Total No. of Questions—12] [Total No. of Printed Pages—7

[3362]-151

S.E. (Elex, E & TC) EXAMINATION, 2008

SIGNALS AND SYSTEMS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Find the even and odd components of each of the following signals :

(*i*) $x(t) = \cos(t) + \sin(t) + \sin(t)\cos(t)$

(*ii*) $x(t) = 1 + t + 3t^2 + 5t^3 + 9t^4$. [6]

(*b*) Categorize each of the following signals as energy signal or power signal and find the energy or time average power of the signal :

(*i*) $$x(t) = \begin{cases} t & 0 \le t \le 1 \\ 2 - t & 1 \le t \le 2 \\ 0 & \text{otherwise} \end{cases}$$

(*ii*) $x(t) = 5\cos(\pi t) + \sin(5\pi t)$ [8]

$-\infty < t < \infty$

P.T.O.

(c) Fig. 1 shows a rectangular pulse $x(t)$ of unit amplitude and unit duration find $y(t) = x(t - 2)$. [4]

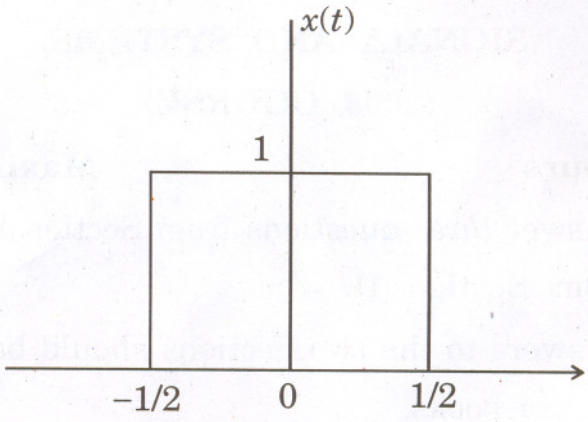


Fig. 1

Or

2. (a) Define Impulse function. Find relation between unit step and impulse function. [4]

(b) Sketch the waveform of the following signals :

(i) $x(t) = u(t) - u(t - 2)$

(ii) $y(t) = r(t + 1) - r(t) - r(t - 2)$. [4]

(c) The system that follows the i/p $x(t)$ and output $y(t)$. For each system determine whether it is :

(i) Memoryless

(ii) Stable

(iii) Causal

(iv) Linear

(v) Time invarient

(I) $y(t) = x(2 - t)$

(II) $y(t) = \cos(x(t))$. [10]

3. (*a*) Write down steps required to evaluate convolution using graphical method. [4]

(*b*) Write the properties of convolution and derive them. [6]

(*c*) For the following impulse response determine whether the corresponding system is memoryless, causal and stable :

(*i*) $h(t) = 3\delta(t)$

(*ii*) $h(t) = u(t + 1)$. [6]

Or

4. (*a*) Prove condition of stability in terms of it impulse response. [4]

(*b*) Find impulse response of the following circuit Fig. 2 and from impulse response find step response. [8]

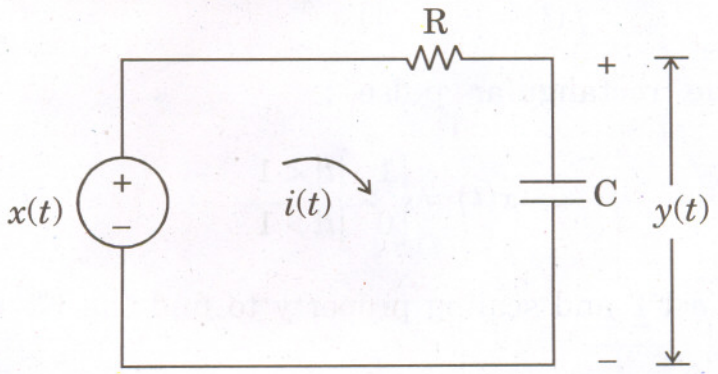


Fig. 2

(*c*) Draw standard signals used for system analysis. [4]

5. (*a*) State and prove time scaling property of Fourier transform. [4]

(*b*) Find the Fourier transform of :

$$\frac{d}{dt}\left(e^{-at}\, u(t)\right)$$

using differentiation property. [4]

(*c*) Find the Fourier representation of the following time domain signal :

$$x(t) = e^{-2t}u(t-3).$$ [4]

(*d*) What are the Dirichlet conditions for existence of Fourier series ? [4]

Or

6. (*a*) Prove the time shifting property of Fourier transform and find the Fourier transform of :

$$f(t) = u(t+4)\, e^{-2(t+4)}.$$ [8]

(*b*) Let the rectangular pulse :

$$x(t) = \begin{cases} 1 & |t| < 1 \\ 0 & |t| > 1. \end{cases}$$

Use the FT and scaling property to find the FT of the following signal :

$$y(t) = \begin{cases} 1 & |t| < 2 \\ 0 & |t| > 2. \end{cases}$$

Sketch all the signals $(x(t), y(t), x(f), y(f))$. [8]

SECTION II

7. (*a*) Find the Laplace transform of the following with ROC :

(*i*) $x(t) = u(t - 5)$

(*ii*) $x(t) = e^{5t}\ u(-t + 3)$. [8]

(*b*) Find the inverse Laplace transform of :

$$X(s) = \frac{3s + 4}{(s + 1)(s + 2)^2}.$$ [4]

(*c*) Find transfer function of the LTI system described by the differential equation :

$$\frac{d^2}{dt^2} y(t) + 3\frac{d}{dt} y(t) + 2y(t) = 2\frac{d}{dt} x(t) - 3x(t).$$ [4]

Or

8. (*a*) Consider the RC circuit shown in Fig. 3 assuming $y_1(t)$ is the output. Find transfer function and also find impulse response of the system. [8]

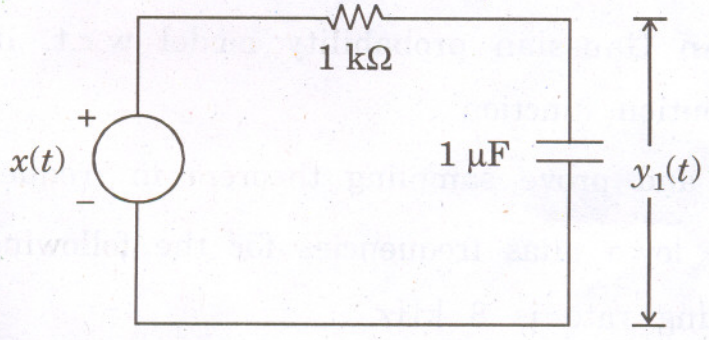


Fig. 3

(b) Determine initial and final values of signal $x(t)$ whose unilater Laplace transform is :

$$X(s) = \frac{7s + 10}{s(s + 10)}.$$

(c) Write differentiation and integration property of Lapla Transform.

