junction. Explain the significance of each symbol in the
expression. (6)

(b) Derive the expressions for:
(i) ripple factor
(ii) rectification efficiency
of half-wave and full-wave rectifiers. (6-5)

P.T.O.
Q. 3. (a) Explain the PN junction diode characteristics in the forward and reverse biased conditions. What is the effect of temperature on these characteristics? (6)

(b) Explain the working principle of :
(i) Schottky diode
(ii) Tunnel diode
Give their characteristics and typical applications. (6.5)

UNIT - II

Q. 4. (a) Find the value of stability factor S with respect to $i_{ce}$ for the circuit shown in Fig. (1). (6)

(b) Explain the output characteristics of an NPN transistor in :
(i) CB configuration
(ii) CE configuration (6.5)

Q. 5. (a) Derive the expressions of $S$, $S_\beta$, $S_v$ for a self bias circuit. Compare stability factor $S$ for various biasing circuits. (9)

(b) Explain the significance of a. c. and d. c. load lines. (3.5)

UNIT - III

Q. 6. (a) Draw $h$-parameter model of BJT in :
(i) CE
(ii) CB
(iii) CC configurations. Write terminal equations for each model. (5)
(b) Derive expressions of $A_v, A_I, Z_{in}, Z_{out}$ for an Emitter Follower. List the applications of such circuit. \hspace{1cm} (5)

(c) Compare the features of transistor amplifier in various configurations. \hspace{1cm} (2.5)

Q. 7. (a) Find the voltage gain of RC coupled amplifier in mid-frequency region. Draw neat circuit diagram of such amplifier and give labelled frequency response curve. \hspace{1cm} (6.5)

(b) Explain the characteristics of N-channel depletion type MOSFET. \hspace{1cm} (6)

UNIT - IV

Q. 8. (a) Using neat circuit diagrams, find the expression of output voltage for the following :
(i) Integrator
(ii) Differentiator
(iii) Summing amplifier \hspace{1cm} (6)

(b) Derive an expression for the output voltage of an Instrumentation Amplifier using OP-AMP. \hspace{1cm} (6.5)

Q. 9. (a) Explain :
(i) Various stages of OP-AMP
(ii) Various parameters of OP-AMP
(iii) Ideal voltage transfer curve of OP-AMP
(iv) Open loop OP-AMP configuration
(v) Closed loop OP-AMP configuration \hspace{1cm} (8)

(b) Give the principle of the following using OP-AMP:
(i) Comparator
(ii) First order filter (LPF)
(iii) Current source \hspace{1cm} (4.5)
Q. 1. (a) With the help of examples differentiate between continuous and discrete signals. 

(b) Express \( v(t) \) shown below using step signals.

Q. 2. (a) Give important properties of LT I systems.

(b) A dc voltage of 100 V is applied in the circuit shown below. The switch \( S \) is open. This is closed at \( t = 0 \). Find the complete expression for the current.
Q. 3. (a) Find the characteristic equation of the following differential equation
\[ \frac{d^4y}{dt^4} + 9 \frac{d^2y}{dt^2} + 7y = \sin t \] 
(5)

(b) Determine Laplace transforms of the following functions.
   (i) \( \delta(t) \), unit impulse
   (ii) \( \cos t - \cos 2t \)
   (iii) \( \frac{1}{2} (1 - e^{-2t}) \) 
(10)

Q. 4. (a) Derive a Laplace transformed circuit representation of inductance parameter.

(b) Consider a series RLC circuit with the capacitor initially charged to voltage of 1V as indicated in the figure below. Find the expression for \( i(t) \)

Q. 5. (a) In reference to graph theory explain what do you understand by cut-set matrix.

(b) Verify reciprocity theorem for the \( T \)-network shown below.
Q. 6.  (a) State and illustrate the Millman’s theorem.
(b) Determine the transmission parameters of the network shown below:

\[ R \]

\[ j\omega L \]

\[ \frac{1}{j\omega C} \]

Q. 7.  (a) Check whether the following polynomial is Hurwitz or not
\[ S^5 + 7S^4 + 5S^3 + S^2 + 2S \]
(b) Synthesise the network function
\[ Z(S) = \frac{S(S^2 + 4)}{2(S^2 + 1)(S^2 + 9)} \] as a Foster - I form.

