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10MAT41

Fourth Semester B.E. Degree Examination, June/July 2018

Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Using the Taylor's series method, solve the initial value problem $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$ at $x = 0.1$ and $x_2 = 0.2$. **(06 Marks)**

b. Obtain an approximate solution of the equation $\frac{dy}{dx} = x + |\sqrt{y}|$ with initial conditions $y = 1$ at $x = 0$ for the range $0 \le x \le 0.4$ in steps of 0.2, using Euler's modified method. Perform two modifications at each step. **(07 Marks)**

c. If $\frac{dy}{dx} = 2e^x - y$, $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.04$ and $y(0.3) = 2.09$, find $y(0.4)$ correct to five decimal places by employing the Milne's predictor-correct method. Use corrector formula twice. **(07 Marks)**

2 a. Find an approximate value of y and z corresponding to $x = 0.1$ given that $y(0) = 2$, $z(0) = 1$ and $\frac{dy}{dx} = x + z$, $\frac{dz}{dx} = x - y^2$. Using Picard's method. **(06 Marks)**

b. Solve, $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$ for $x = 0.2$, correct to four decimal places, with initial conditions $x = 0$, $y = 1$, $\frac{dy}{dx} = 0$, using Runge-Kutta method. **(07 Marks)**

c. Obtain an approximate solution at the point $x = 0.4$ of the initial value problem, $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0$, $y(0) = 1$, $y'(0) = 0.1$ using Milner's method. Given $y(0) = 1$, $y(0.1) = 1.03995$, $y(0.2) = 1.138036$, $y(0.3) = 1.29865$, $y'(0) = 0.1$, $y'(0.1) = 0.6955$, $y'(0.2) = 1.258$, $y'(0.3) = 1.873$. **(07 Marks)**

3 a. If $f(z) = u + iv$ is an analytic function, then prove that $\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$. **(06 Marks)**

b. Find an analytic function $f(z) = u + iv$, given that $u + v = \frac{2\sin 2x}{e^{2y} + e^{-2y} - 2\cos 2x}$. **(07 Marks)**

c. Find an analytic function $f(z) = u + iv$ given the imaginary part $v = r^2\cos 2\theta - r\cos\theta + 2$. **(07 Marks)**

4 a. Find the bilinear transformation that transforms the points $z_1 = i$, $z_2 = 1$, $z_3 = -1$ onto the points $w_1 = 1$, $w_2 = 0$, $w_3 = \infty$ respectively. **(06 Marks)**

b. Evaluate $I = \int_{z=0}^{2+i} (\bar{z})^2 dz$ along the following curves:

i) The straight line $y = \frac{x}{2}$ from the origin θ to the point B(2 + i).

ii) The real axis from 0 to 2 and then vertically to 2 + i. **(07 Marks)**

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

PART – B

5 a. Obtain the series solution Bessel's differential equation leading to Bessel's function of first kind. **(08 Marks)**

b. If α and β are distinct roots of the equation $J_n(ax) = 0$, then prove that $\int_0^a x J_n(\alpha x) J_n(\beta x) dx = 0$. **(07 Marks)**

c. Evaluate $p_0(x)$, $p_1(x)$, $p_2(x)$, $p_3(x)$ by using the Rodrigue's formula. **(05 Marks)**

6 a. A husband and wife appear for two vacancies of a post. The probability of husband's selection is 1/7 and that of wife's selection is 1/5. What is the probability that (i) both of them will be selected? (ii)Only one of them is selected? (iii) Neither is selected? **(06 Marks)**

b. What are independent events? If A and B are independent prove that (i) A and $\bar{B}$ are independent, (ii) $\bar{A}$ and B are independent and (iii) $\bar{A}$ and $\bar{B}$ are independent. **(07 Marks)**

c. An author has four typists typing the manuscript of his latest book. Typist A does 30% of the typing; typist B 25%; typist C 20% and typist D, 25%. Errors occur on 5% of the pages typed by A, on 4% types by B, on 3% typed by C and on 2% typed by D. If a page is chosen at random what is the probability that it contains errors? If a page chosen contains errors, what is the probability that it was typed by typist A or typist B? **(07 Marks)**

7 a. A random variable x has the density function

$$f(x) = \begin{cases} kx^2, & -3 \le x \le 3 \\ 0, & \text{elsewhere} \end{cases}$$

