USN | | | | | | | | | | 10MAT41

# Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
## Engineering Mathematics - IV

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.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

## PART – A

1 a. Using Taylor series method, solve $\frac{dy}{dx} = x^2 + y^2, y(0) = 1$ at the point x = 0.2, 0.3 consider up to $4^{th}$ degree term. **(06 Marks)**

b. Using Runge Kutta method of order 4, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with y(0) = 1 at x = 0.2, 0.4 by taking step length h0.2. **(07 Marks)**

c. Given $\frac{dy}{dx} = \frac{1}{2}xy$, y(0) = 1, y(0.1) =1.0025, y(0.2)=1.0101, y(0.3)=1.0228. Compute y at x = 0.4 by Adams – Bash forth predictor – corrector method use corrector formula twice. **(07 Marks)**

2 a. Evaluate y and z at x = 0.1 from the Picard's second approximation to the solution of the following system of equations given by y = 2 and z = 1 at x = 0 initially $\frac{dy}{dx} = x + z$ $\frac{dz}{dx} = x - y^2$. **(06 Marks)**

b. Given $y'' = x^3(y + y')$ with the initial condition y(0) = 1 $y'(0) = 0.5$ compute y(0.1) by taking h = 0.1 and using $4^{th}$ order Runge Kutta method. **(07 Marks)**

c. Applying Milne's method compute y(0.4) Given that y satisfies the equation $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0$ and y and y′ are governed by the following values
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. Derive Cauchy Riemann Equation in Cartesian form. **(06 Marks)**

b. Prove that for every analytic function f(z) = u + iv the two families of curves u(x,y) = $C_1$ and v(x,y) = $C_2$ form an orthogonal system. **(07 Marks)**

c. If u – v = (x – y) $(x^2 + 4xy + y^2)$ and f(z) = u + iv is analytic function of z = x + iy find f(z) interms of f(z). **(07 Marks)**

4 a. Find the bilinear transformation that maps the points z = 0, i, ∞ onto the points w = 1, –i, –1 respectively, find the invariant points. **(06 Marks)**

b. Discuss the transformation $w = e^z$. **(07 Marks)**

c. Evaluate $\int_c \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)} dz$, where c is the circle |z| = 3. **(07 Marks)**

## PART – B

5 a. Starting from Laplace differential equation. Obtain Bessel's differential equation as $xy'' + xy' + (x^2 - n^2)y = 0$ **(08 Marks)**

b. If $x^3 + 2x^2 - x + 1 = a\,P_0(x) + b\,P_1(x) + c\,P_2(x) + d\,P_3(x)$ find the value of a, b, c, d. **(06 Marks)**

c. Derive Rodrigue's formula $P_n(x) = \frac{1}{2^n n!}\frac{dy}{dx^n}(x^2 - 1)^n$ **(06 Marks)**

6 a. Define axioms of probability. Prove that,
$P(A \cup B \cup C) = P(A) + P(B) + P(C) + P(A \cap B \cap C) - P(A \cap B) - P(B \cap C) - P(C \cap A)$ **(06 Marks)**

b. A solar water heater manufactured by a company consists of two parts the heating panel and the insulated tank. It is found that 6% of the heaters produced by the company have defective heating panels and 8% have defective tank. Find the percentage of non defective heaters produced by the company. **(07 Marks)**

c. A box contains 500 IC chips of which 100 are manufactured by company X and the rest by company Y. It is estimated that 10% of the chips made by company X and 5% made by company Y are defective. If a randomly selected chip is found to be defective find the probability that it came from company X. **(07 Marks)**

7 a. A random variables X takes the values −3, −1, 2 and 5 with respective probabilities $\frac{2k-3}{10}, \frac{k-2}{10}, \frac{k-1}{10}, \frac{k+1}{10}$. Find the value of k and i) $p(-3 < x < 4)$ ii) $p(x \le 2)$. **(06 Marks)**

b. Find the mean and variance of binomial distribution. **(07 Marks)**

c. In an examination 7% of students scores less than 35% marks and 89% of students score less than 60% marks. Find the mean and standard deviation of the marks are normally distribute, it is given that $P(0 < z < 1.2263) = 0.39$ and $P(0 < z < 1.4757) = 0.43$. **(07 Marks)**