9. (a) Define auto-correlation function of power signals. State an prove its properties. [8]

(b) Determine the energy spectral density of :

$x(t) = e^{-at}\, u(t)$ [8]

Or

10. (a) Define correlogram. Find correlogram of $\cos(\omega t)$ and $\sin(\omega t)$. Comment from this diagram. [8]

(b) Find cross-correlation of the following signals :

$$x(n) = \left\{\underset{\uparrow}{2}, 3, 4, 5\right\} \quad y(n) = \left\{\underset{\uparrow}{3}, 2, 1, 4\right\}. \qquad [8]$$

11. (a) Explain Gaussian probability model w.r.t. its density and distribution function. [7]

(b) State and prove sampling theorem in frequency domain. [7]

(c) Write down alias frequencies for the following signal. When sampling rate is 8 kHz :

$$x(t) = 2 \sin(2\pi\ 1000\ t). \qquad [4]$$

(*b*) Determine initial and final values of signal $x(t)$ whose unilateral Laplace transform is :

$$X(s) = \frac{7s + 10}{s(s + 10)}.$$ [4]

(*c*) Write differentiation and integration property of Laplace Transform. [4]

9. (*a*) Define auto-correlation function of power signals. State and prove its properties. [8]

(*b*) Determine the energy spectral density of :

$$x(t) = e^{-at}\ u(t).$$ [8]

Or

10. (*a*) Define correlogram. Find correlogram of $\cos(\omega t)$ and $\sin(\omega t)$. Comment from this diagram. [8]

(*b*) Find cross-correlation of the following signals :

$$x(n) = \left\{\underset{\uparrow}{2}, 3, 4, 5\right\}\ \ y(n) = \left\{\underset{\uparrow}{3}, 2, 1, 4\right\}.$$ [8]

11. (*a*) Explain Gaussian probability model w.r.t. its density and distribution function. [7]

(*b*) State and prove sampling theorem in frequency domain. [7]

(*c*) Write down alias frequencies for the following signal. When sampling rate is 8 kHz :

$$x(t) = 2\ \sin(2\pi\ 1000\ t).$$ [4]

Or

12. (*a*) PDF of a random variable X is given by $f(x) = e^{-x}$ for $x \geq 0$ then, find :

(*i*) Mean $\in$(X)

(*ii*) Mean square $\in(X^2)$

(*iii*) $\in[(X - 1)]^2$

(*iv*) Variance. [8]

(*b*) What is the role of ESD, PSD and autocorrelation in signal and system analysis ? [6]

(*c*) Explain discrete and continuous random variable with example. [4]

Total No. of Questions—12] [Total No. of Printed Pages—8

MAY 2008

[3362]-156

S.E. (E&TC) EXAMINATION, 2008
ELECTRONIC CIRCUIT AND APPLICATION
(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

(*vii*) *All* questions are compulsory.

SECTION I

1. (*a*) For the network with Si diode draw the output waveform. Explain the steps and identify the transition level. (Refer Fig 1.) [6]

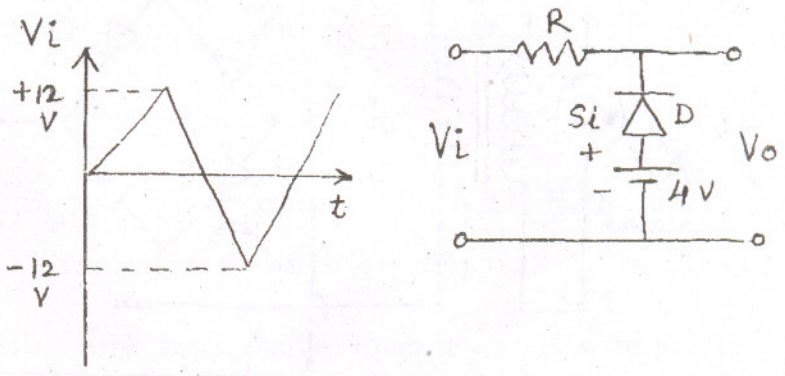


Fig. 1

P.T.O.

(*b*) Draw the equivalent circuits of the following during positive and negative half cycles of input waveform. Draw output waveform and indicate DC shift on the output curve (Refer Fig. 2). [6]

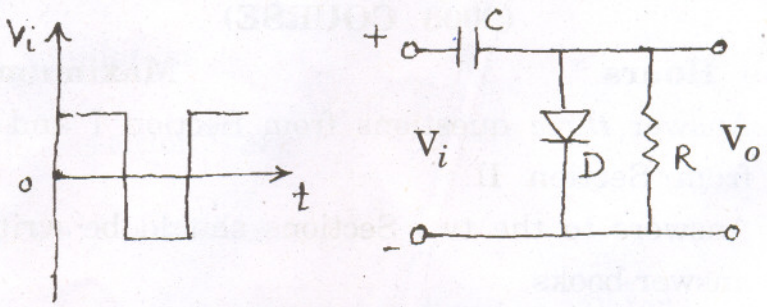


Fig. 2

(*c*) Draw circuit diagram of a clamping circuit which will produce a positive DC shift of 3 volts. [4]

Or

2. (*a*) Diodes D_3 and D_4 in the bridge rectifier circuit are replaced by capacitors C_2 and C_1 respectively in the circuit given below. Draw the resultant circuit. Explain the function and operation this circuit (Refer Fig. 3). [6]

