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10MAT31

**Third Semester B.E. Degree Examination, December 2012**  
**Engineering Mathematics – III**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

**PART – A**

- 1 a. Find the Fourier series of  $f(x) = x - x^2$ ,  $-\pi \leq x \leq \pi$ . Hence deduce that
- $$\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \dots = \frac{\pi^2}{12}$$
- (07 Marks)

Is the above deduced series convergent? (Answer in Yes or No)

- b. Define : i) Half range Fourier sine series of  $f(x)$   
 ii) Complex form of Fourier series of  $f(x)$   
 Find the half range cosine series of  $f(x) = x$  in  $0 < x < 2$ . (07 Marks)

- c. Obtain  $a_0, a_1, b_1$  in the Fourier expansion of  $y$ , using harmonic analysis for the data given.

x	0	1	2	3	4	5
y	9	18	24	28	26	20

(06 Marks)

- 2 a. Find the Fourier transform of
- $$f(x) = \begin{cases} 1 - x^2 & \text{for } |x| \leq 1 \\ 0 & \text{for } |x| > 1 \end{cases}$$

Hence evaluate  $\int_0^{\infty} \frac{x \cos x - \sin x}{x^3} \cos\left(\frac{x}{2}\right) dx$  (07 Marks)

- b. Find the Fourier sine transform of  $\frac{e^{-ax}}{x}$  (07 Marks)

- c. Find the Fourier cosine transform of
- $$f(x) = \begin{cases} 4x & , \text{ for } 0 < x < 1 \\ 4 - x & , \text{ for } 1 < x < 4 \\ 0 & , \text{ for } x > 4 \end{cases}$$
- (06 Marks)

- 3 a. i) Write down the two dimensional heat flow equation (p d e) in steady state (or two dimensional) Laplace's equation. Just mention.

ii) Solve one dimensional heat equation by the method of separation of variables. (07 Marks)

- b. Using D'Alembert's method, solve one dimensional wave equation. (07 Marks)

- c. A string is stretched and fastened to two points  $l$  apart. Motion is started by displacing the string in the form of  $y = a \sin(\pi x/l)$  from which it is released at time  $t = 0$ . Show that the displacement of any point at a distance  $x$  from one end at time  $t$  is,

$$y(x, t) = a \sin\left(\frac{\pi x}{l}\right) \cos\left(\frac{\pi ct}{l}\right)$$

Start the answer assuming the solution to be

$$y = (C_1 \cos(px) + C_2 \sin(px))(C_3 \cos(cpt) + C_4 \sin(cpt))$$

(06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

- 4 a. Fit a linear law,  $P = mW + C$ , using the data

P	12	15	21	25
W	50	70	100	120

(06 Marks)

- b. Find the best values of a and b by fitting the law  $V = at^b$  using method of least squares for the data,

V (ft/min)	350	400	500	600
t (min)	61	26	7	26

Use base 10 for algorithm for computation.

(07 Marks)

- c. Using simplex method,  
Maximize  $Z = 5x_1 + 3x_2$

Subject to,  $x_1 + x_2 \leq 2$  ;  $5x_1 + 2x_2 \leq 10$  ;  $3x_1 + 8x_2 \leq 12$  ;  $x_1, x_2 \geq 0$ . (07 Marks)

### PART – B

- 5 a. Use Newton-Raphson method, to find the real root of the equation  $3x = (\cos x) + 1$ .  
Take  $x_0 = 0.6$ . Perform two iterations. (06 Marks)

- b. Apply Gauss-Seidel iteration method to solve equations

$$20x + y - 2z = 17$$

$$3x + 20y - z = -18$$

$$2x - 3z + 20z = 25$$

Assume initial approximation to be  $x = y = z = 0$ . Perform three iterations. (07 Marks)

- c. Using Rayleigh's power method to find the largest eigen value and the corresponding eigen vector of the matrix.

