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10MAT41

Fourth Semester B.E. Degree Examination, June/July 2013
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Use of Statistical tables permitted.

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.

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PART – A

1 a. Use modified Euler's method to solve $\frac{dy}{dx} = x + y$, $y(0) = 1$ at $x = 0.1$ for three iterations taking $h = 0.1$. **(06 Marks)**

b. Solve $\frac{dy}{dx} = x + y$, $x = 0$, $y = 1$ at $x = 0.2$ using Runge-Kutta method. Take $h = 0.2$. **(07 Marks)**

c. Using Milne's predictor-corrector method find $y(0.3)$ correct to three decimals given, **(07 Marks)**

x	-0.1	0	0.1	0.2
y	0.908783	1.0000	1.11145	1.25253

2 a. Approximate y and z at $x = 0.2$ using Picard's method for the solution of $\frac{dy}{dx} = z$, $\frac{dz}{dx} = x^3(y + z)$ with $y(0) = 1$, $z(0) = 1/2$. Perform two steps (y_1, y_2, z_1, z_2). **(10 Marks)**

b. Using Runge-Kutta method solve $y'' = x(y')^2 - y^2$ at $x = 0.2$ with $x_0 = 0$, $y_0 = 1$, $z_0 = 0$ take $h = 0.2$. **(10 Marks)**

3 a. If $f(z) = u + iv$ is analytic prove that Cauchy-Reimann equations $u_x = v_y$, $u_y = -v_x$ are true. **(06 Marks)**

b. If $w = z^3$ find dw/dz. **(07 Marks)**

c. If the potential function is $\phi = \log\sqrt{x^2 + y^2}$. Find the stream function. **(07 Marks)**

4 a. Find the bilinear transformation which maps the points $z = 1, i, -1$ onto the points $w = j, o, -i$. **(06 Marks)**

b. Discuss the conformal transformation $w = e^z$. Any horizontal strip of height 2π in z-plane will map what portion of w-plane. **(07 Marks)**

c. State and prove Cauchy's integral formula. **(07 Marks)**

PART – B

5 a. Prove that $J_{1/2}^{(x)} = \sqrt{\frac{2}{\pi x}}\sin x$. **(06 Marks)**

b. State and prove Rodrigues formula for Legendre's polynomials. **(07 Marks)**

c. Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre polynomial. **(07 Marks)**

6 a. The probabilities of four persons A, B, C, D hitting targets are respectively 1/2, 1/3, 1/4, 1/5. What is the probability that target is hit by atleast one person if all hit simultaneously? **(06 Marks)**

b. i) State addition law of probability for any two events A and B.

ii) Two different digits from 1 to 9 are selected. What is the probability that the sum of the two selected digits is odd if '2' one of the digits selected. **(07 Marks)**

c. Three machine A, B, C produce 50%, 30%, 20% of the items. The percentage of defective items are 3, 4, 5 respectively. If the item selected is defective what is the probability that it is from machine A? Also find the total probability that an item is defective. **(07 Marks)**

7 a. The p.d.f of x is

x	0	1	2	3	4	5	6
p(x)	k	3k	5k	7k	9k	11k	13k

Find k. Also find $p(x \geq 5)$, $p(3 < x \leq 6)$. **(06 Marks)**

b. A die is thrown 8 times. Find the probability that '3' falls,

i) Exactly 2 times

ii) At least once

iii) At the most 7 times. **(07 Marks)**

c. In a certain town the duration of shower has mean 5 minutes. What is the probability that shower will last for i) 10 minutes or more; ii) less than 10minutes; iii) between 10 and 12 minutes. **(07 Marks)**

8 a. What is null hypothesis, alternative hypothesis significance level? **(06 Marks)**

b. The nine items of a sample have the following values: 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of these differ significantly from the assumed mean of 47.5. Apply student's t-distribution at 5% level of significance. ($t_{0.05}$ for 8df = 2.31). **(07 Marks)**

c. In experiments on a pea breading, the following frequencies of seeds were obtained:

Round-yellow	Wrinkled yellow	Round green	Wrinkled green	Total
315	101	108	32	556

Is the experiment is in the agreement of theory which predicts proportion of frequencies 9:3:3:1 $\left(\chi^2_{0.05}, 3df \equiv 7.815\right)$. **(07 Marks)**

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10EE44

Fourth Semester B.E. Degree Examination, June/July 2013
Field Theory

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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PART – A