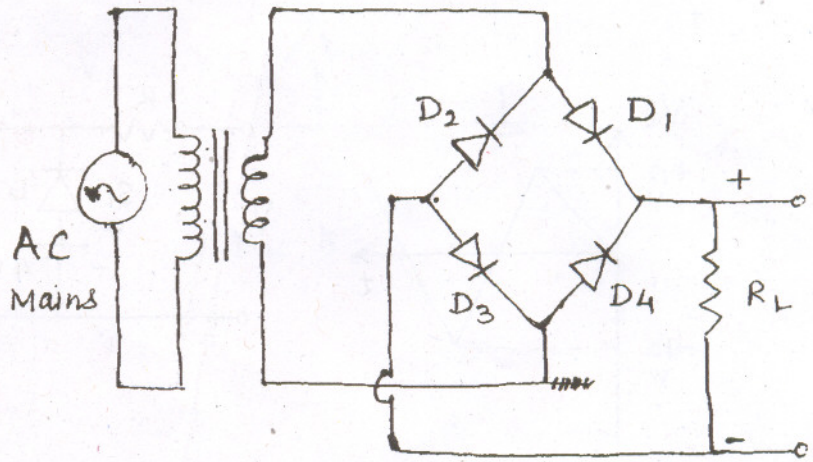


Fig. 3

(*b*) For the circuit shown in Fig. 4 below, draw output waveform showing all possible voltage levels. Also draw transfer characteristics. The input is $V_i = 12 \sin 314\ t$. Assume diode to be ideal. [6]

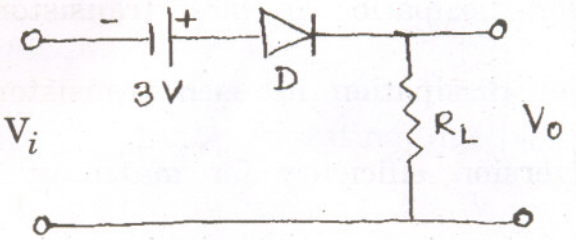


Fig. 4

(*c*) What are the limitations of voltage multipliers ? [4]

3. (*a*) Give classification of power MOSFET and explain construction of any *two* types of power MOSFET in detail. [8]

(*b*) Write notes on the following (any *two*) : [8]

(*i*) Thermal resistance

(*ii*) Safe operating area

(*iii*) BJT as a switch in multiplexed display.

Or

4. (*a*) Explain the construction of POWER BJT and draw and explain I-V characteristics of POWER BJT in different mode. [8]

(*b*) Explain any *one* Drive circuit of Power MOSFET. [4]

(*c*) Features of POWER MOSFET. [4]

5. (*a*) An ideal class B complementary symmetry push-pull amplifier operates with V_{CC} = 12 V and R_L = 4 Ω. If the input is sinusoidal, calculate :

(*i*) Maximum power output

(*ii*) Power dissipation in both transistors

(*iii*) Power dissipation in each transistor

(*iv*) Conversion efficiency for maximum output. [8]

(*b*) Why impedance matching with load is important in power amplifiers and how is it achieved ? [4]

(*c*) Compare different types of power amplifiers on the basis of the following parameters :

(*i*) Collector current conduction angle

(*ii*) Efficiency

(*iii*) Distortion

(*iv*) Power dissipation

(*v*) Position of Q point on load line. [6]

Or

6. (*a*) Using five point method of determination of harmonic components, the following results are obtained :

D_2 = 0.1, D_3 = 0.03, D_4 = 0.015 with I_1 = 5A, and R_C = 10 Ω. Determine :

(*i*) Total distortion

(*ii*) Fundamental power component

(*iii*) Total power

(*iv*) Increase in power because of distortion. [8]

(*b*) Show mathematically that even harmonics get eliminated using push-pull amplifier. [6]

(*c*) A power transistor operating in class A operation has zero signal power dissipation of 12 W and a.c. power output is 4 W. Determine collector efficiency and power rating of the transistor. [4]

SECTION II

7. (*a*) Draw frequency response curves of single tuned and double tuned amplifiers. Discuss salient features of the two and state advantages of double tuned amplifier over single tuned amplifier. [8]

(*b*) What is quality factor and what is its effect on bandwidth ? [4]

(*c*) Explain briefly why low frequency circuit of a transistor is required to be modified when signal frequency exceeds audio frequency range. [4]

Or

8. (*a*) Derive the expression for current gain including source resistance for a high frequency amplifier. [6]

(*b*) Compare single, double and stagger tuned amplifier circuits on the basis of :

(*i*) No. of tuned circuits

(*ii*) Selectivity

(*iii*) Q factor

(*iv*) Bandwidth

(*v*) Gain *versus* frequency response. [6]

(*c*) Distinguish between the following :

(*i*) f_α and f_β

(*ii*) f_α and f_T. [4]

9. (*a*) What is the effect of negative feedback on output impedance of current amplifier and Derive relevant relationship. [10]

(*b*) An RC coupled amplifier has mid frequency gain 400 and lower and upper 3 dB frequencies 100 Hz and 15 kHz respectively. A negative feedback with B = 0.01 is incorporated into amplifier circuit. Calculate gain with feedback and new bandwidth. [4]

(*c*) A single stage amplifier has a voltage gain of 10 and bandwidth 1 MHz. Three such stages are cascaded and negative feedback of 10% is applied to cascade stage. Find overall voltage gain and bandwidth of cascade stage. [4]

Or

10. (*a*) An amplifier has lower 3 dB frequency F_L and upper 3 dB frequency f_H, the feedback ratio is B : [10]

(*i*) Show that the lower 3 dB frequency with feedback is

$$f_{LF} = \frac{f_L}{1 + BA_{mid}}.$$

(*ii*) Upper 3 dB frequency with feedback is $f_{Hf} = F_H(1 + BA_{mid})$.