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$

Take  $[1 \ 0 \ 0]^T$  as the initial approximation. Perform four iterations. (07 Marks)

- 6 a. Use appropriate interpolating formula to compute  $y(82)$  and  $y(98)$  for the data

x	80	85	90	95	100
y	5026	5674	6362	7088	7854

(07 Marks)

- b. i) For the points  $(x_0, y_0)$   $(x_1, y_1)$   $(x_2, y_2)$  mention Lagrange's interpolation formula.  
ii) If  $f(1) = 4$ ,  $f(3) = 32$ ,  $f(4) = 55$ ,  $f(6) = 119$  ; find interpolating polynomial by Newton's divided difference formula. (07 Marks)

- c. Evaluate  $\int_0^6 \frac{1}{1+x^2} dx$ , using

- i) Simpson's  $1/3^{\text{rd}}$  rule ii) Simpson's  $3/8^{\text{th}}$  rule iii) Weddle's rule, using

x	0	1	2	3	4	5	6
$f(x) = \frac{1}{1+x^2}$	1	0.5	0.2	0.4	0.0588	0.0385	0.027

(06 Marks)

- 7 a. Solve the wave equation  $\frac{\partial^2 u}{\partial t^2} = 4 \frac{\partial^2 u}{\partial x^2}$  subject to  $u(0, t), u(4, t) = 0$ .  $u_t(x, 0) = 0$  and  $u(x, 0) = x(4 - x)$  by taking  $h = 1, k = 0.5$  upto four steps. (07 Marks)
- b. Solve two dimensional Laplace equation at the pivotal or nodal points of the mesh shown in Fig.Q7(b). To find the initial values assume  $u_4 = 0$ . Perform three iterations including computation of initial values. (07 Marks)

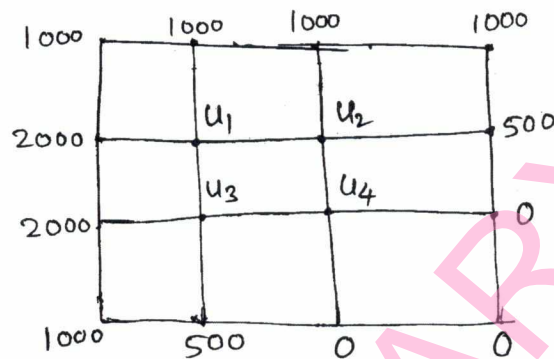


Fig.Q7(b)

- c. Solve the equation  $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ , subject to the conditions  $u(x, 0) = \sin \pi x, 0 \leq x \leq 1$ ;  $u(0, t) = u(1, t) = 0$ . Carry out computations for two levels, taking  $h = 1/3, k = 1/36$ . (06 Marks)
- 8 a. Find the z-transform of  $\frac{n}{3^n} + 2^n n^2 + 4 \cos(n\theta) + 4^n + 8$  (07 Marks)
- b. State and prove i) Initial value theorem ii) Final value theorem of z-transforms. (07 Marks)
- c. Using the z-transform solve  $u_{n+2} + 4u_{n+1} + 3u_n = 3^n$  with  $u_0 = 0, u_1 = 1$ . (06 Marks)

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**Third Semester B.E. Degree Examination, December 2012**  
**Analog Electronic Circuits**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

**PART – A**

- 1 a. Explain reverse recovery time of a semiconductor diode. (07 Marks)  
 b. Explain avalanche breakdown and zener breakdown. (06 Marks)  
 c. For the diode circuit shown in Fig.Q.1(c), calculate  $I_D$ ,  $V_D$  and  $V_R$ , assume  $V_r = 0.7V$ . (07 Marks)

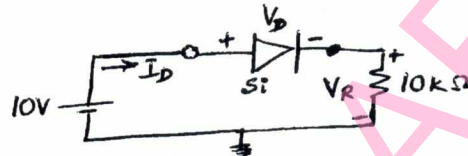


Fig.Q.1(c)

- 2 a. Explain with a neat diagram, fixed bias configuration to fix the operating point. (06 Marks)  
 b. Derive the expression for stability factors for fixed-bias circuit, with respect to  $I_{CQ}$ ,  $V_{BE}$  and  $\beta$ . (06 Marks)  
 c. For the emitter bias circuit shown in Fig.Q.2(c), find the values of  $R_C$ ,  $R_E$  and  $R_B$  using the following specifications  $I_{C(sat)} = 10 \text{ mA}$ ,  $I_{CQ} = 1/2 I_{C(sat)}$ ,  $V_C = 20V$ . Assume silicon transistor with  $\beta = 100$ . (08 Marks)

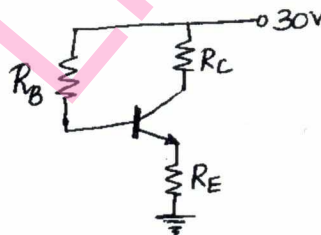


Fig.Q.2(c)