Q. 8.  (a) Check whether the following function is p. r. or not.
\[ F(S) = \frac{4S + 1}{S + 2} \]
(b) Realize \( Z_{RC}(S) = \frac{S^2 + 4S + 1}{4S^2 + 5S + 1} \) in Caner - II form.
Q. 1. (a) Show that \( p \Rightarrow q = \neg p \lor q \). 
(b) Define a Poset by giving an example. 
(c) Discuss the commutativity and associativity of the binary operation \( \cdot \) defined on the set of integers \( I \) as 
\[ a \cdot b = a - b + ab \]
for all \( a, b, \in I \). 
(d) Let \( S = \{ a, b, c, d \} \). How many functions can be defined from the set \( S \) to itself? How many of these are one-one, onto? 
(e) For a planar graph given below, verify the Euler's formula:

(f) Let \( S = \{ 2, 3, 4, 6, 8, 12, 24, 36, 48 \} \). Define the relation 
\( \leq \) in \( S \) by \( X \leq Y \) if \( X \) divides \( Y \). 

(g) In a Boolean Algebra if \( a + x = b + x \) and \( a + x' = b + x' \) then prove that \( a = b \).
(h) Find a minimal spanning tree of the following connected graph:

```
(4)
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UNIT - I

Q. 2. (a) Define a relation R on the set of all natural numbers N given by:

\[ R = \{(a, b) \mid a - b \text{ is an odd positive integer}\} \]

Which of the following properties are satisfied by R:

(i) Reflexive  (ii) Symmetric  (iii) Antisymmetric
(iv) Transitive  (v) Equivalence relation
(vi) Partial ordering relation

(b) Solve the linear difference equation:

\[ u_1 = 2; \quad u_n = u_{n-1} + 6 \quad n \geq 2 \]

Q. 3. (a) Using the Principle of Mathematical Induction, prove that

\[ A(n) = 5 \times 2^{3n-2} + 3^n \]

is divisible by 19.

(b) Given two sentences A, B as:

\[ A = \{3 < 8\} \]
\[ B = \{5 < 8\} \]

What is the meaning of the sentences:

(i) \( A \cup B \),  (ii) \( A \cap B \),  (iii) \( A \Rightarrow B \),  (iv) \( \neg A \),  (v) \( \neg B \).

Which of these sentences are True and which are False?

UNIT - II

Q. 4. (a) Seventy-five tourists out of a group of 120 speak German, 50 speak French, 40 speak Spanish, 30 speak both German and French, 15 speak both German and Spanish and 12 speak both French and Spanish. How many tourists in the group speak all the three languages?
(b) Let \( S = \{ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 \} \). Define a relation \( R \) on \( S \) by \( xRy \) if and only if \( x^2 - y^2 \) is a multiple of 3. Show that \( R \) is an equivalence relation on \( S \). Determine the equivalence classes in \( S \) under the relation \( R \).

(6)

Q. 5. (a) Let \( f : R \to R \) be given by \( f(x) = (x + 1)^2 - 1 \).

Find \( f^{-1} \) and its domain. Also find the set \( S = \{ x : f(x) = f^{-1}(x) \} \).

(4)

(b) Let \( N \) be the set of natural numbers and \( X = N \times N \). Define a binary operation \( \cdot \cdot \cdot \) on \( X \) by \( (a, b) \cdot \cdot \cdot (c, d) = (ac, bd) \); \( a, b, c, d \in N \).

Show that \( \cdot \cdot \cdot \) is both commutative and associative.

(4)

(c) Three films A, B, C were shown in a cinema hall for a week to 40 students (each of whom saw either all the three films or only one film). 13 students saw film A, 16 students saw film B, and 19 students saw film C. How many students saw all the three films?

(4-5)

UNIT - III

Q. 6. (a) For the ordered set \( A \) given in the figure

Let \( L(A) \) be the set collection of all linearly ordered subsets of \( A \) with 2 or more elements. Let \( L(A) \) be ordered by inclusion. Draw the Hasse diagram of \( L(A) \).

(6)

(b) Convert the function

\( F(x, y, z) = (x + y + z)(xy + x'z) \) into conjunctive and disjunctive normal forms.

(6-5)
Q. 7. (a) In a lattice \((L, \text{Relation} \leq)\), \(a, b, \in L\), show that \(a \cap b = b\) if and only if \(a \cup b = a\).

\[Q. 7.\]

(b) Let \(B\) be the set of positive integers which are divisors of 30 and the operation \(\land, \lor\) on it are defined as:
\[
\begin{align*}
\land & = \text{L. C. M.} (a, b) \\
\lor & = \text{H. C. F.} (a, b)
\end{align*}
\]

\[a' = \frac{30}{a} \text{ for all } a, b \in B\]

Prove that \((B \lor, \land, \cdot, 1, 30)\) is a Boolean Algebra.

UNIT - IV

Q. 8. (a) Examine the isomerism of graphs \(G\) and \(H\) given below:

\[Q. 8.\]

(b) Obtain a minimal spanning tree for the graph:

\[Q. 9.\]

Q. 9. (a) Define the following types of graphs with examples:

(i) Euler Path

(ii) Hamiltonian circuits

(iii) Directed graph

(b) Define a tree and show that a tree with \(n\) vertices has exactly \((n-1)\) edges.