(*b*) Explain and draw Hartley oscillator circuit. [4]

(*c*) Why is quartz crystal used in place of an L–C oscillator in signal generator ? [2]

(*d*) How does a signal generator differ from an ordinary oscillator ? [2]

11. (*a*) Draw and explain internal block diagram of 3-terminal voltage regulator. [4]

(*b*) Design adjustable voltage regulator using IC7805 to give variable output voltage from +5 V to 9 V with I_L = 1 A. [4]

(*c*) Write notes on the following :

(*i*) Short circuits protection

(*ii*) Current limitation circuits. [8]

Or

12. (*a*) Explain the following parameters in detail :

(*i*) Line regulation

(*ii*) Load regulation

(*iii*) Ripple rejection ratio

(*iv*) Long term stability. [8]

(*b*) Show a necessary arrangement to boost regulator output current and find out the formula. [4]

(*c*) For the emitter follower series regulator shown in Fig. 5, determine the output voltage, Zener current, power dissipated in the zener, power dissipated in series pass transistor. [4]

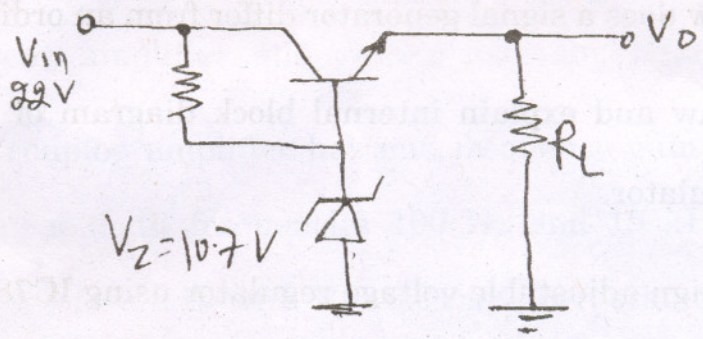


Fig. 5

Total No. of Questions—**12**] [Total No. of Printed Pages—**4+2**

May 2008

[3362]-158

S.E. (E&TC) EXAMINATION, 2008

ELECTRICAL CIRCUIT AND MACHINES

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I, Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12** from Section II.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of electronic pocket calculator is allowed.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Derive the e.m.f. equation of d.c. generator. [4]

(*b*) A 2 pole d.c. series motor runs at 800 r.p.m., when taking 50 Amp. at 100 volts with field coils in series. Calculate the speed if the coils were connected in parallel with each other. The load torque remains the same. Resistance of each series coil is 0.03 ohm. and that of armature is 0.04 Ω. Assume magnetic field is unsaturated. [8]

P.T.O.

(*c*) Explain the function of Holding coil and overload coil used in three-point starter. Also explain the disadvantage of the three-point starter. [6]

Or

2. (*a*) Explain the method of speed control of d.c. series motor above the rated speed. [6]

(*b*) A D.C. shunt motor runs at 600 rpm from 250 V supply and takes a line current of 50 Amp. Its armature and field resistances are 0.4 Ω and 125 Ω respectively. Neglecting the effect of armature reaction and allowing 2 V brush drop. Calculate.

(*i*) No load speed if no load line current is 5 Amp.;

(*ii*) The percentage reduction in flux/pole in order that speed may be 800 rpm when armature current is 40 Amp. [8]

(*c*) Explain the concept of Dynamic braking used in d.c. motor. [4]

3. (*a*) Explain the method of measuring reactive power by using one wattmeter method. [6]

(*b*) Three similar resistors are connected in Delta across 230 volts, 3-phase lines. The line current is 10 Amp. Calculate :

(*i*) The value of each resistor

(*ii*) If two wattmeters are used to measure total power in above case, find the reading of two wattmeters. [8]

(*c*) Write the names of different types of tariffs used for L.T. consumers. [2]

Or

4. (*a*) Explain the effect of power factor on two wattmeter readings. [6]

(*b*) Two wattmeters are connected to measure the power supplied to a 3-phase 500 V. Circuit, indicate the total input to be 10 kW. The power factor is 0.3 lagging. Find the reading on each wattmeter. [8]

(*c*) Explain the concept of improving the power factor. [2]

5. (*a*) Explain and draw the equivalent circuit of 1 ϕ-transformer. [8]

(*b*) 20 kVA, 2500/250 V, 50 Hz single-phase transformer gave the following test results.

open ckt (L.V. side)→ 250 V, 1.4 Amp, 105 W

short ckt (H.V. side)→104 V, 8 Amp, 320 W

Calculate the parameters of approximate equivalent ckt. [8]

Or

6. (*a*) Explain the construction of auto-transformer. Show the saving of cu.loss in Auto-transformer. [8]

(*b*) A 25 kVA, 230/500 volts, single-phase transformer gave the following test results :

O.C test : 230 V, 5 A, 200 W (L.V. side)

S.C. test : 6 V, 100 A, 180 W (L.V. side)

Calculate the efficiency and regulation on full load and 0.8 p.f. lagging. [8]

SECTION II

7. (*a*) Explain the working principle of induction motor and concept of rotating magnetic field. [4]

(*b*) What is the necessity of starter for 3-phase induction motor and sketch rotor resistance starter diagram. [6]

(*c*) A 4 pole, 3-phase, 50 Hz induction motor has a star connected rotor. The rotor has a resistance of 0.1 Ω per phase and standstill reactance of 2 Ω per phase. The induced e.m.f. between the slip rings is 100 V. If the full load speed is 1460 r.p.m.; calculate :

(*i*) The slip

(*ii*) The e.m.f. induced in the rotor in each phase

(*iii*) The rotor reactance per phase

(*iv*) The rotor current and

(*v*) The rotor power factor.