- 3 a. Obtain the expressions for voltage gain  $Z_{in}$  and  $Z_o$  of common-base configuration using AC equivalent circuit with  $r_e$  model. (07 Marks)  
 b. Explain with a neat circuit diagram, Emitter follower configuration justify how. Voltage gain is approximated to unity. (07 Marks)  
 c. For the circuit shown in Fig.Q.3(c) determine  $V_{CC}$  if  $A_v = -160$  and  $r_o = 100 \text{ k}\Omega$ , take  $\beta = 100$ . (06 Marks)

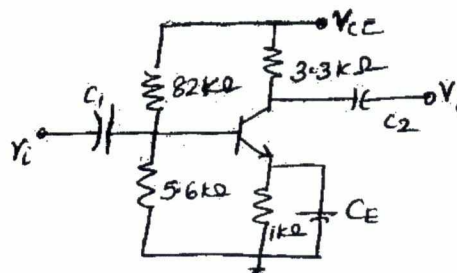


Fig.Q.3(c)

- 4 a. Describe the factors that affect the low frequency response of a BJT-CE amplifier. (10 Marks)  
 b. For the common-base amplifier shown in Fig.Q.4(b) calculate  $r_e$ ,  $R_i$ ,  $A_v$ ,  $C_s$ ,  $C_c$ , over all lower cut-off frequency  $\beta = 75$  and  $r_0 = \infty$ . (10 Marks)

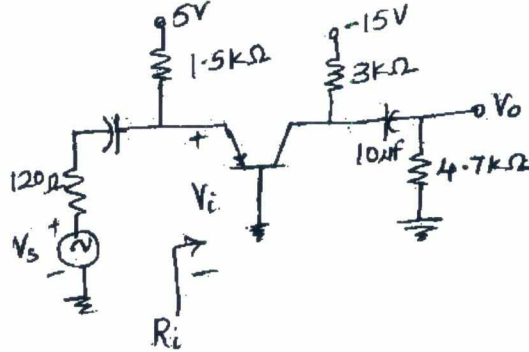


Fig.Q.4(b)

**PART – B**

- 5 a. With the help of a neat circuit diagram, explain the working of a Dalington Emitter-Follower and derive  $Z_i$ ,  $A_i$ ,  $A_v$  and  $Z_o$ . (10 Marks)  
 b. List the general characteristics of a negative feedback amplifier and derive the expression for gain with negative feedback. (10 Marks)
- 6 a. Explain the operation of a class B push-pull power amplifier with the help of a neat circuit diagram and also draw the i/p and o/p waveforms of the class B power amplifier, justify elimination of even harmonic distortion. (10 Marks)  
 b. A class B push-pull amplifier operating with  $V_{CC} = 25V$  provides a 22V peak signal to an  $8\Omega$  load. Find. Peak load current, dc current drawn from the supply, input power, output power, circuit efficiency, power dissipation. (10 Marks)
- 7 a. Derive the expression for frequency of a Wein Bridge oscillator and explain the operation using a neat circuit diagram. (08 Marks)  
 b. In a transistor Colpitts oscillator  $C_1 = 1nF$  and  $C_2 = 1000nF$ . Find the value of L for a frequency of 100 kHz. (06 Marks)  
 c. A crystal has the following parameter  $L = 0.3344$ ,  $C_M = 1pF$ ,  $C = 0.065 pF$  and  $R = 5.5 K\Omega$ . Calculate the series resonant frequency, parallel resonant frequency and find the Q of the crystal. (06 Marks)
- 8 a. Explain the operation of JFET amplifier using fixed bias configuration. Draw the JFET small signal model and derive expressions for input impedances output impedance and voltage gain  $A_v$ . (10 Marks)  
 b. For the JFET amplifier shown in Fig.Q.8(b). Calculate  $Z_i$ ,  $Z_o$  and  $A_v$ . (10 Marks)

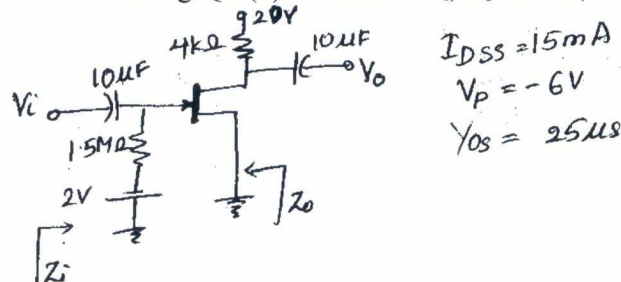


Fig.Q.8(b)