(c) Show that a non-empty connected graph \(G\) is Eulerian if and only if its vertices are all of even degree.

\[Q. 9.\]

\[\text{*****}\]

\[Q. 9.\]
1. Short answer type. 
   a) Explain the procedure for creating input and output objects. 
   b) Describe the bit fields required in self() function. 
   c) Describe the use of scope resolution operator and reference operator. 
   d) What are static objects? 
   e) How a class type can be changed to another class type? 
   f) How are constructors and destructors executed in multilevel inheritance? 
   g) What are virtual destructors? 
   h) Explain object slicing. 
   i) What are VPTR and VTABLE? Explain. 
   j) Describe the two methods of opening of files. 

   \[10 \times 2.5 = 25\]

2. a) What precautions should we take at the time of function overloading? 
   b) Write a program to allocate memory using new operator for 10 integers. Read and display the integers. 

   \[10\]

3. a) Explain typecasting. What are explicit and implicit type conversions? 
   b) Write a program to display only even numbers in between 1 and 150. 

   \[2.5\]
   \[10\]

Unit II

4. a) What are inline functions? Explain advantages and disadvantages of inline functions. 
   b) Write a program to overload the function fabs(). The function should return absolute value of the given number for data type int and float. 

   \[2.5\]
   \[10\]

5. a) Which operators are used to access class members? 
   b) Write a program to define three classes. Define a friend function. Read and display the data of three classes using constructors, member functions and friend functions. 

   \[2.5\]
   \[10\]

Unit III

6. a) What is the difference between overloading binary and unary operators. 
   b) Write a program to pass reference of object to operator function and change the contents of object. Use single object as source and destination object. 

   \[2.5\]
   \[10\]

7. a) What do you mean by object delegation? 
   b) Write a program to demonstrate object slicing. 

   \[2.5\]
   \[10\]

Unit IV

8. a) Describe the various error trapping functions. 
   b) Write a program to count characters and numerals present in a file. 

   \[5\]
   \[7.5\]

9. a) What are the differences between templates and macros? 
   b) Write a program to display reverse string using template function. 

   \[2.5\]
   \[10\]
Q. 1. (a) Can Binary Search be applied to a linked list. Explain with taking suitable example.  

(b) What do you understand by reverse polish notation? Write an algorithm for correcting infix to reverse polish notation.  

(c) Write a recursive routine to find the number of nodes in a linked list.  

(d) Given the following elements to be sorted using insertion sort.  
40, 50, 20, 30, 55, 15  
(i) How many iterations will be required?  
(ii) Is there any change in the sequence after the first iteration? Why?  
(iii) What is the sequence after the third iteration?  

(e) Q is a queue that contains integer elements A, B and C. Show what is written by the following segment of code:  
    Clearq (Q);  
    enq (Q, 4);  
    enq (Q, 5);  
    enq (Q, 6);  
    enq (Q, 7);  
    deq (Q, A);  
    deq (Q, B);  
    enq (Q, A+1);  
    deq (Q, A);  
    deq (Q, B);  
    printf (A, B)
(f) Define the following:
   (i) Critical path
   (ii) Connected graph
   (iii) Minimum spanning tree
   (iv) Adjacency matrix

UNIT - I

Q. 2. Write the algorithm / C / C++ code to perform the following operations:
   (a) Insert a node with value y in the sorted linked list. (3)
   (b) Insert a node P pointed by a pointer Q in a doubly linked list. (3.5)
   (c) Count the number of nodes in a circular linked list. (3)
   (d) Delete a node containing value x from a linked list. (3)

OR

Q. 3. (a) Assuming all the stack operations, write an algorithm to evaluate an expression given in postfix notation. (5)
   (b) Define sparse matrices. How they are represented? Write an algorithm to add two sparse matrices. (5)
   (c) How do you measure the time and space complexity of an algorithm? (2.5)

UNIT - II

Q. 4. (a) Suppose the following sequences list the nodes of a binary tree T in Pre-order and In-order respectively:
   Draw the diagram of the tree. (5)
   (b) Write an algorithm for finding minimum spanning tree of the given graph. (5)
   (c) Define threaded binary tree. (2.5)

OR

Q. 5. (a) Define a binary search tree. Construct a binary search tree by inserting the following numbers in order of their occurrence:
   50, 33, 44, 22, 77, 35, 60, 40
   Assume that tree is initially empty. (4.5)
(b) Give Dijkstra’s algorithm to solve single source shortest path in graphs. Illustrate with the help of a suitable example. (6)
(c) How graphs are represented? (2)

UNIT - III

Q. 6. (a) Write an algorithm to sort the elements of an array using selection sort. (6-5)
(b) Explain AVL trees. Construct an AVL search tree by inserting the following elements in order of their occurrences:
   64, 1, 44, 26, 13, 110, 98, 85 (6)

OR

Q. 7. (a) What do you mean by hashing? How do you resolve a collision in hashing? (6)
(b) Write an algorithm to sort the elements of an array using merge sort. (6-5)

UNIT - IV

Q. 8. Write a note on the following:
   (i) B – trees (4-5)
   (ii) Sequential file organization (4)
   (iii) Inverted files (4)

OR

Q. 9. Write a note on the following:
   (i) Cellular partitions (4)
   (ii) Random file organization (4-5)
   (iii) Tries (4)

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END TERM EXAMINATION
THIRD SEMESTER [B.TECH.]—DECEMBER 2009

Paper Code: ETMA-201/ETEN-201
Paper ID: 36201/56201
Subject: Applied Mathematics-III

Note: Attempt any five questions in all. Q.No.1 is compulsory. Attempt one question from each unit.

Q.1 (a) What are the sufficient conditions for the existence of the Laplace transform of a function \( f(x) \)? All those necessary also? Justify by giving an example. (4)
(b) State and prove Laplace Convolution Theorem. (5)
(c) How do find the Fourier series expansion of a function \( f(x) \) of period \( 2\pi \). When it is specified only on the half-range interval \( 0 \leq x \leq \pi \)? Explain. (4)
(d) Using the transform of integrals, find the Fourier Transform of \( f(x) = e^{-x^2} \). (5)
(e) Prove that \( B(l,m) = \frac{\Gamma(l) \Gamma(m)}{\Gamma(l+m)}, l > 0, m > 0 \). (4)
(f) Find the PDE of all planes which are at a constant distance \( d \) from the origin. (3)

UNIT-I

Q.2 (a) Find (i) \( L^{-1}\left[ \frac{s^3}{s^4-a^4} \right] \) (ii) \( L^{-1}\left[ \frac{s^3}{s^4-1} \right] \). (3, 3)
(b) Solve the following boundary value problem using the Laplace transform \( y''(t) + 9y(t) = \cos 2t; y(0) = 1, y'(\pi/2) = -1 \). (6, 5)

Q.3 (a) Find (4, 4)
(i) \( L\left[ f(t) \right] \) where \( f(t) = \begin{cases} 2 + t^2, & 0 < t < 2 \\ 6, & 2 \leq t < 3 \\ 2t - 5, & 3 \leq t < \infty \end{cases} \)
(ii) \( L^{-1}\left[ \frac{3s+1}{s^2(s^2+4)} \right] e^{-3s} \)
(b) State and prove the second shifting theorem of Laplace transform. (4, 5)

UNIT-II

Q.4 (a) Find the Fourier Series expansion of the function \( f(x) = \begin{cases} 1 + 2x/\pi, & -\pi < x < 0 \\ 1 - 2x/\pi, & 0 \leq x < \pi \end{cases} \) and deduce that \( \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} \frac{\pi^2}{8} \). (6)

P.T.O.
Following values of \( y \) give the displacement of a certain machine 
part for the rotation \( x \) of the flywheel. \( \text{ (6.5) } \)

\[
\begin{array}{|c|c|c|c|c|c|c|}
\hline
x & 0 & \frac{\pi}{3} & \frac{2\pi}{3} & \pi & \frac{4\pi}{3} & \frac{5\pi}{3} & 2\pi \\
\hline
y & 1.98 & 2.15 & 2.77 & -0.22 & -0.31 & 1.43 & 1.98 \\
\hline
\end{array}
\]

Express \( y \) in Fourier series up to the third harmonic.

**UNIT-II**

Q.5 (a) Find the inverse Fourier transform of \( f(w) = \frac{1}{(4 + w^2)(9 + w^2)} \). \( \text{ (6) } \)

(b) By applying an integral transform solve the b.v.p. \( f''(x) - f(x) = 3e^{-2x}, 0 < x < \infty \) and \( f(0) = x_0, f(\infty) \) bounded. \( \text{ (6.5) } \)

**UNIT-III**

Q.6 (a) (i) Express \( \int_0^1 x^n(1 - x^p)^m \, dx \) in terms of Beta function and 

hence evaluate the integral \( \int_0^1 x^{\frac{3}{2}} (1 - \sqrt{x})^{\frac{1}{2}} \, dx \). \( \text{ (3) } \)

(ii) Show that \( B(m, n) = B(m+1, n) + B(m, n+1) \). \( \text{ (3) } \)

(b) State and prove Rodrigue's formula. \( \text{ (6.5) } \)

Q.7 (a) Show that \( J_0^2 + 2(J_1^2 + J_2^2 + J_3^2 + \cdots + J_n^2) - 1 \) where the letters have 

their usual meanings. \( \text{ (6) } \)

(b) State and prove the orthogonality property of Legendre polynomials. \( \text{ (6.5) } \)

**UNIT-IV**

Q.8 (a) Find the steady temperature in a rectangular plate when 
the sides \( x = 0, x = a, y = b \) are insulated while the edge \( y = 0 \) is 
kept at temperature \( k\cos(nx/a) \). \( \text{ (6.5) } \)

(b) A tightly stretched string with fixed end points \( x = 0 \) and \( x = \ell \) is 