Evaluate K, and find (i) $p(1 \le x \le 2)$ ii) $p(x \le 2)$ iii) $p(2 < x \le 3)$ and iv) $p(x > 1)$. **(06 Marks)**

b. Find the mean, variance and standard deviation for the binomial distribution. **(07 Marks)**

c. The life of a certain type of electrical lamps is normally distributed with mean of 2040 hrs and standard deviation 60 hours. In a consignment of 2000 lamps, find how many would be expected to burn for (i) more than 2150 hours (ii) less than 1950 hours, and (iii) between 1920 hours and 2160 hours given that A(1.5) = 0.4332, A(1.83) = 0.4664 and A(2) = 0.4772. **(07 Marks)**

8 a. The mean and standard deviation of marks scored by a sample of 100 students are 67.45 and 2.92. Find (i) 95% and (ii) 99% confidence intervals for estimating the mean marks of the student population. **(06 Marks)**

b. Consider the sample consisting of nine numbers 45, 47, 50, 52, 48, 47, 49, 53 and 51. The sample is drawn from a population whose mean is 47.5. Find whether the sample mean differs significantly from the population mean at 5% level of significance. **(07 Marks)**

c. Fit a binomial distribution to the following data:

x_i	0	1	2	3	4	5
f_i	2	14	20	34	22	8

Test the goodness of this fit at 5% level of significance. **(07 Marks)**

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10EE44

Fourth Semester B.E. Degree Examination, June/July 2018
Field Theory

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. State and explain coulombs' law in vector form. **(06 Marks)**

b. Derive an expression for Gauss law in differential form. **(08 Marks)**

c. A zone point charge in located at P(2, 4, -3). Find : i) E(r) ii) Find the locus of all points at which E(x) = 1V/mt. **(06 Marks)**

2 a. Show that Electric Field Intensity is equal to negative gradient of potential in an electrostatic field. **(10 Marks)**

b. A spherical surface in free space, r = 4cm contains a uniform surface charge density of 20micro coulombs/m^2. Find r_A if the region $0.06 < r < r_A$. Contains 1 milli Joule of Energy. **(10 Marks)**

3 a. State and prove uniqueness theorem. **(08 Marks)**

b. Derive Laplace equation from Maxwell's first equation of electrostatics. **(06 Marks)**

c. Solve Laplace's equation between two conical surfaces. **(06 Marks)**

4 a. Compute the magnetic field at a point on the axis of a square loop of wire carrying a current of 'I' amperes of a side 'a' mts, **(10 Marks)**

b. If $\overline{A} = 10P^{1.5}\overline{a}_z$ wb/mt in free space find i) $\overline{H}$ ii) $\overline{J}$. **(10 Marks)**

PART – B

5 a. Explain phenomena of Magnetization and permeability in magnetic materials and show that $\mu_r = 1 + x_m$. **(10 Marks)**

b. A square loop in z = 0 plane in carrying 2 milli amperes in the field of an infinite filament on the y-axis carrying a current of 15Amps. Determine the total force on the loop. **(06 Marks)**

c. Derive an expression for self inductance of a Torroid. **(04 Marks)**

6 a. Write down the Maxwell's Equation in differential scalar form. **(08 Marks)**

b. Show that in a capacitor, conduction current is equal to displacement current. **(06 Marks)**

c. Explain briefly the concept of related potentials in time varying fields. **(06 Marks)**

7 a. Derive expression for attenuation constant and phase constant of Electromagnetic wave in a conducting medium. **(10 Marks)**

b. State and prove poynting vector theorem. **(10 Marks)**

8 a. Discuss clearly reflection and refraction of electromagnetic waves. **(06 Marks)**

b. Define the terms i) Reflection co-efficient ii) Transmission co-efficient with respect to reflections of electromagnetic waves. **(04 Marks)**

c. Given region 1, $z < 0$, $\epsilon_1 = 20$pF/mt , $\mu_1 = 2$ μH/mt ; region 2, $0 < z < 8$cm, $\epsilon_2 = 50$pF/mt , $\mu_2 = 2.5$μH/mt and region 3, $z > 8$cm, $\epsilon_3 = \epsilon_1$ and $\mu_3 = \mu_1$; let $\sigma = 0$ everywhere i) what is the lowest frequency at which a uniform plane wave incident from region 1 on the boundary at z = 0 will have no reflection? i) If f = 200MHz what will be SWR in region 1? **(10 Marks)**