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### Third Semester B.E. Degree Examination, December 2012

### Logic Design

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

#### PART – A

- 1 a. Define canonical Minterm form and canonical Maxterm form. (05 Marks)
- b. Design a three-input, one output minimal two-level gate combinational circuit which has an output equal to 1 when majority of its inputs are at logic 1 and has an output equal to 0 when majority of its inputs are at logic 0. (05 Marks)
- c. Minimize the following multiple output functions using K-MAP:
 
$$f_1 = \sum m(0, 2, 6, 10, 11, 12, 13) + d(3, 4, 5, 14, 15)$$

$$f_2 = \sum m(1, 2, 6, 7, 8, 13, 14, 15) + d(3, 5, 12)$$
 (10 Marks)
- 2 a. Use a K-Map to simplify the following functions:
  - i)  $f(A, B, C, D) = (A + B + \bar{C})(\bar{B} + \bar{D})(\bar{A} + C)(B + C)$
  - ii)  $f(A, B, C, D) = \pi(1, 2, 4, 5, 7, 8, 10, 11, 13, 14)$
 (10 Marks)
- b. Find all the prime implicants of the function
 
$$f(a, b, c, d) = \sum (7, 9, 12, 13, 14, 15) + \sum d(4, 11)$$
 Using Quine Mc Clusky algorithm. (10 Marks)
- 3 a. Reduce the given function using MEV technique:
  - i)  $f = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + ABCE + ABC\bar{E} + d(\bar{A}\bar{B}CD + \bar{A}\bar{B}CE)$
  - ii)  $f = m_0 + m_1F + m_2 + m_4F + m_6(E + \bar{E}) + m_7F + m_{10}E + m_{12} + m_{13}F + d(m_3F + m_9\bar{F} + m_{11}\bar{E} + m_8E)$
 (10 Marks)
- b. Write the condensed truth table for a 4 to 2 line priority encoder with a valid output where the highest priority is given to the highest bit position or input with highest index and obtain the minimal sum expressions for the outputs. (06 Marks)
- c. Describe general working principle of decoder. (04 Marks)
- 4 a. Explain the working principle of four-bit parallel fast look ahead carry adder. (10 Marks)
- b. Design a comparator to check if two n-bit numbers are equal. Configure this using cascaded stages of 1-bit comparators. (10 Marks)

#### PART – B

- 5 a. With a neat diagram, explain the working of Master-Slave JK flip-flop along with waveforms. (10 Marks)
- b. Explain switch debouncer using SR latch with waveforms. (10 Marks)
- 6 a. Explain universal shift register with the help of logic diagram, mode control table. (10 Marks)
- b. Design and implement a divide-by-10 asynchronous counter using T FFS. (10 Marks)

- 7 a. Design and implement a synchronous BCD counter using J-K FFS. (10 Marks)  
 b. A sequential circuit has one input and one output state diagram is as shown in Fig.Q7(b). Design the sequential circuit with J-K flip-flop.

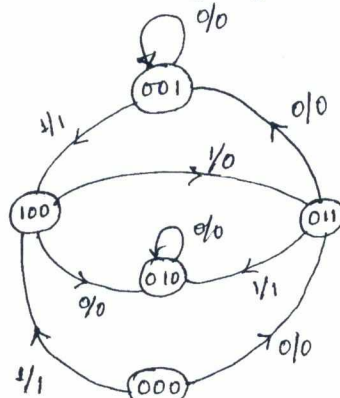


Fig.Q7(b)

(10 Marks)

- 8 a. Design a sequence detector for the following sequence 1, 0, 1, 1, 1 with overlap. Write the state diagram and logic diagram. (10 Marks)  
 b. A sequential circuit has two flip-flops A and B, two inputs x and y, and an output z. The flip-flop input functions and the circuit output functions are as follows:

$$J_A = xB + \bar{y}\bar{B}; \quad K_A = x\bar{y}B$$

$$J_B = x\bar{A}; \quad K_B = x\bar{y} + A$$

$$z = xyA + \bar{x}\bar{y}B$$

Obtain the logic diagram, state table and state equations, also state diagram. (10 Marks)

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Third Semester B.E. Degree Examination, December 2012

Network Analysis

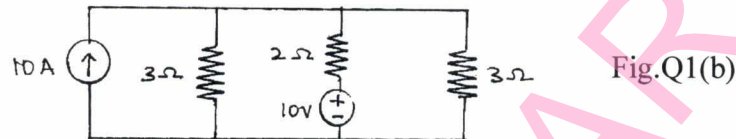
Time: 3 hrs.