8 a. Explain the following terms :

i) Null hypothesis
ii) Type I and Type II error
iii) Confidence limits. **(06 Marks)**

b. A coin is tossed 1000 times and it turn up head 540 times decide on the hypothesis that the coin is unbiased. **(07 Marks)**

c. A certain stimulus administered to each of the 12 patients resulted is the following change is blood pressure 5, 2, 8, −1, 3, 0, 6, −2, 1, 5, 0, 4 can it be calculated that the stimulus will increase the blood pressure ($t_{0.05}$ for 11 df 2.201.) **(07 Marks)**

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# Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

## Microcontroller

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 block diagram architecture of 8051 microcontroller. **(12 Marks)**

b. Explain Harward and Von-Neumann CPU architectures with necessary diagrams. **(08 Marks)**

2 a. Explain the different addressing modes supported by 8051 μc with an example for each. **(10 Marks)**

b. Correct the following instructions if found to have any wrong syntax. Explain the operation of the corrected instructions:

(i) MOVx R0, @ R1 (ii) MOV A, # B (iii) MOV 77h, A8H
(iv) XCHG A1, R2 (v) ADD A, @B **(10 Marks)**

3 a. Write a program that computes the number of zeros in the following 16-bit stream:
0 1 0 1 1 0 1 0 0 1 0 1 1 0 1 0 **(10 Marks)**

b. Assume Timer 1 is operating in mode 1. It is required to schedule a new task after 0.05 second. If the timer oscillator operates at 10.0 MHz, how should the timer registers be configured for this operation. **(10 Marks)**

4 a. Draw the internal structure of port '0' and explain its operation. **(10 Marks)**

b. Write a 'C' program to monitor the status of a switch 'SW' connected to pin P2.7 and perform the following:
i) If SW = 0, the stepper motor rotates clockwise
ii) If SW = 1, the stepper motor rotates counter clockwise (ACW)
Use the wave drive 4-step sequence. **(10 Marks)**

## PART – B

5 a. Explain interrupt vector table. **(10 Marks)**

b. Write the bit pattern of TCON SFR and explain. **(10 Marks)**

6 a. How many types of serial communications are there? Name them and explain each type. **(10 Marks)**

b. Write a program to serially transmit the message 'GOOD' continuously at a baud rate of 9600, 8-bit data and 1 stop bit. **(10 Marks)**

7 a. With a neat block diagram, explain the architecture of MSP 430 μ controller. **(10 Marks)**

b. Explain with an example of MOV instruction the different addressing modes of MSP430. **(10 Marks)**

8 a. Assume that a 60 Hz external clock is being fed into pin T1 (P3.5). Write an 8051 C program for counter 1 in mode 2 to display the seconds and minutes on P1 and P2 respectively. **(10 Marks)**

b. Explain the importance of TI and RI flag used in serial data transfer. **(10 Marks)**

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# Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
## Control Systems

Time: 3 hrs. Max. Marks:100

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

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.

## PART - A

1 a. Define Control System. Give the difference between open loop and closed loop control system, with an example. **(06 Marks)**

b. For the mechanical system shown in fig.Q1(b),
i) Write the nodal circuit ii) Write the performance equation
iii) Write force voltage and force current analogous circuits. **(09 Marks)**

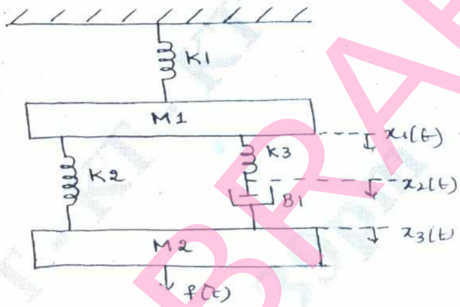



Fig.Q1(b)

c. For the mechanical system shown in fig.Q1(c),
i) Write the nodal circuit ii) Write the performance equations. **(05 Marks)**

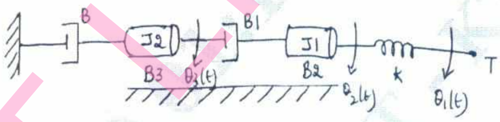



Fig.Q1(c)

2 a. Find the transfer function C(s)/R(s), using block diagram reduction technique for the figure shown in fig. Q2(a). **(10 Marks)**