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10EE45

Fourth Semester B.E. Degree Examination, June/July 2018

Power Electronics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With a block diagram, explain the working of a power electronic converter with the help of a controller. **(06 Marks)**

b. Explain the control characteristics of (i) SCR (ii) GTO (iii) MCT (iv) MOSFET (v) SITH. Draw symbol, input, control signal and output waveforms for each device. **(10 Marks)**

c. With neat diagram, explain the working of thyristorized tap changers. **(04 Marks)**

2 a. Explain the need of base drive control with diagram. Explain proportional drive control of BJT. **(06 Marks)**

b. For the transistor switch of Fig.Q2(b), β varies between 8 and 40. Calculate:
i) The value of R_B that drives the device into saturation with ODF = 5
ii) Forced β_f
iii) Total power loss in the device.

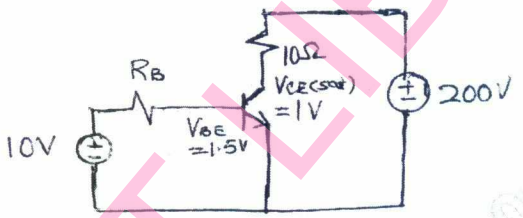

Fig.Q2(b) **(08 Marks)**

c. What is dv/dt and di/dt? Explain how to protect the device against dv/dt and di/dt. **(06 Marks)**

3 a. Why SCR is called as a semicontrolled device? Define latching current and holding current of a SCR. **(06 Marks)**

b. A SCR has a di/dt = 120 A/μs and du/dt = 300 V/μs. It operates on a dc voltage of 250 V. Calculate the value of components of protection circuit. **(06 Marks)**

c. Derive an expression for an equalizing resistance 'R' to be connected across each SCR of a series connected SCRs to share equal voltages under steady state conditions. **(08 Marks)**

4 a. What is commutation? Distinguish between natural commutation and forced commutation. **(06 Marks)**

b. With a neat diagram and waveform, explain the working of auxiliary voltage commutation. **(08 Marks)**

c. A complimentary commutation circuit operates from a dc source of 120 V and uses $R_1 = R_2 = 10\ \Omega$, commutating capacitor C = 10 μF. Calculate: (i) Circuit turn off time (ii) Peak thyristor current. **(06 Marks)**

PART – B

5 a. With a circuit diagram, explain the working of a 1-ϕ full converter with R-load. Derive an expression for average and rms output voltage. Draw waveforms showing output voltage, output current, current through SCR and diode. **(12 Marks)**

b. A 1-ϕ semiconverter is operated from 120V, 50Hz ac supply. The load resistance is 10Ω. If the average output voltage is 25% of the maximum possible average output voltage. Determine: (i) Firing angle (ii) rms and average output current (iii) rms and average thyristor current. **(08 Marks)**

6 a. Explain the principle of operation of step-up chopper with resistive load. Derive the expression for average output voltage. Draw relevant waveforms. **(07 Marks)**

b. Explain different control strategies used for choppers. Draw relevant waveforms. **(06 Marks)**

c. A chopper is operated on TRC at a frequency of 2 kHz. The supply voltage is 460 V and the load voltage is 350 V. Calculate the conduction and non conduction period of the thyristor in each cycle. **(07 Marks)**

7 a. With neat circuit, waveforms showing conduction intervals, sequence of device conduction and equivalent circuit, explain the working of 3-ϕ inverter for 180° conduction. Also show the line voltage V_{RY} and phase voltage V_{RN}. **(10 Marks)**

b. A 1-ϕ bridge inverter has a resistive load of 10Ω and the dc input voltage is V_s = 220 V. Calculate:

i) The rms output voltage at fundamental frequency
ii) The average, rms and peak currents of each thyristor
iii) The output power **(05 Marks)**

c. With neat circuit diagram, explain the working thyristorized current source inverter. **(05 Marks)**