Max. Marks:100

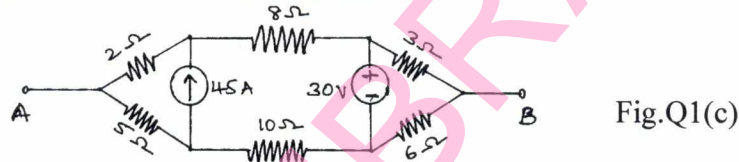
Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART - A

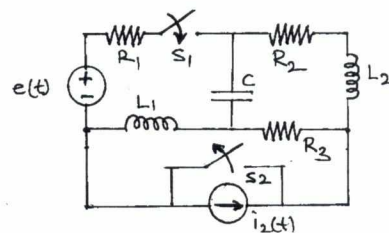
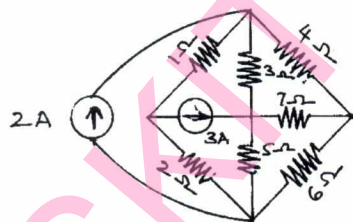
- 1 a. Define and distinguish the following network elements:
  - i) Linear and non-linear
  - ii) Active and passive
  - iii) Lumped and distributed
  - iv) Ideal and practical current sources
 (08 Marks)
- b. Write the mesh equation for the circuit shown in Fig.Q1(b) and determine mesh currents using mesh account analysis. (06 Marks)



- c. Reduce the network shown in Fig.Q1(c) to a single voltage source in series with a resistance using source shift and source transformations. (06 Marks)

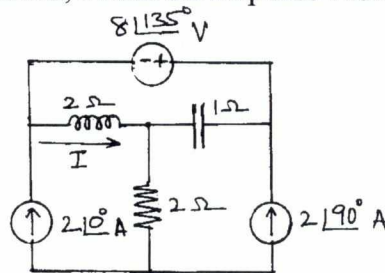


- 2 a. Define the following terms with reference to network topology. Give examples.
  - i) Tree
  - ii) Graph
  - iii) Sub-graph
  - iv) Tie-set
  - v) Cut-set
 (10 Marks)
- b. Construct a tree for the network shown in Fig.Q2(b) so that all loop currents pass through 7Ω. Write the corresponding the set matrix. (06 Marks)



- c. What are dual networks? Draw the dual of the circuit shown in Fig.Q2(c). (04 Marks)

- 3 a. Using superposition theorem, obtain the response I for the network shown in Fig.Q3(a).



(08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.



- 6 b. In the network shown in Fig.Q6(b), 'K' is changed from position 'a' to 'b' at  $t = 0$ . Solve for  $i$ ,  $\frac{di}{dt}$  and  $\frac{d^2i}{dt^2}$  at  $t = 0^+$ , if  $R = 1000 \Omega$ ,  $L = 1H$  and  $C = 0.1\mu F$  and  $V = 100V$ . Assume that the capacitor is initially uncharged. (10 Marks)

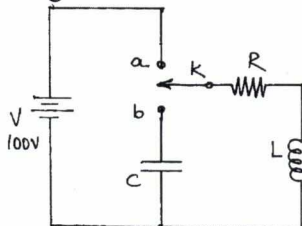


Fig.Q6(b)

- 7 a. Assuming that the staircase waveform of Fig.Q7(a) is not repeated, find its Laplace transform. If this voltage wave is applied to a RL series circuit with  $R = 1\Omega$  and  $L = 1H$ , find the current  $i(t)$ . (10 Marks)

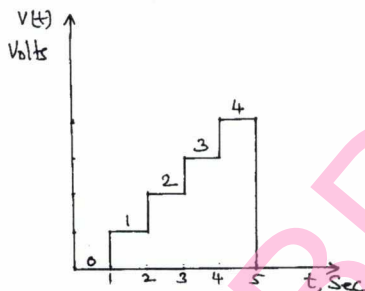


Fig.Q7(a)