1 a. State and explain Coulomb's law of force between the two point charges. Also indicate the units of quantities in the force equation. **(05 Marks)**

b. State and apply Gauss law to obtain an expression for the electric field intensity due to an infinite sheet of charge with a surface charge density ρ_s C/m^2 and area A m^2. **(10 Marks)**

c. Find : i) Electric field intensity and ii) Electric flux density at the origin due to $Q_1 = 0.35\,\mu C$ at (0, 4, 0) m and $Q_2 = -0.55\,\mu C$ at (3, 0, 0) m. **(05 Marks)**

2 a. Explain with mathematical expressions: i) Potential difference ii) Absolute potential iii) Potential gradient. **(06 Marks)**

b. Derive an expression for the equation of continuity of current. **(06 Marks)**

c. At the boundary between glass ($\epsilon_r = 4$) and air, the lines of electric field make an angle of 40° with normal to the boundary. If electric flux density in air is 0.25 μC/m^2, determine the orientation and magnitude of, i) Electric flux density and ii) Electric field intensity, in glass. **(08 Marks)**

3 a. Derive Poisson's and Laplace equations starting from point form of Gauss law. **(06 Marks)**

b. Using Laplace equation derive an expression for the capacitance of a concentric spherical capacitor. The inner spherical conductor is of radius 'a' and potential V, while outer conductor is of radius 'b' and potential zero. **(08 Marks)**

c. Determine whether or not the following potential fields satisfy Laplace's equation :
i) $V = 2x^2 - 3y^2 + z^2$ ii) $V = r^2 + z^2$ **(06 Marks)**

4 a. Write an explanatory note on Biot Savarts law. **(04 Marks)**

b. Discuss the concept of scalar and vector magnetic potential and arrive at the expressions for Poissons equation in magnetostatics. **(08 Marks)**

c. State and prove ampere's circuital law and apply it to a straight solid conductor to calculate the magnetic field intensity. **(08 Marks)**

PART – B

5 a. Find the expression for the force on differential current carrying elements. **(06 Marks)**

b. Define Lorentz force equation and mention the application of its solution. **(06 Marks)**

c. Calculate the inductance of a Solenoid of 200 turns wound tightly on a cylindrical tube of length 60 cm and of diameter 6 cm, with air as media. Derive the expression used. **(08 Marks)**

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6 a. With necessary relationships, explain Faradays law of electromagnetic induction for both static and time varying conditions. **(10 Marks)**

b. Starting from Faradays law of electromagnetic induction derive $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$. **(06 Marks)**

c. Find the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2 \times 10^{-4}$ s/m and $\epsilon_r = 81$. **(04 Marks)**

7 a. What is uniform plane wave? Explain its propagation in free space with necessary equation. **(08 Marks)**

b. Define skin depth and depth of penetration. **(08 Marks)**

c. For copper the conductivity is 58 mega-s/m. Find the skin depth at a frequency of 10 MHz. **(04 Marks)**

8 a. With necessary equations, explain standing wave ratio. **(10 Marks)**

b. Find weather the wet, marshy soil characterized by $\sigma = 10^{-2}$ s/m, $\epsilon_r = 15$ and $\mu_r = 1$ may be considered as a conductor, a dielectric or neither for the frequencies: i) 60 Hz ii) 1 MHz iii) 100 MHz iv) 10 GHz. **(10 Marks)**

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10EE45

Fourth Semester B.E. Degree Examination, June/July 2013
Power Electronics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting atleast TWO questions from each part.*
2. Draw suitable sketches wherever necessary.
3. Missing data, if any, may be suitable assumed.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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PART – A

1 a. With suitable sketches, explain the control characteristics of SCR and IGBT. **(06 Marks)**

b. What are the industrial applications of power electronic circuits? **(08 Marks)**

c. Write a brief note on 'Thyristorised tap changer'. **(06 Marks)**

2 a. The bipolar transistor shown in Fig. Q2(a) is specified to have β in the range 8 to 40. The load resistance is R_C = 11 Ω. The DC supply voltage is V_{CC} = 200 V and the input voltage to the base circuit is V_B = 10 V. If $V_{CE(sat)}$ = 1 V and $V_{BE(sat)}$ = 1.5 V find :
i) The value of R_B that results in saturation with an overdrive factor of 5
ii) Forced B_f iii) The power loss in the transistor. **(08 Marks)**