Assume slip rings are short circuited. [8]

Or

8. (*a*) Derive the torque equation and obtain the condition for maximum torque of a 3-phase induction motor. [6]

(*b*) Explain V/*f* control method used for controlling the speed of 3-phase induction motor. [4]

(c) A 6 pole, 3-phase, 50 Hz induction motor gives full load output of 20 HP at 945 r.p.m. Stator losses amount to 1 kW. Allowing 13.65 N-m for mechanical torque lost in friction, find :

(i) Rotor copper loss

(ii) Input to motor

(iii) Efficiency. [8]

9. (a) Compare salient pole and non-salient pole construction of 3-phase alternator. [4]

(b) Define voltage regulation of an alternator. Explain its significance. [4]

(c) A 1200 kVA, 3300 V, 50 Hz, three-phase, star-connected alternator has armature resistance of 0.25 Ω per phase. A field current of 40 A produces a short circuit current of 200 A and an open circuit e.m.f. of 1100 V line to line. Find the voltage regulation on :

(i) Full load 0.8 p.f. lagging

(ii) Full load 0.8 p.f. leading. [8]

Or

10. (a) Explain why 3-phase synchronous motors are not self starting. [4]

(b) What is hunting in synchronous motor ? How is it minimised ? [4]

(c) Consider a 3300 V delta connected synchronous motor having a synchronous reactance per phase of 18 Ω. It operates at a leading p.f. of 0.707 when drawing 800 kW from mains. Calculate its excitation e.m.f. and load angle. [8]

11. (*a*) Why is single-phase induction motor not self-starting ? How is it made self-starting ? [4]

(*b*) Compare AC and DC servo motor. [4]

(*c*) Discuss with suitable diagram the construction and operation of shaded pole motor. [4]

(*d*) Explain the construction and operation of repulsion motor. [4]

Or

12. Write short notes on (any *four*) : [16]

(*a*) Stepper motor

(*b*) Hysterisis motor

(*c*) Reluctance motor

(*d*) Universal motor

(*e*) Servomotor.

Total No. of Questions—12] [Total No. of Printed Pages—4+2

[3362]-159

May 2008

S.E. (E&TC) EXAMINATION, 2008

DATA STRUCTURE AND FILES

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I and Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12** from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) What are different parameter passing techniques ? Explain each technique with suitable example. [8]

(*b*) Explain structure and union in 'C' in detail with suitable example. [4]

(*c*) What is 'File' in 'C' ? Explain different operations on file with suitable example. [4]

P.T.O.

Or

2. (*a*) Database of 100 students is required to be stored.

Each student record contains fields such as Roll No, Name of student, total marks. Write a program in 'C' to input the database of 100 students with the fields mentioned above using :

(*i*) Array

(*ii*) Array of structures.

Display record of student who scores maximum marks. [8]

(*b*) Explain Random Access File. [4]

(*c*) What is recursive function ? Explain how it works using proper example. [4]

3. (*a*) Explain different methods of storage representation in two-dimensional array. Explain Address calculation. [6]

(*b*) Define ADT. Write down ADT of stack. [4]

(*c*) Sort the given table of numbers using Quick Sort. Show the steps in detail : [8]

91, 2, 3, 100, 55, 82, 23, 62, 73.

Or

4. (*a*) What is Hash table ? Explain with example. How collisions can be avoided in Hash table ? [10]

(*b*) Write a function in 'C' to find maximum of each row for a given matrix of order M × N having integer elements and print them. [8]

5. (*a*) Represent the following polynomial using G.L.L. : [8]

$$3x^{10}y^3z^2 + 5x^8y^3z^2 + 7x^8y^2z^2 + x^4y^4z + 6x^3y^4z + 9yz.$$

(*b*) Write a function in 'C' to delete a node from Doubly Linked List, without using any additional pointer. [4]

(*c*) Write down difference between static memory allocation and dynamic memory allocation. [4]

Or

6. (*a*) Consider a Linked list which is pointed by pointer P having nodes P_1, P_2, P_3,..... P_n. Consider another Linked list pointed by pointer Q, having nodes Q_1, Q_2, Q_3.....Q_n.

Write a function in 'C' to merge the above two Linked Lists in the third list having nodes P_1, Q_1, P_2, Q_2.....P_n, Q_n.

No additional memory allocation should be done while merging.

Size of 2 linked lists could be different. [10]

(*b*) Write a function in 'C' to insert a node in sorted singly linked list, so that after insertion the list remains sorted. Consider all cases of insertion. [6]

SECTION II

7. (*a*) Consider an infix expression

$$-a + (c / d) * (e * f)$$

Convert it to postfix and prefix form. [4]

(*b*) Evaluate above postifx expression for the values given as

$a = 2,\ c = 4,\ d = 2,\ e = 3,\ f = 5.$

show the steps in detail. [6]

(*c*) Differentiate between Linear and Circular queue when represented using array. [6]

Or

8. (*a*) Write functions in 'C' for push, POP, is empty for stack using Linked list. Give declaration in 'C' for implementing above functions for stack. [8]

(*b*) What do you mean by priority queue ? Explain any *one* application in detail. [8]

9. (*a*) Create Binary Search Tree for the following data and print the tree using all tree traversals :

MAR, OCT, JAN, APR, NOV, FEB, MAY, DEC, JUN, AUG, JUL, SEP. [6]

(*b*) (*i*) Give declaration in 'C' for Threaded Binary Tree. [2]

(*ii*) Write a function in 'C' to perform traversal of threaded binary tree. [6]

(*iii*) Compare traversal of Threaded binary tree with binary tree. [4]

Or

10. (*a*) Give Pseudo code to print the leaves of tree using any traversal. [8]

(*b*) Define the following terms with example : [10]

(*i*) Complete Binary Tree

(*ii*) Siblings

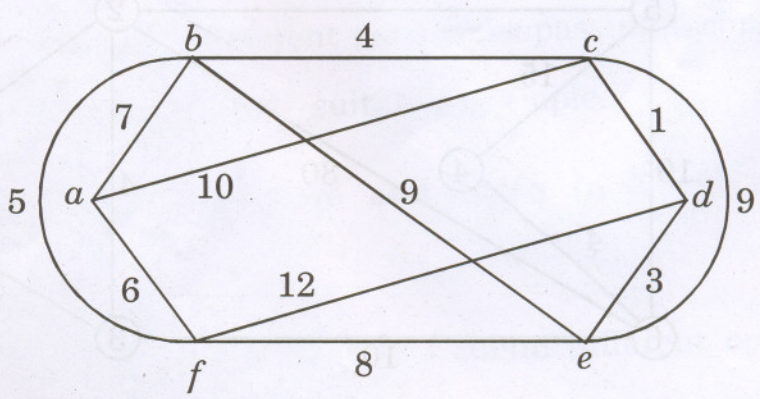
(*iii*) Height

(*iv*) Binary Search Tree

(*v*) Forest.