- b. The network shown in Fig.Q7(b) was in steady state before  $t = 0$ . The switch is opened at  $t = 0$ . Find  $i(t)$  for  $t > 0$ , using Laplace transform. (10 Marks)

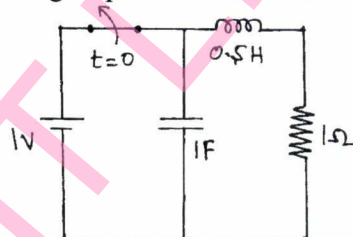


Fig.Q7(b)

- 8 a. Obtain the h-parameters for the network shown in Fig.Q8(a). (10 Marks)

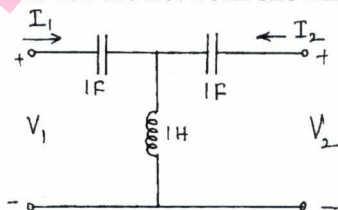


Fig.Q8(a)

- b. Obtain ABCD parameters in terms of z-parameters and hence show that  $AD - BC = 1$ . (10 Marks)

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**Third Semester B.E. Degree Examination, January 2013**  
**Field Theory**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting  
atleast TWO questions from each part.**

**PART – A**

- 1
  - a. Define 'Electric field intensity'. Derive an expression for electric field intensity' ( $\vec{E}$ ) at a point due to many charges. (07 Marks)
  - b. Point charges of 50 nc each are located at A(1, 0, 0) B(-1, 0, 0) C(0, 10) and D(0, -1, 0)m, find the total force on the charge at A and also find  $\vec{E}$  at A. (05 Marks)
  - c. Given  $\vec{D} = 5a\vec{r}$  c/m<sup>2</sup>, prove divergence theorem for a shell region enclosed by spherical surfaces at  $r = a$  and  $r = b$  ( $b > a$ ) and centred at the origin. (08 Marks)
- 2
  - a. Find the electric field intensity at point x(1, 2, -1) given the potential  $V = 3x^2y + 2y^2z + 3xyz$ . (05 Marks)
  - b. Derive boundary conditions between conductor and free space if different ' $\epsilon$ '. (08 Marks)
  - c. Show that capacitance of co-axial cable is  $C = \frac{2\pi \epsilon L}{\ln[b/a]}$  F with usual notations. (07 Marks)
- 3
  - a. With usual representations derive Poisson's equation. (05 Marks)
  - b. Verify that the potential field given below satisfies the Laplace's equation  $V = 2x^2 - 3y^2 + z^2$ . (05 Marks)
  - c. A large spherical cloud of radius 'b' has a uniform volume charge distribution of  $\rho_v$  c/m<sup>3</sup>, find the potential distribution and electric field intensity at any point in space using Laplace. (10 Marks)
- 4
  - a. State and explain Biot – Savart law. (06 Marks)
  - b. Calculate the value of vector current density in cylindrical co –ordinates at p(1.5, 90°, 0.5) if 
$$\vec{H} = \frac{2}{\rho} \cos 0.2\phi \vec{a}_\phi$$
 (06 Marks)
  - c. Given  $\vec{H} = 20r^2 \vec{a}_\phi$  A/m, determine the current density J also determine the total current that crosses the surface  $r = 1$  m,  $0 < \phi < 2\pi$  and  $z = 0$  in cylindrical co-ordinate. (08 Marks)

**PART – B**

- 5
  - a. Derive lorentz force equation. (05 Marks)
  - b. Find the force per meter length between two long parallel wires separated by 10 cm in air and carrying a current of 10A in the same direction. (05 Marks)
  - c. Calculate the inductance of a solenoid of 200 turns wound tightly on a cylindrical tube of 6 cm diameter. The length of the tube is 60 cm, the solenoid is in air. Derive the equation for 'L'. (10 Marks)