initially in a position given by \( u(x) = u_0 \sin^3 (\pi x/\ell) \). If it is 
released from rest from this position, find the displacement \( u(x, t) \). \( \text{ (6) } \)

Q.9 (a) For the p.d.e. by eliminating the arbitrary functions from the 
equation \( \frac{\partial}{\partial y} \left( \frac{\partial}{\partial x} \right) \phi(x, y) \). \( \text{ (4) } \)

(b) The points of trisection of a string are pulled aside through the 
same distance on the opposite sides of the position of 
equilibrium and the string is released from rest. Derive an 
expression for the displacement of the string at subsequent time 
and show that the mid-point of the string always remains at 
rest. \( \text{ (8.5) } \)
END TERM EXAMINATION

THIRD SEMESTER [B.TECH.]—DECEMBER 2009

Paper Code: ETCS-203
Paper ID: 27203

Time : 3 Hours  
Maximum Marks : 75

Note: Attempt all questions including Q.No. 1 is compulsory. Internal choice is indicated.

Q.1

[a] Answer the following: -
(b) Explain how temperature affects the V-th characteristics of an injection diode. (3)
(c) Explain the ratings that limit the operation of a transistor as an amplifier. (3)
(d) Show the region on the output characteristics of the transistor. (3)
(e) Explain the difference in ac and dc load lines, which is more, ac load or dc load? (3)
(f) Draw a practical self-biased CE amplifier circuit. Explain the importance of various capacitors used. (3)
(g) What is the alternate notation for 11, 12, 21 and 22 in n-parameters? Who introduced this? (3)
(h) Compare the important parameters (A_v, A_i, R_i, R_v) of a transistor amplifier in different transistor configurations. (3)
(i) Make op-amp (ideal) amplifier for the following: -
(ii) A_v = -10 ; R_i = 10KΩ
(iii) A_v = +10 ; R_i = ∞
(iv) A_v = +1 ; R_i = ∞

Q.2

(a) Show that the transition capacitance of a step graded pn junction diode is
given by \( C_T = A \left( \frac{q E N_o}{2(V_o - V_D)} \right)^{1/2} \). Assume \( N_A >> N_P \). All the symbols lane
their usual meaning. (6.5)
(b) For the zener regulator circuit shown in Fig.1, find the maximum and minimum current flowing through the zener diode. (6)

OR

Q.3

(a) Explain the breakdown mechanism in a diode. (3)
(b) Derive an expression for the dc current in a half wave rectifier if the diode used is not ideal, i.e., \( V_r = 0, R_l = 0 \). (3)
(c) Find the total voltage across load \( R_l \) in the circuit shown in Fig.2. Given: \( V_r = 0.6V, R_l = 10Ω \) and \( q = 2 \) for the diode. (6.5)

Q.4

(a) For a transistor in CE configuration, (i) Derive an expression between \( I_C, I_B \) and \( I_{CO} \). (ii) Explain why slope of the output characteristics is more than in CB configuration. (iii) Cut-off condition. (6.5)

P.T.O.
(b) The circuit shown in Fig.3 uses a silicon transistor. Given $\beta = 100$, $V_{BE} = 0.2V$, $V_{BE, sat} = 0.8V$, $V_{RE, act} = 0.7V$, $v_c = 0.5V$. Find the region of operation of the transistor.

![Circuit Diagram]

Q.5 (a) Explain the Ebers-Moll mode of a pnp transistor.
(b) Explain why self-bias circuit is better than a fixed biased circuit.
(c) For the circuit shown in Fig.4, determine (i) $V_C$ (ii) $S(I_C)$. Assume $\beta = 120$.

![Circuit Diagram]

Q.6 (a) Draw the circuit of an RC coupled amplifier and explain its frequency response.
(b) A transistor amplifier is shown in Fig.5. Compute $A_v = V_o/V_i$, $A_r = I_o/I_i$, $R_i$ and $R_e$. Assume $h_{re} = 1k\Omega$, $h_{re} = 100$, $h_{re} = h_{re} = 0$.

![Circuit Diagram]

OR

Q.7 (a) Draw the basic structure of an n-channel JFET. Draw and explain the CS drain characteristics qualitatively.
(b) For an emitter follower, derive expressions for $A_i$, $A_v$, $R_i$ and $R_o$. Compute these for $R_e = 5k\Omega$, $R_e = 1k\Omega$. Assume transistor parameters as: $h_{re} = 1k\Omega$, $h_{re} = 100$, $h_{re} = h_{re} = 2x10^{-4}$ and $h_{re} = 20\mu A/V$.

Q.8 (a) Draw the block schematic of an op-amp. Explain the function of each block.
(b) Draw and explain the working of an op-amp square wave generator. Derive an expression for the frequency of oscillation.

OR

Q.9 (a) Draw the circuit of a three op-amp instrumentation amplifier, and derive an expression for the output voltage. What are the important features?
(b) Write short notes on any two of the following:
   (i) op-amp integrator
   (ii) Second order LPF using op-amp
   (iii) op-amp regenerative comparator

**********
END TERM EXAMINATION