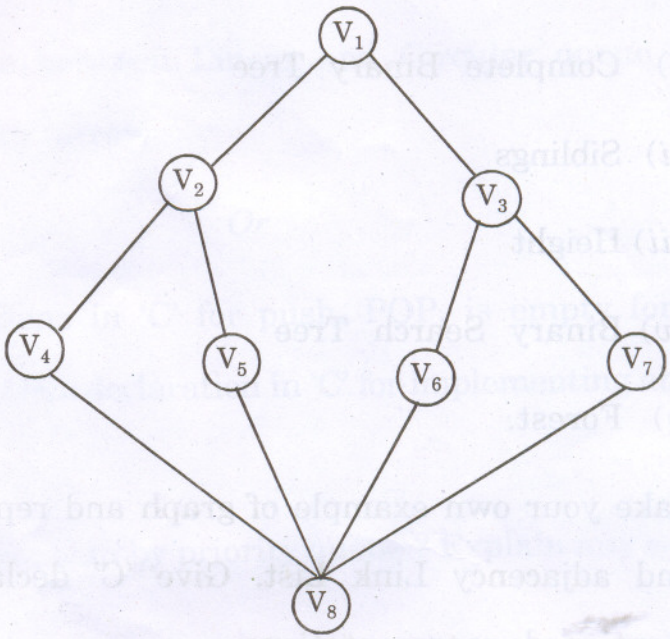
11. (*a*) Take your own example of graph and represent it using matrix and adjacency Link List. Give 'C' declaration for the above mentioned representations. [8]

(*b*) What do you mean by spanning tree ? Construct minimum spanning tree using Kruskal's Algorithm for the graph given below. [8]

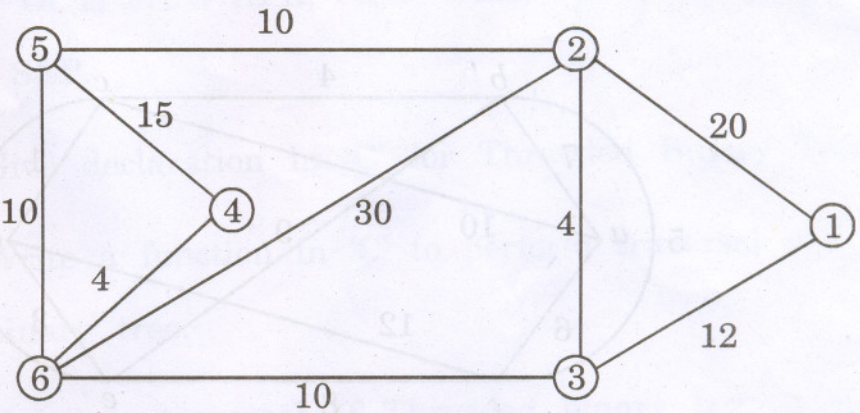


Or

12. (*a*) Define DFS and BFS for Graph. Show DFS and BFS for the graph given below. [6]



(*b*) Find the shortest path from node 1 to all the nodes in the graph shown below using Dijkstra's algorithm. [10]



Total No. of Questions—12] [Total No. of Printed Pages—4+2

May 2008

[3362]-160

S.E. (E&TC) EXAMINATION, 2008

ANALOG COMMUNICATION

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Why is modulation necessary in electronic communication system ? [4]

(*b*) What is FDM ? Explain in detail with the help of block diagram. [6]

(*c*) Explain the generation and detection of PPM wave with waveforms. [8]

Or

2. (*a*) Explain in brief different communication channels. [4]

P.T.O.

(*b*) What is baseband transmission ? What are its limitations ? State different baseband signals and give their bandwidth. [6]

(*c*) What is analog modulation ? Explain any *two* techniques with waveforms. [8]

3. (*a*) With neat diagram explain non-linear DSB-SC modulator. Prove that the output contains two side bands with suppressed carrier. [6]

(*b*) Which modulation technique is used in Television Communication ? Explain it with the help of frequency spectrum. [6]

(*c*) An AM transmitter has carrier of 550 W and modulated upto a depth of 65%. Find total power in the transmitted wave in the following cases :

(*i*) Standard AM

(*ii*) SSBSC. [4]

Or

4. (*a*) With neat block diagram explain low level AM transmitter. [6]

(*b*) A modulating signal $m(t)$ is given by :

(*i*) $m(t) = \cos 100t$

(*ii*) $m(t) = \cos 100t + 2 \cos 300t$.

In each case

(*i*) Sketch the spectrum of $m(t)$.

(*ii*) Sketch DSBSC signal spectrum for carrier of 2 cos 10000*t*.

(*iii*) Sketch USB spectrum if LSB is suppressed along with carrier. [6]

(*c*) Sketch AM signal [A + $m(t)$] cos $\omega_c t$ for a periodic triangular signal $m(t)$ having V_{p-p} equal to 6 V and frequency of 1 kHz corresponding to modulation index of 0.5. [4]

5. (*a*) Design an Armstrong indirect FM modulator to generate an FM carrier with a carrier frequency of 96 MHz and Δf = 20 kHz. A narrowband FM generator with f_c = 200 kHz and adjustable Δf in the range of 9 to 10 Hz is available. There is an oscillator with adjustable frequency in the range of 9 to 10 MHz. There is a bandpass filter with any centre frequency and only frequency doublers are available. (only block diagram is expected). [8]

(*b*) Why is noise immunity batter in FM ? [4]

(*c*) What is the need of pre-emphasis ? Draw circuit diagram and explain its working. [4]

Or

6. (*a*) An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^5$ is described by the equation

$$\varphi_{EM}(t) = 10 \cos(\omega_c t + 5 \sin 2000\, t + 10 \sin 3000\, \pi t).$$