- 6 a. Explain Maxwell's equations for time varying fields. (10 Marks)  
 b. Find amplitude of displacement current density ( $J_D$ ) in the free space within a large power distribution transformer  $\vec{H} = 10^6 \cos(377t + 1.2566 \times 10^6 z) \vec{a}_y$  A/m. (05 Marks)  
 c. Given  $H = H_m e^{j(\omega t + \beta z)} \vec{a}_x$  A/m in free space find  $\vec{E}$ . (05 Marks)
- 7 a. Starting from Maxwell's equations obtain the general wave equations in electric and magnetic field. (10 Marks)  
 b. A 300 MHz uniform plane wave propagates through fresh water for which  $\sigma = 0$ ,  $\mu_r = 1$ ,  $\epsilon_r = 78$ , calculate :  
 i) Attenuation constant  
 ii) Phase constant  
 iii) Wave length  
 iv) Intrinsic impedance. (05 Marks)  
 c. State and explain Poynting theorem. (05 Marks)
- 8 a. Define transmission co-efficient and reflection co-efficient deduce the relationship between them. (06 Marks)  
 b. A traveling  $\vec{E}$  field in the free space of amplitude 100 v/m strikes a perfect dielectric as shown in Fig. Q8(b). Determine  $E_t$ . (10 Marks)

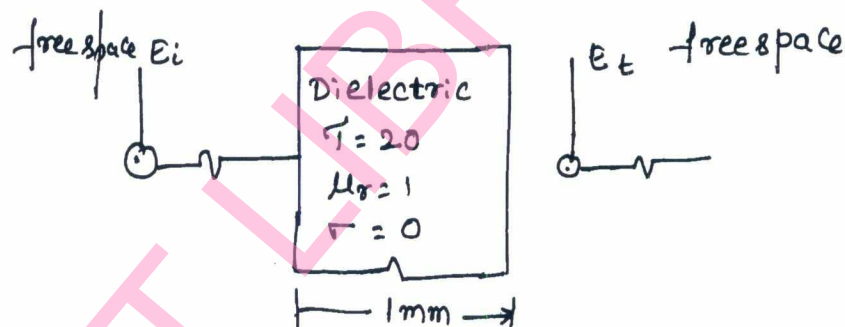


Fig. Q8(b)

- c. Write a note on SWR. (04 Marks)

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10EE36

**Third Semester B.E. Degree Examination, January 2013**  
**Electric Power Generation**

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer FIVE full questions, selecting at least TWO questions from each part.**  
**2. Assume missing data if any.**

**PART – A**

- 1 a. With block diagram, explain the working of wind energy conversion system. (08 Marks)
- b. With a neat sketch, explain the working of geothermal plant. (06 Marks)
- c. With a neat sketch, explain the working of fuel cell. (06 Marks)
- 2 a. Explain how the use of regenerator intercooler and reheater in gas turbine plants help in improvement in thermal efficiency. (08 Marks)
- b. With a neat sketch, explain the working of biogeneration plant. (08 Marks)
- c. Mention the application of diesel electric power plant. (04 Marks)
- 3 a. Explain the factors to be considered for the selection of site for a hydro electric power plant. (06 Marks)
- b. Explain the functions of the following in a thermal plant:
  - i) Air pre heater
  - ii) Boiler
  - iii) Condenser. (08 Marks)
- c. Explain the power station structure and control in hydro electric power plant. (06 Marks)
- 4 a. Explain the functions of the following in a nuclear reactor:
  - i) Nuclear fuels
  - ii) Moderator
  - iii) Control rod
  - iv) Coolants
  - v) Reflector
  - vi) Biological shield. (12 Marks)
- b. Explain the advantages and disadvantages of nuclear power plant. (08 Marks)

**PART – B**

- 5 a. Explain the following terms as applied to power system:
  - i) Load factor
  - ii) Demand factor
  - iii) Diversity factor
  - iv) Plant capacity factor
  - v) Plant use factor. (10 Marks)

- b. The yearly load duration curve of a certain power station can be approximated as a straight line the maximum and minimum loads being 80 mw and 40 mw respectively. To meet this load three alternator units, two rated at 20 mw each and at 10 mw are installed. Calculate:
- installed capacity
  - kwh generated per year
  - load factor
  - plant factor
  - utilization factor. (10 Marks)
- 6 a. Explain:
- Block rate tariff
  - Two part tariff. (04 Marks)
- b. Calculate the power factor of an installation supplying following loads:
- 20 kw at unity power factor
  - 100 kw at 0.707 lagging power factor
  - 50 kw at 0.9 leading power factor. (10 Marks)
- c. With neat sketch, explain single bus bar with sectionalizing scheme. (06 Marks)
- 7 a. With a neat sketch, explain ungrounded system in power system. (10 Marks)
- b. With a neat sketch, explain solid grounding. (10 Marks)
- 8 a. With a neat sketch and phasor diagram, explain resonant grounding. (12 Marks)
- b. With a neat sketch, explain the grounding system through an earthing transformer. (08 Marks)