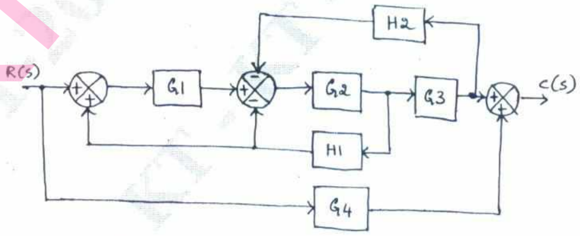



Fig.Q2(a)

b. For the signal flow graph, shown in fig.Q2(b), find the transfer function using Mason's gain formula. **(10 Marks)**

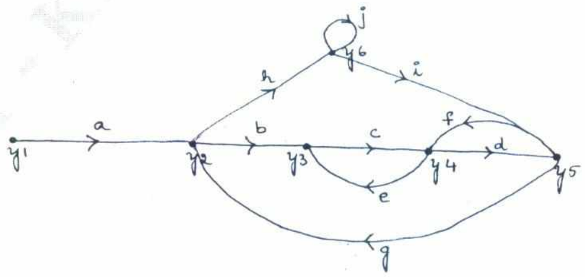



Fig.Q2(b)

3 a. For the unity feedback system having open – loop transfer function
$G(s) = \dfrac{K(s+2)}{S(s^3+7s^2+12s)}$, find i) Type of the system ii) Error co-efficient
iii) Steady state error when the input of the system is $\frac{R}{2}t^2$. **(10 Marks)**

b. A feedback control system shown has a damping factor of 0.8. Determine constant K and all the time domain specifications for the system shown in fig.Q3(b). **(10 Marks)**

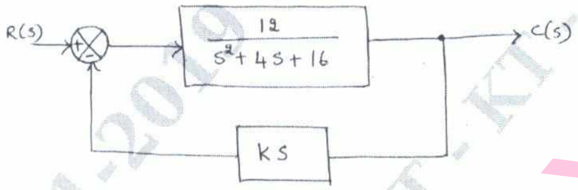


Fig.Q3(b)

4 a. What are the necessary conditions for a system to be stable according to Routh – Hurwitz criteria? **(04 Marks)**

b. The open loop transfer function of a unity feedback control system is given by
$G(s) = \dfrac{K}{(s+2)(s+4)(s^2+6s+25)}$
i) Find the range of K for which the system is stable.
ii) Find K for which system oscillates and what is the corresponding frequency of oscillation. **(10 Marks)**

c. Determine the stability of control system with characteristic equation.
$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. **(06 Marks)**

## PART - B

5 a. The open – loop transfer function of a feedback control system is given by **(12 Marks)**
$G(s)\,H(s) = \dfrac{K}{S(s+1)(s+2)}$
Construct the root locus of the control system and find the range of K for which the closed loop system is stable.

b. Sketch the root locus of the control system with open loop transfer function
$G(s)\,H(s) = \dfrac{K}{s^2+10s+100}$. Determine the stability of closed loop system. **(08 Marks)**

6 a. A unity feedback control system has **(10 Marks)**
$G(s) = \dfrac{80}{S(s+2)(s+20)}$. Draw the Bode plot and determine Gain margin, Phase margin, $W_{ge}$ and $W_{pc}$. Comment on stability.

b. Determine the transfer function from the magnitude plot shown in fig. Q6(b). **(10 Marks)**

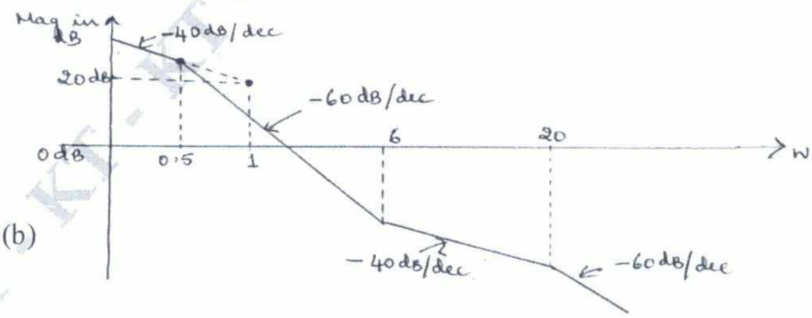


Fig.Q6(b)