THIRD SEMESTER [B.TECH.]—DECEMBER 2009

Paper Code: ETEC-205
Paper ID: 28205
Subject: Circuits and Systems

Time: 3 Hours
Maximum Marks: 75

Note: Attempt any five questions. All questions carry equal marks. Assuming missing data if any. Requirement of Calculators.

Q.1  (a) Define a signal and also describe the different types of the signals.  (7)
      (b) The voltage waveform across the capacitor of 0.2\mu F is shown in Fig.1. Determine the current waveform through it.  (8)

\[ L(t) \]
\[ 10V \]
\[ 0 \quad 2 \quad t \]

Q.2  (a) Describe the transient response of a series R-L Circuit having sinusoidal excitation.  (7)
      (b) The step voltage applied to a series R-L Circuit is 36V with R = 15\Omega. Determine the value of inductance L required to make the current of 1.0A at 250 sec. Assume the initial current as zero.  (8)

Q.3  (a) Define Laplace Transform and state all the properties of Laplace Transform.  (7)
      (b) Find the Laplace Transforms of the following functions.
         (i) \[ e^{at} \sin wt \]
         (ii) \[ 10u(t) - \delta(t) - 5\delta(t-4) \]

Q.4  (a) Draw the transformed circuits for all electrical components.  (7)
      (b) In the circuit shown in Fig.2, the switch s is closed at \( t = 0 \) with the network previously unenergized. Evaluate \( i_1(t) \).  (8)

\[ \text{Fig.2} \]

P.T.O.
Q. 5 (a) In reference to graph theory explain the concept of duality with the help of suitable example.  
(b) Obtain the h-parameters of the network in terms of all other parameters.

Q. 6 (a) State and prove the maximum power transfer theorem for an A.C. Circuit.  
(b) Find the current $I$ for the circuit shown in Fig. 3 using Norton's Theorem.

\[ \text{Fig. 3} \]

Q. 7 Realize $Z(S) = \frac{(S + 2)}{(S^2 + 1)(S + 3)}$ in Foster-II form.

Q. 8 Write notes on any two of the following:
(a) Superposition Theorem
(b) Interconnection of two R-2 port networks
(c) Foster's I form

***************
Q.1 (a) A relation R is defined on the set Z of integers as follows: $xRy$ if and only if $x^2 + y^2 = 25$. Express R and $R^{-1}$ as the sets of ordered pairs and hence find their respective domains. 

(b) Show that $-(p \leftrightarrow q) \equiv (p \land \sim q) \lor (\sim p \land q)$. 

(c) Construct an input and output table for the expression $x_1 \cdot (x_2^3 + x_3) + x_2$. 

(d) Show that a tree with n vertices has exactly n-1 edges. 

(e) G is a non-empty connected graph whose vertices are all of even degree. Show that G is an Eulerian graph. 

(f) For the statement "If N is an odd number then $N^2$ is also an odd number". What are the inverse, converse and contrapositive statements of the above statement? 

(g) Solve the recurrence relation $U_{n+1} = aU_n = 0$ where $a < 1$ is a constant and initially $u_0 = 3$. 

(h) Prove that if $m + n \geq 125$, then $m \geq 63$ or $n \geq 63$, $m$, $n$ being positive integers. 

UNIT-I

Q.2 (a) Prove by mathematical induction that $T_n = n^3 + 3n^2 + 5n + 3$ is divisible by 3 for all $n \in \mathbb{N}$. 

(b) (i) Obtain the Disjunctive Normal Form of the Boolean function $F = x \cdot y \cdot z + x \cdot z$. 

(ii) Obtain the Conjunctive Normal Form in three variables of the Boolean function $F_1 = (x + y) \cdot (x + z')$. 

(c) Give example of relations R on $A = \{a, b, c, d\}$ having the stated property. 

(i) R is both symmetric and antisymmetric. 

(ii) R is neither symmetric nor antisymmetric. 

(iii) R is transitive but $R \cup R^{-1}$ is not transitive. 

Q.3 (a) Assume the statements: 

A $(x) = \{x - 2 > 0\}$ 

B $(x) = \{x + 2 \geq 0\}$ 

Where $x \in R$. Determine the underlying set of real numbers on which the following statements are true: 

(i) $A(x) \cup B(x)$ 

(ii) $A(x) \cap B(x)$ 

(iii) $B(x) \Rightarrow A(x)$ 

(iv) $B(x) \Rightarrow A(x)$. 

Let Z be the set of integers. Show that the relations $xRy$ if and only if $x + y$ is even, is an equivalence relation Z. Determine the equivalence class of 1 $\in Z$. 

P.T.O.
Q.4 (a) A, B, C are three study programmes in a university each of 3 years duration. The programme A has 26 papers, programme B has 32 papers and programme C has 40 papers. The programmes A and C have 6 papers in common and B and C have 3 papers in common. Further A, B and C have 2 papers in common.

(i) How many different papers in the three programmes are being taught?

(ii) How many papers are in the programme B but not in A and C?