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**Third Semester B.E. Degree Examination, December 2012**

**Advanced Mathematics – I**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions.**

- 1** a. Find the modulus and amplitude of the complex number  $1 - \cos \alpha + i \sin \alpha$ . (05 Marks)  
 b. If  $z_1$  and  $z_2$  are two complex numbers, show that  $|z_1 + z_2|^2 + |z_1 - z_2|^2 = 2\{|z_1|^2 + |z_2|^2\}$ . (05 Marks)  
 c. Find the fourth roots of  $-1 + i\sqrt{3}$ . (05 Marks)  
 d. If  $2 \cos \theta = x + \frac{1}{x}$ , prove that  $2 \cos r\theta = x^r + \frac{1}{x^r}$ . (05 Marks)
- 2** a. Find the  $n^{\text{th}}$  derivative of  $e^{2x} \cos^3 x$ . (07 Marks)  
 b. Find the  $n^{\text{th}}$  derivative of  $\frac{x}{x^2 - 5x + 6}$ . (06 Marks)  
 c. If  $y = e^{a \sin^{-1} x}$ , prove that  $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - (n^2 + a^2)y_n = 0$ . (07 Marks)
- 3** a. Find the angle between the pair of curves  $r = 6 \cos \theta$ ,  $r = 2(1 + \cos \theta)$ . (07 Marks)  
 b. Find the pedal equation of the curve  $r^2 = a^2 \sin 2\theta$ . (06 Marks)  
 c. Obtain the Maclaurin's series expansion of the function  $\sqrt{1 + \sin 2x}$ . (07 Marks)
- 4** a. If  $u = x^2y + y^2z + z^2x$ , prove that  $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = (x + y + z)^2$ . (05 Marks)  
 b. If  $u = \tan^{-1}\left(\frac{x^3y^3}{x^3 + y^3}\right)$ , prove that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{3}{2} \sin 2u$ . (05 Marks)  
 c. If  $u = x + y + z$ ,  $v = y + z$ ,  $z = uvw$ , find Jacobian of  $x, y, z$  with respect to  $u, v, w$ . (05 Marks)  
 d. If  $z = f(x, y)$  and  $x = e^u + e^{-v}$  and  $y = e^{-u} - e^v$ , prove that  $\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x \frac{\partial z}{\partial x} - y \frac{\partial z}{\partial y}$ . (05 Marks)
- 5** a. Obtain the reduction formula for  $\int_0^{\pi/2} \cos^n x \, dx$  and hence evaluate  $\int_0^{\pi/2} \cos^6 x \, dx$  and  $\int_0^{\pi/2} \cos^9 x \, dx$ . (07 Marks)  
 b. Evaluate  $\int_0^1 \int_{x^2}^{\sqrt{x}} xy(x + y) \, dy \, dx$ . (06 Marks)  
 c. Evaluate  $\int_0^a \int_0^x \int_0^{x+y} e^{x+y+z} \, dz \, dy \, dx$ . (07 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8=50, will be treated as malpractice.

- 6 a. Define Gamma and Beta functions. Show that  $\beta(m, n) = 2 \int_0^{\pi/2} \sin^{2m-1} \theta \cos^{2n-1} \theta d\theta$ . (07 Marks)
- b. Prove that  $\int_0^{\infty} x^2 e^{-x^4} dx \times \int_0^{\infty} e^{-x^4} dx = \frac{\pi}{8\sqrt{2}}$ . (07 Marks)
- c. Evaluate  $\int_0^1 (\log x)^6 dx$ . (06 Marks)
- 7 a. Solve the equation  $\frac{dy}{dx} + x \tan(y - x) = 1$ . (06 Marks)
- b. Solve  $x^2 y dx - (x^3 + y^3) dy = 0$ . (07 Marks)
- c. Solve  $(e^y + y \cos xy) dx + (x e^y + x \cos xy) dy = 0$ . (07 Marks)
- 8 a. Solve the equation  $(D^3 + 1)y = 0$ , where  $D = \frac{d}{dx}$ . (06 Marks)
- b. Solve the equation  $(D^2 - 2D + 1)y = x e^x$ . (07 Marks)
- c. Solve  $\frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} + y = e^{2x} - \cos^2 x$ . (07 Marks)

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