7 a. Construct the Nyquist plot for the control system with **(14 Marks)**

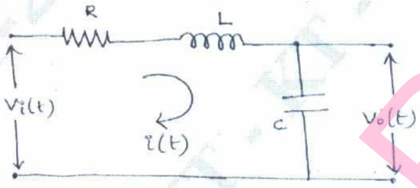
$G(s)\,H(s) = \dfrac{K(s+1)}{S(s-1)}$. From the plot, determine the stability of closed loop system.

b. State Nyquist stability criteria and explain the procedure to find the stability of the system using Nyquist criteria. **(06 Marks)**

8 a. State the advantages of state space approach. **(04 Marks)**

b. Obtain the state model of the given electrical network in standard form shown in fig. Q8(b). Given at $t = t_o$, $i(t) = q(t_o)$ and $V_o(t) = V_o(t_o)$. **(06 Marks)**

Fig.Q8(b)




c. State and prove the properties of state transition matrix. **(10 Marks)**

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# Fourth Semester B.E. Degree Examination, Dec.2018/Jan. 2019
# Field Theory

Time: 3 hrs.   Max. Marks:100

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

## PART – A

1 a. State and explain Gauss's law. **(06 Marks)**

b. A line charge densities of 24 nc/m is located in free space on the line y = 1, z = 2.

i) Find E at p(6, –1, 3)

ii) What point charge $Q_A$ should be located at Q(–3, 4, 1) to cause $E_y$ to be equal to zero at point P. **(08 Marks)**

c. A vector field $\overline{F} = \left(\frac{5r^3}{4}\right)\bar{a}_r$ given in spherical coordinates. Evaluate both sides of divergence theorem for the volume enclosed between θ = 0° to $\theta = \frac{\pi}{4}$ and r = 4m. **(06 Marks)**

2 a. Show that the vector electric field intensity E is the negative gradient of scalar electric potential V. **(06 Marks)**

b. Obtain the boundary conditions between the two dielectric materials of permittivities $\varepsilon_1$ and $\varepsilon_2$. **(08 Marks)**

c. Give $V = 2x^2y - 5z$ at point p(–4, 3, 6). Find the potential, electric field intensity and volume charge density. **(06 Marks)**

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

b. Two concentric conducting spheres have radius of 3cm and 5cm. The region between them is filled with a homogeneous dielectric for which $\varepsilon_r = 5$. If the potential of the inner sphere is 100 volts while that of the outer sphere is –100 volts, find :

i) V

ii) $\overline{E}$

iii) $\overline{D}$

iv) the value of r at which V = 0. **(08 Marks)**

c. If a potential $V = x^2yz + Ay^3z$, find :

i) The value of 'A', so that V satisfies the Laplace's equation

ii) With the value of 'A' determine electric field at (2, 1, –1). **(04 Marks)**

4 a. Using Biot-Savart law, obtain the magnetic field intensity expression due to an infinite length conductor carrying current I amps along Z – direction. **(06 Marks)**

b. Discuss the concept of scalar and vector magnetic potential. **(08 Marks)**

c. In cylindrical coordinates a magnetic field is given as $H = [2\rho - \rho^2]\ \bar{a}_\phi\ A/m$.

i) Determine the current density

ii) What total current passes through the surface z = 0, 0 ≤ ρ ≤ = 1 in the $\bar{a}_z$ direction. **(06 Marks)**

## PART – B

5 a. Derive an expression for the force on a differential current carrying element. **(06 Marks)**

b. A current filament carrying 8 A in the $\bar{a}_z$ direction lies along the entire z – axis n free space. A rectangular loop connecting A(0, 0.2, 0) to B(0, 0.2, 0.3) to C(0, 0.7, 0.3) to D(0, 0.7, 0.2) to A lies in the x = 0 plane. The loop current is 3mA and it flows in the $\bar{a}_z$ direction in the AB segment.

i) Find F on the AB segment
ii) Find F on the side DA
iii) Find $F_{total}$ on the loop. **(08 Marks)**

c. Define mutual inductance. Calculate the inductance of 400 turns wound on a solenoid with 10cm diameter and 50cm length. Assume that solenoid is in air. **(06 Marks)**