Find :

(*i*) The power of the modulated signal

(*ii*) Frequency deviation Δf

(*iii*) Phase deviation $\phi\Delta$

(*iv*) Bandwidth of $\varphi_{EM}(t)$. [8]

(*b*) Compare NBFM and WBFM. [4]

(*c*) Why is FM known as constant BW modulation ? [4]

SECTION II

7. (*a*) Explain with neat block diagram superheterodyne AM receiver. [8]

(*b*) A radio receiver is tuned to 550 kHz calculate :

(*i*) Image frequency

(*ii*) Rejection ratio if loaded Q of RF section is 40

(*iii*) Rejection ratio at 50 MHz with the same Q. [6]

(*c*) What is tracking ? Explain three-point tracking. [4]

Or

8. (*a*) State different methods of FM detection. Explain any *one* method in detail. [8]

(*b*) A diode detector load is having 5 kΩ resistor in parallel with a 0.01 μF capacitor. Determine the maximum depth of sinusoidal modulation that the detector can handle without diagonal peak clipping when the modulating frequency is 10 kHz. [6]

(*c*) Explain any *one* method of SSBSC detection. [4]

9. (*a*) Explain the terms :

(*i*) Avalanche noise

(*ii*) Shot noise. [4]

(*b*) If R_1 = 10 kΩ and R_2 = 15 kΩ, calculate the thermal noise generated by :

(*i*) R_1

(*ii*) R_2

(*iii*) R_1 in series with R_2

(*iv*) R_1 in parallel with R_2.

Assume 15 MHz noise bandwidth. [6]

(*c*) Explain the performance of DSBSC in presence of noise. [6]

Or

10. (*a*) Explain the terms :

(*i*) Noise Bandwidth

(*ii*) Signal to noise ratio. [4]

(*b*) What is noise factor ? Derive expression for noise factor of two amplifiers in cascade. [6]

(*c*) Explain the term noise temperature. A mixer circuit has noise figure of 12 dB. It is preceded by an amplifier having equivalent noise temperature of 240 K and a power gain of 20 dB. Calculate equivalent noise temperature of the combination referred to the amplifier input. [6]

11. (*a*) Explain the following terms related to antenna :

(*i*) Polarization

(*ii*) Effective aperture

(*iii*) Beam width

(*iv*) Directivity. [8]

(*b*) Explain sky wave propagation. Explain the terms virtual height and skip distance. [8]

Or

12. (*a*) What is half wave dipole ? Why is it used in Yagi antenna ? Draw neat diagram of Yagi antenna with five directors. Draw its radiation pattern. [8]

(*b*) Write short notes on :

(*i*) Duct propagation

(*ii*) Extraterrestrial propagation. [8]

Total No. of Questions—12] [Total No. of Printed Pages—8

May 2008

[3362]-157

S.E. (E & TC/Comp/I.T. (For Sem.-II)/Elect./Elect. SW/Instru. (For Sem.-I)) EXAMINATION, 2008

ENGINEERING MATHEMATICS—III

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) In Section I, attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**.

In Section II, attempt Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12**.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of non-programmable electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Solve the following (any *three*) :

(*i*) $\left(D^2 + 9\right) y = \sec 3x$

(*ii*) $\left(D^5 - D\right) y = 4e^x + 2^{-x}$

(*iii*) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = e^x \tan x$ [By variation of parameters]

(*iv*) $\left(x^3 D^3 + x^2 D^2 - 2\right) y = x + \frac{1}{x^2}$. [12]

P.T.O.

(*b*) Solve :

$$\frac{dx}{x(2y^4 - z^4)} = \frac{dy}{y(z^4 - 2x^4)} = \frac{dz}{z(x^4 - y^4)}.$$ [5]

Or

2. (*a*) Solve the following (any *three*) :

(*i*) $(D^2 + 5D + 6)\, y = e^{-2x} \sec^2 x\, (1 + 2 \tan x)$

(*ii*) $(D^5 - D^4 + 2D^3 - 2D^2 + D - 1)\, y = \sin x$

(*iii*) $x^3 \frac{d^2y}{dx^2} + 3x^2 \frac{dy}{dx} + xy = \cos(\log x)$

(*iv*) $(D^2 - 1)\, y = (1 + e^{-x})^{-2}$ [By variation of parameters]. [12]

(*b*) An e.m.f. E sin *pt* is applied at $t = 0$ to a circuit containing a condenser C and inductance L in series :

$$i = -\frac{dq}{dt}$$

and initially the current i and the charge q are zero. If

$$p^2 = \frac{1}{LC},$$

find the current in the circuit at time t. [5]

3. (*a*) If $f(z)$ is analytic, show that :

$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right) |f(z)|^n = n^2\, |f(z)|^{n-2}\, |f'(z)|^2.$$ [5]

(*b*) If

$$f(z_0) = \oint_C \frac{3z^3 + 5z + 2}{z - z_0}\, dz$$

where 'C' is the ellipse :

$$\frac{x^2}{4} + \frac{y^2}{9} = 1,$$

find :

(*i*) $f(1)$,

(*ii*) $f''(1 - i)$. [6]

(*c*) Find the image of the triangular region bounded by $x = 0$, $y = 0$, $x + y = 1$ under the transformation $w = z^2$. [5]

Or

(*a*) Find the analytic function $f(z) = u + iv$ where :

$$u = \left(r + \frac{1}{r}\right) \cos \theta, \quad r \neq 0.$$ [5]

(*b*) Evaluate :

$$\oint_C \frac{e^z}{(z+1)^3 (z-1)^2}\, dz$$

where 'C' is the contour $|z + 1| = \frac{1}{2}$. [6]

(*c*) Show that the transformation :

$$w = z + \frac{1}{z} - 2i$$

maps the circle $|z| = 2$ into an ellipse. Find the centre of the ellipse and its semi major and minor axes. [5]

5. (*a*) Find z-transforms of the following :

(*i*) $Ka^{K-1}\ U(K-1),\ K \geq 0$

(*ii*) $\cos(7K+2),\ K \geq 0.$ [6]