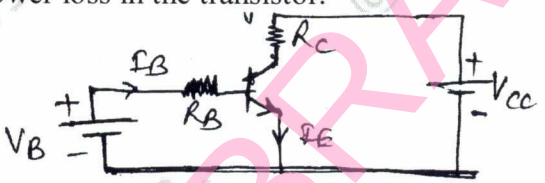

Fig. Q2(a)

b. With the help of a circuit schematic describe how the base current peaking is obtained during turn on of power transistors. **(06 Marks)**

c. Describe di/dt and dv/dt protection for transistor. **(06 Marks)**

3 a. Describe two transistor model of thyristor and obtain the expression for anode current. **(06 Marks)**

b. Ten thyristors are used in a string to withstand a DC voltage of V_S = 15 KV. The maximum leakage current and recovery charge differences of thyristors are 10 mA and 150 μC respectively. Each thyristor has a voltage sharing resistance of R = 56 KΩ and capacitance of C_1 = 0.5 μF. Determine : i) The maximum steady state voltage sharing $V_{DS(mas)}$ ii) The steady state voltage derating factor iii) the maximum transient voltage sharing $V_{DT(max)}$ and iv) transient voltage derating factor. **(08 Marks)**

c. Describe the need of isolation in thyristor triggering circuit and show typical schematic showing pulse transformer isolation. **(06 Marks)**

4 a. With the help of a suitable schematic describe self commutation circuit. **(08 Marks)**

b. What is natural commutation? With the help of suitable circuit and waveforms, explain in brief, natural commutation. **(08 Marks)**

c. The circuit shown in Fig. Q4(c) has load resistances of $R_1 = R_2 = R = 5\Omega$, C = 10 μF and supply voltage V_S = 100 V. Determine the circuit turn off time. **(04 Marks)**

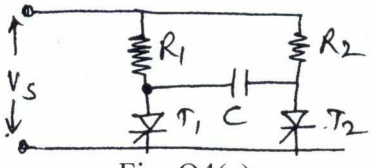

Fig. Q4(c)

PART – B

5 a. Describe the operation of single phase semi-controlled rectifier feeding resistive load. Obtain the expression for the average DC output voltage. **(06 Marks)**

b. Evaluate the form factor, ripple factor, transformer utilization factor and P/V of thyristor for the circuit shown in Fig. Q5(b). Also find the rectification efficiency. Assume triggering and angle = 90°. $V_S = V_m \sin wt$. **(08 Marks)**

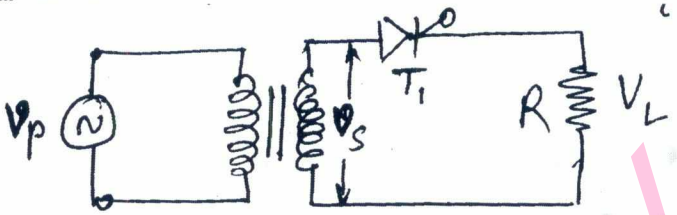

Fig. Q5(b)

c. Draw the schematic of three phase half wave controlled rectifier feeding resistive load. Also draw the waveforms of input voltages and output voltage for any triggering angle (No explanation required). **(06 Marks)**

6 a. With the help of a circuit schematic describe principle of step up chopper. Obtain the expression for average output voltage in terms of duty ratio. **(06 Marks)**

b. A step down chopper with resistive load has a resistive load of 10 Ω and the input voltage is $V_S = 220$ V. When the converter switch remains on, its voltage drop is 2V and the chopping frequency is F = 1 KHz. If the duty cycle is 50% determine :

i) Average output voltage
ii) rms output voltage
iii) Chopper efficiency
iv) The effective input resistance of chopper. **(08 Marks)**

c. Mention the various performance parameters of the stepup and stepdown choppers. **(06 Marks)**

7 a. With the help of circuit schematic and waveforms describe full bridge single phase inverter. **(06 Marks)**

b. The single phase full bridge inverter has a resistive load of R = 2.4 Ω and the DC input voltage is $V_S = 48$ V. Determine :

i) The rms output voltage at the fundamental frequency and
ii) The output power. **(04 Marks)**

c. With the help of neat sketches of circuit schematic and waveforms explain the operation of three phase inverters in 180 degrees conduction mode. **(10 Marks)**

8 a. With the help of a circuit schematic and waveforms explain the principle of on-off control. State the equation of output voltage. **(08 Marks)**

b. A single phase fullwave AC voltage controller has a resistive load of R = 10 Ω and the input voltage is $V_S = 120$ V (rms), 60 Hz. The delay angles of the thyristors T_1 and T_2 are equal and 90°. Determine :

i) The rms output voltage and
ii) The input power factor. **(04 Marks)**

c. Describe how the power electronic converters produce electromagnetic interference. How is this interference minimized? **(08 Marks)**