(b) Let X be a binary operation in R, the set of all real numbers, defined by \( a \times b = a + b + ab \) for all \( a, b \in R \). Find the inverse of a \( a \in R \) (a ≠ -1).

Q.5 (a) Find the total number of ways in which 10 students can be seated in a (i) row (ii) circle.

(b) Let \( S = \{1, 2, 3\} \). Find the number of different functions that can be defined from \( S \) to \( S \). How many of these functions are one-one, onto.

(c) Show that in the set of integers \( I \), the relation \( R \) given by \( aRb \) if a divides b is reflexive, transitive and antisymmetric.

UNIT-III

Q.6 (a) Define a Boolean expression and minimize the following Boolean expression: \( F = \overline{A}B + A + AB \).

(b) Simplify the Boolean function \( F (A, B, C, D) = \Sigma (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 11) \).

Q.7 (a) Let \( R \) be a relation defined in the set \( Z' \) of all positive integers such that \( aRb \), for any \( a, b \in Z' \) if a divides b. Let \( D_n \) be the set of all divisions of \( n \), \( n \) is a positive integer. Show that \( (D_n, R) \) is a sublattice of \( (Z', R) \).

(b) Prove that in a distributive lattice, if an element has a complement then this complement is unique.

UNIT-IV

Q.8 (a) Show that a simple non-directed graph \( G \) is a tree if and only if it is connected and has no cycles.

(b) Find the minimal spanning tree of the following:

Q.9 (a) State and prove five colour theorem.

(b) Explain an algorithm that finds the shortest distances between all pairs of vertices in a graph.
**END TERM EXAMINATION**

THIRD SEMESTER [B. TECH.] – DECEMBER 2009

**Paper Code: ETTT-209**  
**Paper ID: 31209**  
**Subject: Object Oriented Programming**

**Time : 3 Hours**  
**Maximum Marks : 75**

*Note: Attempt all questions. Internal choice is indicated.*

**Q.1** Give a short answer:  
(a) What two factors distinguish OOP from procedure oriented programming?  
(b) What is common about C and C++?  
(c) Name few languages that supports OOPs.  
(d) What is constructor and destructor?  
(e) What are the characteristics of public and private declaration in a class?  
(f) What should be done to define a class function outside the class?  
(g) What is meant by multiple inheritance? Give an example.  
(h) Define different types of polymorphism.  
(i) What are the merits and demerits of using friend function?  
(j) Why do we need to use virtual functions?

**UNIT-I**

**Q.2** Distinguish between following terms:  
(a) Object and Class  
(b) Data Abstraction and Data Encapsulation  
(c) Inheritance and Polymorphism  
(d) Dynamic Binding and Message Passing

**OR**

**Q.3** Explain the chief characteristics of OOP. What are its advantages over procedural oriented programming?

**UNIT-II**

**Q.4** Define a class to represent student marks consisting of following members:  
(a) Data Members: Student roll-number, name of type character and total marks percentage of type integer.  
(b) Member functions to input values, calculate result as I Division, II Division, III Division, failed based on percentage, display roll number, name and result.  

In the main Program construct a array of student of dimension 50 and invoke its functions to input student information and display their result.

**OR**

**Q.5**  
(a) Is it possible to invoke the private member data outside the class? Justify your answer.  
(b) Give an illustration of copy constructor, multiple constructs, dynamic constructor in a Class.

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P.T.O.
UNIT-III

Q.6 Define a class for representing a weight in kilogram and gram. Provide following operators for two weight units:
(a) Addition (b) Subtraction
(c) Greater than (d) Less than
In the main program use this class to initialize three weights w1, w2, w3 and find sum of three weights and output them in ascending order.

OR

Q.7 (a) Write a program to show inheritance beyond single level with the following details. Country is the base class having protected member data name. Country has derived class state with members data name, population and state has derived class village having data members name, number of schools. Each of the class country, state and village have two public member functions in ( ) and disp ( ) for input and displaying the respective data. (Draw the inheritance structure).
(b) What is an abstract class? Explain with example.

UNIT-IV

Q.8 (a) Illustrate two ways to open a file. (2)