(*b*) Solve the difference equation :

$$f(K+1)+\frac{1}{2}f(K)=\left(\frac{1}{2}\right)^{K},\ K \geq 0,\ f(0)=0.$$ [5]

(*c*) Find the Fourier transform of :

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

and hence evaluate :

$$\int_0^{\infty}\left(\frac{x\cos x-\sin x}{x^3}\right)\cos\frac{x}{2}\,dx.$$ [6]

Or

6. (*a*) Show that Fourier transform of :

$$f(x)=e^{-x^2/2}$$

is it self. [6]

(*b*) Find the inverse sine transform of :

$$F_s(\lambda)=\frac{1}{\lambda}e^{-a\lambda}.$$ [5]

(*c*) Find inverse z-transform of :

(*i*) $\dfrac{z^2}{z^2+1}$ (using inversion integral method)

(*ii*) $\dfrac{3z^2+2z}{z^2-3z+2},\ 1<|z|<2.$ [6]

SECTION II

7. (*a*) Find Laplace transform of (any *two*) :

(*i*) $\int_0^t te^{-4t} \sin 3t \, dt$

(*ii*) $t^2 v(t-1) - te^{-2t} \, \delta(t-2)$

(*iii*) $\frac{d}{dt}\left(\frac{\sin t}{t}\right)$. [8]

(*b*) Find inverse Laplace transform of $\frac{s}{(s^2 + a^2)^2}$. [4]

(*c*) Solve by Laplace transform method :

$$\frac{dy}{dt} + 3y(t) + 2\int_0^t y(t)\, dt = t, \text{ given } y(0) = 0.$$ [4]

Or

8. (*a*) Find inverse Laplace transform of (any *two*) :

(*i*) $\frac{e^{-3s}}{s^2 + 8s + 25}$

(*ii*) $\frac{s+1}{(s^2 + 2s + 2)^2}$

(*iii*) $\log\left(1 + \frac{a^2}{s^2}\right)$. [8]

(*b*) Find Laplace transform of :

$$f(t) = \begin{cases} t & , \quad 0 < t < \pi \\ \pi - t & , \quad \pi < t < 2\pi \end{cases} \quad \text{and} \quad f(t + 2\pi) = f(t). \qquad [4]$$

(*c*) Express the following function in terms of Heavisides unit step function and hence find the Laplace transform :

$$f(t) = \begin{cases} \cos t & , \quad 0 < t < \pi \\ \sin t & , \quad t > \pi \end{cases}. \qquad [4]$$

9. (*a*) Prove the following (any *two*) :

(*i*) $\nabla \cdot \left[r \nabla \left(\frac{1}{r^3} \right) \right] = \frac{3}{r^4}$

(*ii*) $\bar{a} \cdot \nabla \left[\bar{b} \cdot \nabla \left(\frac{1}{r} \right) \right] = \frac{3(\bar{a} \cdot \bar{r})(\bar{b} \cdot \bar{r})}{r^5} - \frac{(\bar{a} \cdot \bar{b})}{r^3}$

(*iii*) $\nabla^2 f(r) = f''(r) + \frac{2}{r} f'(r)$. [8]

(*b*) Find the constants m, n such that the surface $mx^2 - 2nyz = (m + 4)x$ will be orthogonal to the surface $4x^2y + z^3 = 4$ at the point $(1, -1, 2)$. [5]

(*c*) Find the function $f(r)$ so that $f(r)\,\bar{r}$ is solenoidal. [4]

Or

10. (*a*) Show that :

$$\bar{F} = \left(ye^{xy} \cos z\right) \bar{i} + \left(xe^{xy} \cos z\right) \bar{j} - e^{xy} \sin z \, \bar{k}$$

is irrotational. Find ϕ if $\bar{F} = \nabla\phi$. [6]

(*b*) Find the directional derivative of :

$$\phi = 4xz^3 - 3x^2y^2z$$

at (2, –1, 2) along a line equally inclined with co-ordinate axes. [6]

(*c*) If $\rho\overline{E} = \nabla\phi$, prove that $\overline{E} \cdot \text{curl}\,\overline{E} = 0$. [5]

11. (*a*) Find the work done in moving the particle once round the ellipse :

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, z = 0,$$

if field of force is :

$$\overline{F} = (2xy + 3z^2)\,\bar{i} + (x^3 + 4yz)\,\bar{j} + (2y^2 + 6xz)\,\bar{k}.$$ [6]

(*b*) Evaluate :

$$\iint_S (x^3\bar{i} + y^3\bar{j} + z^3\bar{k}) \cdot d\overline{S}$$

where S is the surface of the sphere $x^2 + y^2 + z^2 = 16$. [5]

(*c*) Evaluate :

$$\iint (\nabla \times \overline{F}) \cdot d\overline{S},$$

where :

$$\overline{F} = (x^3 - y^3)\,\bar{i} - xyz\,\bar{j} + y^3\,\bar{k}$$

and S is the surface $x^2 + 4y^2 + z^2 - 2x = 4$ above the plane $x = 0$. [6]

Or

12. (*a*) Evaluate :

$$\int_C \overline{F} \cdot d\overline{r} \text{ for } \overline{F} = 3x^2\,\overline{i} + (2xz - y)\,\overline{j} + z\,\overline{k}$$

along the straight line joining (0, 0, 0) to (1, 2, 3). [6]

(*b*) Prove that :

$$\iint_S \frac{\overline{r}}{r^3} \cdot \hat{n}\, dS = 0. \quad [5]$$

(*c*) Maxwell's equations are given by :

$$\nabla \cdot \overline{E} = 0,\ \nabla \cdot \overline{H} = 0,\ \nabla \times \overline{E} = -\frac{\partial \overline{H}}{\partial t},\ \nabla \times \overline{H} = \frac{\partial \overline{E}}{\partial t},$$

show that $\overline{E}$ and $\overline{H}$ satisfy :

$$\nabla^2 u = \frac{\partial^2 u}{\partial t^2}. \quad [6]$$