Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.Tech(ECE)/SEM-1/MEC-101/2009-10

2009

ADVANCED ENGINEERING MATHEMATICS FOR COMMUNICATIONS

Time Allotted : 3 Hours | Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Graph(s) will be supplied by the Institution.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Legendre polynominal $P_2(\cos\theta)$ is equal to

a) 1

b) $\frac{1}{4}(3\cos 2\theta + 1)$

c) $\frac{1}{2}(3\cos^2\theta - 1)$

d) $\cos\theta$.

ii) $H n^{(2)}(x)$ represents

a) standing wave in cylindrical coordinates system

b) standing wave in spherical coordinates system

c) inward travelling wave in cylindrical coordinates system

d) outward travelling wave in cylindrical coordinates system.

iii) A function is odd symmetrical function when

a) $f(t) = f(-t)$

b) $f(t) > 0$; $f(-t) = 0$ & $f(t) = 0$

c) $f(t) = -f(-t)$

d) $f(-t) > 0$.

iv) Laplace transform of $\frac{df(t)}{dt}$ is

a) $sF(s)$ b) s

c) $f(0) + sF(s)$ d) $-f(0) + sF(s)$.

v) Initial value theorem state that

a) $\lim_{s \varnothing 0} [sX(s)] = x(t \varnothing \bullet)$

b) $\lim_{s \varnothing \bullet} [sx(s)] = x(t \varnothing 0)$

c) $x(t \varnothing 0) = \lim_{s \varnothing 0} [sx(s)]$

d) $x(t \varnothing 0) = \lim_{s \varnothing \bullet} [sx(s)]$.

vi) For symmetrical even function dc component of Fourier series is

a) zero b) < 0

c) > 0 d) $\bullet$.

vii) Shifting property of Fourier transform is expressed by

a) $1/a\, F(\omega / a)$ = F.T. of $f(at)$

b) $\bar{e}^{jaw} F(\omega)$ = F.T. of $f(t-a)$

c) $\frac{1}{2}[F(\omega - a) + F(\omega + a)]$ = F.T. of $f(t)\cos(at)$

d) $\bar{e}^{jaw} F(\omega)$ = F.T. of $f(t+a)$.

viii) Chebychev polynomial $T_{n-1}(x)$ is expressed by

$T_{n-1}(x) = \cos[(n-1)\cos^{-1}(x)]$ in the region

a) $x \le 1$ b) $-1 \le x$

c) $-1 \le x \le \bullet$ d) $-1 \le x \le 1$.

ix) The most important probability distribution in queering theory is

a) Gaussian b) Exponential

c) Gamma d) None of these.

x) Expected queuing length for $S = 1$ with the usual notation as (λ = mean arrival rate, μ = mean service rate $\rho = \lambda/\mu$)

a) λ b) $\lambda/(\mu - \lambda)$

c) μ d) $1 - \rho$.

xi) Explain number of persons is queuing system L is related to expected queue length Lq as

a) $L = Lq$ b) $L = Lq + \lambda$

c) $L = Lq + 1/\mu$ d) $L = Lq + \lambda/\mu$.

GROUP – B

(Short Answer Type Questions)

Answer any *four* of the following. $4 \times 5 = 20$

2. A single short pulse of width τ of the form

is sent in a communication channel. Complete using Fourier transform the frequency distribution as magnitude *vs* frequency and show graphical representation of the components. 3 + 2

3. Find the Laplace transform of $10\, e^{-5t} \cos(3t)$. 5

4. The electric field of a uniform plane wave is given by

$$\bar{E} = x\ 10 \sin\left(3\pi \infty 10^{8} t - \pi z\right)\ V/m$$

Find

a) phase velocity

b) magnetic field component

c) the polarization of the wave.

Mention the dimension of each parameter. 2 + 2 + 1

5. Define binomial series using mathematical represention. Expand $(1 + x)^{-1/2}$ as a power series using binomial coefficients. $2\frac{1}{2} + 2\frac{1}{2}$

6. Define standard deviation and probability of occurrence using mathematical representations. Express Gaussian distribution function mathematically and graphically. $2\frac{1}{2} + 2\frac{1}{2}$

7. Discuss the advantages and disadvantages among optical switching networks as OCS (Optical Circuit Switching), OPS (Optical Packet Switching) and OBS (Optical Burrs Switching).

8. Explain how burrs loss can be avoided in an ingress mode having more than OBS path passing in a given link of an OBS network.

9. Explain little formula for the relationship between expected number of customers L, mean arrival rate λ and the waiting time W in the system. Find also the relation considering individual customer.

GROUP – C
(Long Answer Type Questions)

Answer any *two* of the following. $2 \times 20 = 40$

10. a) Explain the terms : Accuracy, Error and Uncertainty in measurements. What are the types of errors ? 5

b) What do you understand by standard uncertainty and how it is expressed mathematically ? 4

c) In the measurement of thickness of metal a micrometer is used and following data is given :

Micrometer length = 0 – 25 mm

Least count = 0·01 mm

The repeated observations found under the same conditions are

10·25, 10·23, 10·22, 10·26 and 10·19

Calculate Standard Uncertainty in the measurements. 6

d) Define Chebyshev polynomial $T_m(x)$ in the range $- \bullet < x < \bullet$. What are the properties of Chebyshev polynomials ? Give graphical representation of $T_1(x)$ & $T_3(x)$. 2 + 2 + 1

11. a) Define Dirichlet and Neumann boundary conditions. 1 + 1

b) Find the solution $u(x, t)$ of the diffusion of heat in the direction x, $0 < x < \bullet$, using Fourier Transform. Initial conditions are

$$u(x, 0) = 1 \quad \text{for } 1 \le x < 2$$
$$= 0 \quad \text{elsewhere}$$
$$u(0, t) = 0$$

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c) Find the inverse Laplace transform of

$$\frac{S^2 + 2S + 3}{S^2 + 2S + 1}.$$ 4

d) The following circuit is switched ON at time $t = 0$ and had initial capacitor voltage

$v_c(0^-) = 10^{-6}$ volt. Find the output voltage $v_0(t)$ using Laplace transform. 6

12. a) Explain how in each multiple queens to hold date packets in local access networks and hence show the formation of bursts in heavy and light loads with time based algorithm.

b) Discuss the burst size distribution in time based assemble algorithm.

c) Explain the balance equation for the birth-and-death process and sin out the expression for the queuing system.

13. a) Explain the role of the exponential distribution in the queuing system.

b) What is M/M/S model considering S number of servers ? Discuss the variation of P_0 and L with ρ for various value of S.

c) Explain What finite queue variation is on the M/M/S mode known as M/M/S/K model.