(b) Describe the various file mode available. (2)
(c) What are the various components of Standard Template Library? (6)
(d) Distinguish between the vectors and lists in Standard Template Library. (2.5)

OR

Q.9 (a) Write a code that define a vector of size five and initialize its elements as 10, 20, 30, 49, 12. It should then display these elements. (5)
(b) A file contains a list of student name and corresponding telephone numbers. The name is a single word and name, telephone numbers are separated by a white space. Write a code that finds the telephone number of a specified student from this file. (7.5)
END TERM EXAMINATION
THIRD SEMESTER [B.TECH.] - DECEMBER 2009

Paper Code: ETCS-211
Paper ID: 27211

Subject: Data Structure

Time: 3 Hours
Maximum Marks: 75

Note: Attempt all questions as per internal choice given. Assume missing data if any.

Q.1 Give a short answer: 
(a) How is the performance of an algorithm measured?  (4, 4, 4, 5, 4, 4)
(b) What are the different operations which can be carried out on ordered List? What are the two ways to represent the List?  
(c) Give an example of a binary tree of depth 4. Work out the different ways to traverse this tree.  
(d) Define and give example of Binary Tree, Threaded Binary Tree, Height Balanced Tree and Spanning Tree.  
(e) Which are the different algorithms to sort the data? Give the best, average and worst time for each of them.  
(f) Describe what do you mean by Cellular partition.

UNIT-I

Q.2 (a) Derive a general formula for accessing an element in three dimensional array stored in column major order.  (4)
(b) Consider two strings 
S1 = "END SEMESTER EXAMINATION"
S2 = "STUDENTS ARE WORKING HARD"
(i) Write down the algorithm / C code to concatenate two strings and validate it for above strings.  
(ii) Write down the algorithm to insert a new element say '/' after n-th element and validate the algorithm for above string s1 when n = 11.  

OR

Q.3 (a) Write down the algorithm to find infix to postfix of any expression. Apply the above algorithm to find postfix of the following expression:  
\((A+B) \ast (C+D-E) \ast (F)\).  (7)

(b) Assuming all the queue operations, write down the algorithm which will append q1 at the end of q2, work out the steps for following queues \(q1, q2\).
\(q1 = \{e_1, e_2, e_3\}\)
\(q2 = \{f_1, f_2\}\)

UNIT-II

Q.4 (a) Give a representation of Binary tree using C or C++. What are the various applications of trees?  (5.5)

(b) Give Dijkstra's algorithm to solve single source shortest path in graphs, work out the steps for suitable graph.  (7)

OR

P.T.O.
Q.5  (a) Give the flow chart for traversing a graph using depth first traversal and breadth first traversal. Write corresponding algorithms.  
     (8)

     (b) Explain the following concepts with suitable examples 
     (i) transitive closure, (ii) critical path, (iii) activity network, (iv) minimum spanning tree.  
     (4.5)

UNIT-III

Q.6  (a) Assume that following information is read in the given order 15, 10, 14, 19, 8, 30, 40, 17, 35. If the tree where information field contains integer is initially empty, how would it look after these insertions. Illustrate the steps of procedure for deleting an element from this tree by deleting successively: 40, 35, 10. Give the final tree.  
     (5)

     (b) Define the term Multi-way search tree with help of an example. Explain the algorithm for searching an element in this tree.  
     (6.5)

OR

Q.7  (a) Consider the following list of numbers: 42, 25, 78, 11, 65, 58, 94, 36, 99, 85. Write down the algorithm for sorting the above list using Quicksort and Merge Sort technique. Work out the steps for the algorithm to sort the above list.  
     (10)

     (b) Compare the efficiency of searching an ordered sequential table of size n and searching an unordered table of the same size for the key k.  
     (2.5)

UNIT-IV

Q.8  (a) Distinguish between the following:  
     (i) Files and Records  
     (ii) Sequential and Random Access  
     (iii) Input, Output and Input/Output Files  
     (iv) Text and Binary Files  
     (v) Absolute addressing and Relative addressing  
     (5)

     (b) What are the different techniques for indexing a file?  
     (7.5)

Q.9  Write short notes on following:  
     (a) Sequential File Organization  
     (b) Hashed File Organization  
     (c) Random File Organization  
     (d) Inverted Files  
     (3, 3, 3.5, 3)

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