6 a. What is inconsistency of Ampere's law with the equation of continuity? Derive the modified form of Ampere's law of Maxwell. **(08 Marks)**

b. Starting from Faraday's law of electromagnetic induction derive $\nabla \times \bar{E} = -\frac{\partial \bar{B}}{\partial t}$. **(06 Marks)**

c. For the losses dielectric $\sigma = 5$ s/m and $\varepsilon_r = 1$. The electric field intensity is $E = 100 \sin 10^{10}t$. Find $J_C$, $J_D$ and frequency at which both have equal magnitude. **(06 Marks)**

7 a. Determine the relation between E and H of an EM wave travelling in z – direction. **(10 Marks)**

b. Obtain the solution of wave equation for uniform plane wave propagating in free space. **(10 Marks)**

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

b. A 100 V/m, 3 GHz wave is propagating in material having $\varepsilon_{R1} = 4$, $\mu_{R1} = 1$ and $\sigma = 0$. It is normal to another perfect dielectric in region 2, **z** > 0, where $\varepsilon_{R2} = 9$, $\mu_{R2} = 1$. Calculate, phase constants, coefficient of reflection, transmission and standing wave ratio. **(10 Marks)**

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# Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
## Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

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



1 a. Prove that the angle between two lines whose direction cosines are ($l_1$, $m_1$, $n_1$) and ($l_2$, $m_2$, $n_2$) is $\cos\theta = l_1 l_2 + m_1 m_2 + n_1 n_2$ **(07 Marks)**

b. Find the value of K if the angle between the lines with direction ratios $-2, 1, -1$ and $1, -K, -1$ is $\frac{2\pi}{3}$. **(07 Marks)**

c. Find the projection of the line segment AB on CD where A = (3, 4, 5), B = (4, 6, 3), C = (–1, 2, 4), D = (1, 0, 5) **(06 Marks)**

2 a. Derive the equation of the plane in the intercept form $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **(07 Marks)**

b. Find the image of the point (2, –1, 3) in the plane $2x+4y+z-24=0$. **(07 Marks)**

c. Find the equation of the plane containing the line $\frac{x+1}{2}=\frac{y+2}{3}=\frac{z+3}{4}$ and is perpendicular to the line $x-2y+3z=4$. **(06 Marks)**

3 a. Show that the position vectors of the vertices of a triangle $2i-j+k$, $i-3j-5k$ and $3i-4j-4k$ form a right angled triangle. **(07 Marks)**

b. Find the cosine and sine of the angle between the vectors $2i-j+3k$ and $i-2j+2k$. **(07 Marks)**

c. Find the value of λ such that the vectors $\vec{a}=\lambda i-5j-2k$, $\vec{b}=-7i+14j-3k$ and $\vec{c}=11i+4j+k$ are coplanar. **(06 Marks)**

4 a. A particle moves along a curve $x=t^3-4t$, $y=t^2+4t$, $z=8t^2-3t^3$. Determine its velocity and acceleration and also the magnitude of velocity and acceleration at t = 2. **(07 Marks)**

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

c. Find the directional derivative of the function $\phi=xyz$ along the direction of the normal to the surface $xy^2+yz^2+zx^2=3$ at the point (1, 1, 1) **(06 Marks)**

5 a. If $\vec{F}=\nabla(x^3+y^3+z^3-3xyz)$ find $\text{div}\,\vec{F}$ and $\text{curl}\,\vec{F}$. **(07 Marks)**

b. Show that $\text{curl}(\text{grad}\phi)=0$. **(06 Marks)**

c. Show that $\vec{F}=\frac{xi+yj}{x^2+y^2}$ is both solenoidal and irrotational. **(07 Marks)**

6 a. Find the Laplace transform of $t^n$, where n is a positive integer. **(05 Marks)**

b. Find $L(\sin 5t \cos 2t)$. **(05 Marks)**

c. Find $L(t\cos at)$. **(05 Marks)**

d. Find $L\left(\frac{\cos at - \cos bt}{t}\right)$. **(05 Marks)**

7 a. Find $L^{-1}\left[\frac{s+5}{s^2 - 6s + 13}\right]$. **(07 Marks)**

b. Find $L^{-1}\left[\frac{1}{s(s+1)(s+2)(s+3)}\right]$. **(07 Marks)**

c. Find $L^{-1}\left[\log\left(\frac{s+a}{s+b}\right)\right]$. **(06 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. Using Laplace transform solve $\frac{dx}{dt} + y = \sin t$, $\frac{dy}{dt} + x = \cos t$ given $x(0) = 1$, $y(0) = 0$ **(10 Marks)**

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