8 a. With a neat diagram and relevant waveforms, explain the principle of operation of bidirectional controllers with RL load. Derive an expression for rms value of output voltage. **(08 Marks)**

b. In an ON-OFF control circuit using 1-ϕ, 230 V, 50 Hz supply the ON time is 10 cycles and OFF time is 4 cycles. Calculate the rms value of the output voltage. **(04 Marks)**

c. Explain the effects of power electronic converter and remedial measures adopted. **(08 Marks)**

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10EE46

Fourth Semester B.E. Degree Examination, June/July 2018

Transformers and Induction Machines

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain with a neat sketch the construction of a three phase core type transformer. **(04 Marks)**

b. With schematic representation and relevant phasor diagram, explain the operation of a practical single phase transformer, when it is supplying an inductive load. **(06 Marks)**

c. A single phase 200/100 V transformer is connected to a load of $5\angle 30^\circ\ \Omega$. The no load current drawn by the transformer is $0.6\angle 75^\circ$ A. Calculate:

i) Load current ii) Load power iii) Primary current
iv) Primary power factor v) Primary input power **(10 Marks)**

2 a. Derive an approximate expression for the voltage regulation of a transformer. **(05 Marks)**

b. The equivalent series leakage impedance referred to HV side of a 50 KVA, 2400/240 V, 50 Hz one phase transformer is $(1.5 + j2)\Omega$. The transformer is supplying full load at 0.8 power factor lagging. Determine the voltage regulation. **(05 Marks)**

c. A 5 KVA, single phase transformer has a coreloss of 40 Watts and full load ohmic loss of 100 Watts. The daily variation of load on the transformer is as follows:
7 AM to 1 PM : 3 KW at pf 0.6
1 PM to 6 PM : 2 KW at pf 0.8
6 PM to 1 AM : 6 KW at pf 0.9
1 AM to 7 AM : No load
Determine the all day efficiency of the transformer. **(10 Marks)**

3 a. Derive an expression for saving of copper when an autotransformer is used. Mention its applications. **(10 Marks)**

b. A 1000 KVA single phase transformer with 0.01 per unit resistance and 0.04 per unit leakage reactance operates in parallel with 500 KVA transformer having resistance of 0.012 per unit and leakage reactance of 0.036 per unit. How will they share a load of 1500 KVA at 0.8 lagging power factor. Assume that the secondary voltages are equal. **(10 Marks)**

4 a. Explain the need for parallel operation of transformers and give the necessary conditions for the parallel operation of three phase transformers. **(10 Marks)**

b. A three phase transformer bank consisting of three-single phase transformers is used to step down the voltage of a 3-phase, 6600 V transmission line. If the primary line current is 10 A, calculate the secondary line voltage, line current and output KVA for the following connections (i) λ/Δ and (ii) Δ/λ. The turns ratio is 12. Neglect losses. **(10 Marks)**

PART – B

5 a. Explain with neat sketches, the construction of squirrel cage and slip ring induction motor. **(06 Marks)**

b. Explain torque-slip characteristics of a 3-phase induction motor. **(04 Marks)**

c. A 3-phase, 4-pole, 1440 rpm, 50 Hz, induction motor has star connected rotor winding, having a resistance of 0.2 Ω per phase and a stand still leakage reactance of 1Ω per phase. When the stator is energized at rated voltage and frequency the rotor induced emf at stand still is 120 V per phase. Calculate:
i) Rotor current ii) Rotor power factor
iii) Starting torque iv) Full load torque **(10 Marks)**

6 a. Explain how to arrive at the approximate equivalent circuit of a 3-phase induction motor. **(10 Marks)**

b. A 10 HP, 4-pole, 50 Hz, 3-phase induction motor runs at 1450 rpm on full load. The stator copper loss is 231 Watts and the rotational loss is 343 Watts. Determine:
i) The shaft torque ii) The mechanical power developed
iii) The air gap power iv) The rotor copper loss
v) The input power vi) The efficiency **(10 Marks)**

7 a. Explain high torque double cage rotor induction motor. Draw its equivalent circuit and torque slip characteristics for its 2 cages. **(10 Marks)**

b. The impedances at standstill of the inner and outer cages of a double-cage rotor are $(0.01 + j0.5)\Omega$ and $(0.05 + j0.1)\Omega$ respectively. The stator impedance may be assumed to be negligible. Calculate the ratio of the torques due to the two cages: (i) at starting and (ii) when running with a slip of 5%. **(10 Marks)**