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10EE46

Fourth Semester B.E. Degree Examination, June/July 2013
Transformers and Induction Machines

Time: 3 hrs. Max. Marks:100

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

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PART – A

1 a. With a neat sketch, explain the construction and working principle of core type and shell type of transformer. **(06 Marks)**

b. With a phasor diagram, explain the operation of practical power transformer on load condition i) inductive load; ii) resistive load. **(08 Marks)**

c. A single phase transformer has a term ratio of 144/432 and operates at a maximum flux of 7.5×10^{-3} wb at 50 Hz when on no load the transformer takes 0.24 KVA at a power factor of 0.26 lagging from the supply. If the transformer supplies a load of 1.2 KVA at a power factor of 0.8 lagging. Find: i) the magnetizing current; ii) primary current; iii) primary power factor. **(06 Marks)**

2 a. With neat circuit diagrams, explain how you conduct NO-LOAD test and IMPEDANCE test on a transformer. Bring out the formula used. Also mention the advantages of these tests. **(10 Marks)**

b. A 200 KVA, 2000/440V, 50Hz single phase transformer gave the following test results:

O.C. test	2000V,	1.8A,	1.75 kW	On HV side
S.C. test	13V,	300A,	1.0kW	On LV side

Obtain the equivalent circuit as referred to HV side. **(10 Marks)**

3 a. With the help of relevant circuit diagram, explain the back-to-back test. Mention the advantages of this test. **(10 Marks)**

b. In a 25 KVA, 2000/200 volts transformer iron and copper losses are 350 and 450 watts respectively. Calculate the efficiency of UPF at i) Full load and ii) Half load. Determine the load for maximum efficiency, iron and copper losses in this case. **(10 Marks)**

4 a. Write a brief note on parallel operation of two-single phase transformers with unequal voltage ratio. Also derive the necessary relation. **(05 Marks)**

b. Briefly explain open-delta OR U-V connection. **(05 Marks)**

c. Write a short note on Scott connection. **(05 Marks)**

d. A 3-phase transformer of ratio 33/6.6 kV, delta/star, 2 MVA has a primary resistance of 8Ω per phase and a secondary resistance of 0.08Ω per phase. The percentage impedance is 7%. Calculate the secondary load voltage with rated primary voltage and hence the regulation for full load 0.75 p.f lagging condition. **(05 Marks)**

PART – B

5 a. Explain what is meant by starting torque and its effect on the performance of an induction motor, derive the necessary relation for starting torque and condition for maximum starting torque. Also explain the effect of change in voltage. **(10 Marks)**

b. A 3-phase induction motor having 6-poles, stator winding is star connected runs on 240V, 50Hz supply. The rotor resistance and stand still reactance are 0.12Ω and 0.85Ω per phase. The ratio of stator to rotor turns is 1.8 and full load slip is 4%. Calculate the developed torque at full load, maximum torque and the speed at maximum torque. **(10 Marks)**

6 a. With the help of a neat curve, explain the different operating regions or modes based on the value of slip of an induction motor. **(08 Marks)**

b. A 3-phase induction motor of 18.65 kW 4-pole, 50Hz, has friction and windage losses of 2.5% of the output. The full load slip is 4%, find for full load i) the rotor copper loss; ii) the rotor input; iii) the shaft torque; iv) the gross electro magnetic torque. **(06 Marks)**

c. A 3-phase induction motor with 6-pole 50Hz gives full load output of 20H.P at 945 rpm stator losses = 1 kW, allowing 13.65 Nm for mechanical torque lost in friction. Find: i) rotor copper loss; ii) input to motor; iii) efficiency. **(06 Marks)**

7 a. With a neat circuit diagram and a phasor diagram explain the equivalent circuit of a 3-phase induction motor at any slip and derive the necessary relation. **(10 Marks)**

b. A 3-phase, 25 kW, 4-pole, 50Hz induction motor is running at 1410 rpm, supplying full load. The mechanical losses are 850W and stator losses = 1.7 times the rotor copper losses on full load. Calculate:

i) Gross mechanical power developed.
ii) Rotor copper losses.
iii) The value of rotor resistance per phase if rotor current on full load per phase is 65A.
iv) Full load efficiency. **(10 Marks)**