8 a. Explain star-delta method of starting of 3-phase induction motor with necessary diagram. **(06 Marks)**

b. A squirrel cage induction motor has a full load slip of 0.05. The motor starting current at rated voltage is 6 times its full load current. Find the tapping on the autotransformer starter which should give full load torque at start. Also find the line current at starting in terms of full load. **(06 Marks)**

c. Explain with neat diagrams any 2-types of making 1-phase induction motor self starting. **(08 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June/July 2018

Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions.*

1 a. Find the ratio in which the point C, (9, 8, -10) divides the line segment joining the points A(5, 4, -6) and B(3, 2, -4). **(06 Marks)**

b. If $\cos\alpha$, $\cos\beta$, $\cos\gamma$ are the direction cosines of a straight line, prove that (i) $\sin^2\alpha+\sin^2\beta+\sin^2\gamma=2$ (ii) $\cos2\alpha+\cos2\beta+\cos2\gamma=-1$. **(07 Marks)**

c. Find the constant K such that the angle between the lines with direction ratios (-2, 1, -1) and (1, -K, 1) is 90°. **(07 Marks)**

2 a. Show that the angles between the diagonals of a cube is $\theta=\cos^{-1}(1/3)$. **(06 Marks)**

b. Find the equation of the plane through the points (1, 0, -1) and (3, 2, 2) and parallel to the line $\frac{x-1}{1}=\frac{1-y}{2}=\frac{z-2}{3}$. **(07 Marks)**

c. Show that the points A(-6, 3, 2), B(3, -2, 4), C(5, 7, 3) and D(-13, 17, -1) are coplanar. Also find the equation of the plane containing them. **(07 Marks)**

3 a. Find the angle between the vectors $\vec{a}=2i+6j+3k$, $\vec{b}=12i-4j+3k$. **(06 Marks)**

b. Find the area of a parallelogram whose adjacent sides are $i-2j+3k$ and $2i+j-4k$. **(07 Marks)**

c. Find a unit vector perpendicular to both vectors $\vec{a}=2i-3j+k$, $\vec{b}=7i-5j+k$. **(07 Marks)**

4 a. Show that the four points whose position vectors are $3i-2j+4k$, $6i+3j+k$, $5i+7j+3k$ and $2i+2j+6k$ are coplanar. **(06 Marks)**

b. A particle moves along the curve $x=t^3+1$, $y=t^2$, $z=2t+3$ where t is the time. Find the components of velocity and acceleration at $t=1$ in the direction of $i+j+3k$. **(07 Marks)**

c. Find the directional derivative of $f(x,y,z)=xy^2+yz^3$ at the point (2, -1, 1) in the direction of vector $i+2j+2k$. **(07 Marks)**

5 a. Find div F and curl F where $F=\text{grad}(x^3+y^3+z^3-3xyz)$. **(06 Marks)**

b. Show that $F=x(y-z)i+y(z-x)j+z(x-y)k$ is solenoidal. **(07 Marks)**

c. Find the constants a and b so that the vector $\vec{F}=(axy+z^3)\hat{i}+(3x^2-z)\hat{j}+(bxz^2-y)\hat{k}$ is irrotational. **(07 Marks)**

6 a. Find the Laplace transforms of $1+2t^3-4e^{3t}+5e^{-t}$. **(07 Marks)**

b. Find the Laplace transform of $t^2\sin^2 t$. **(07 Marks)**

c. Find the Laplace transform of $\frac{\sin at}{t}$. **(06 Marks)**

7 a. Find the inverse Laplace transform of $\frac{3s-4}{16-s^2}$. **(06 Marks)**

b. Find the inverse Laplace transform of $\frac{1}{s^2+4s+9}$. **(07 Marks)**

c. Evaluate $L^{-1}\left\{\frac{1}{(s+1)(s+2)}\right\}$. **(07 Marks)**

8 a. Obtain the Laplace transforms of $f'(t)$, $f''(t)$. **(08 Marks)**

b. Solve the differential equation using Laplace transforms $y''-3y'+2y=1-e^{2t}$ under the conditions $y(0) = 1$, $y'(0) = 0$. **(12 Marks)**

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