8 a. Why induction motor is not self starting? Explain the double revolving field theory. **(05 Marks)**

b. Write a brief note on crawling and cogging in the case of an induction motor. **(05 Marks)**

c. With a neat sketch explain the construction and working principle of split phase induction motor. **(05 Marks)**

d. With a neat figure explain the construction of a double cage rotor of an induction motor. **(05 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June/July 2013

Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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1 a. If l, m, n are the direction cosines of a line then prove that $l^2 + m^2 + n^2 = 1$. **(06 Marks)**

b. Show that the direction ratios of three lines 2, 1, 1; 4, $\sqrt{3}-1$, $-\sqrt{3}-1$ and 4, $-\sqrt{3}-1$, $\sqrt{3}-1$ are equally inclined to one-another. **(07 Marks)**

c. Find the expression for the angle between two lines whose direction cosines are l_1, m_1, n_1 and l_2, m_2, n_2. **(07 Marks)**

2 a. Find the equation of the plane passing through three points (x_1, y_1, z_1), (x_2, y_2, z_2) and (x_3, y_3, z_3). **(06 Marks)**

b. Find the equation of the plane through the point (3, –3, 1) and its normal to the line joining the prints (3, 2, –1) and (2, –1, 5). **(07 Marks)**

c. Find the equation of the plane through (1, –2, 2), (–3, 1, –2) and perpendicular to the plane $2x - y - z + 6 = 0$. **(07 Marks)**

3 a. If $\vec{a} = r\cos\theta\sin\phi\,\hat{i} + r\sin\theta\sin\phi\,\hat{j} + r\cos\theta\hat{k}$, then show that $|\vec{a}| = r$. **(06 Marks)**

b. Prove that $\vec{a}\times(\vec{b}\times\vec{c}) = (\vec{a}.\vec{c})\vec{b} - (\vec{a}.\vec{b})\vec{c}$. **(07 Marks)**

c. Show that the position vectors of the vertices of a triangle $\vec{a} = 3(\sqrt{3}\hat{i} - \hat{j})$, $\vec{b} = 6\hat{j}$, $\vec{c} = 3(\sqrt{3}\hat{i} + \hat{j})$ form an isosales triangle. **(07 Marks)**

4 a. Find the unit tangent vector to the space curve $x = \cos t^2$, $y = \sin t^2$ and $z = 0$. **(06 Marks)**

b. Prove that $\frac{d}{dt}[\vec{F},\vec{G},\vec{H}] = \left[\frac{d\vec{F}}{dt},\vec{G},\vec{H}\right] + \left[\vec{F},\frac{d\vec{G}}{dt},\vec{H}\right] + \left[\vec{F},\vec{G},\frac{d\vec{H}}{dt}\right]$ **(07 Marks)**

c. Find the tangent and normal components of its acceleration at t = 1 of a particle moves along the curve $\vec{r} = t^2\hat{i} - t^3\hat{j} + t^4\hat{k}$. **(07 Marks)**

5 a. Prove that $\text{div}(\vec{A} + \vec{B}) = \text{div}\vec{A} + \text{div}\vec{B}$. **(06 Marks)**

b. If $\vec{A}$ is a vector function and ϕ is a scalar function then $\nabla\times(\phi\vec{A}) = \phi(\nabla\times\vec{A}) + \nabla\phi\times\vec{A}$. **(07 Marks)**

c. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $x = z^2 + y^2 - 3$ at (2, –1, 2). **(07 Marks)**

6 a. Find L[f(t)] given that $f(t) = \begin{cases} 0 & \text{for } 0 < t < 2 \\ 4 & \text{for } t > 2 \end{cases}$. **(05 Marks)**

b. Find: i) $L[\cos^2 4t]$; ii) $L[\sin 2t \cos 3t]$; iii) $L\left[\frac{1-\cos t}{t}\right]$ **(15 Marks)**

7 a. If $L[f(t)] = F(s)$, show that $L\left\{\int_0^t f(t)dt\right\} = \frac{1}{s}F(s)$. **(05 Marks)**

b. Find: i) $L^{-1}\left[\frac{5s+1}{s^2+16}\right]$

ii) $L^{-1}\left[\frac{1}{(s+1)(s+2)(s+3)}\right]$

iii) $L^{-1}\left[\frac{s}{(s+2)^3}\right]$ **(15 Marks)**

8 a. Using Laplace transform solve:

$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}$, $y(0) = 0 = y'(0)$. **(10 Marks)**

b. Solve the system of equation using Lapalce transforms $\frac{dx}{dt} + y = \sin t$, $\frac{dy}{dt} + x = \cos t$. **(10 Marks)**

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