REV-00
MSE/05/10 2014/01

M.Sc. ELECTRONICS
First Semester
Engineering Mathematics & Statistics

(MSE-01)

Duration: 3Hrs. **Full Marks: 70**

Part-A (Objective) =20
Part-B (Descriptive)=50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins. **Marks: 50**

1. Answer the following questions (any *five*): **2×5=10**

(a) Find $L\{f(t)\}$ where $f(t)=k$, k is constant and $t \geq 0$

(b) Prove Curl $(u + v)$ = Curl u + Curl v.

(c) Define even and odd function.

(d) Find the Z-transform of $\{(1/2)^{|k|}\}$.

(e) Find, $L\left\{\int_0^t \frac{1-e^{-u}}{u} du\right\}$.

(f) Prove that for any two events A and B in a sample space S,
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

(g) Write applications of Laplace Transform.

2. Answer the following questions (any *five*): **3×5=15**

(a) Prove, $\text{div}(v \text{x} u) = v.\text{Curl}u + u.\text{Curl}v$

(b) Prove that the Fourier transform of the convolution of f and g is the product of their Fourier transform.

(c) If $Z[\{f(k)\}]=F(z)$, then prove that $Z[\{kf(k)\}]=-z\frac{d}{dz}F(z)$.

(d) Prove that Poisson distribution is the limiting case of binomial distribution for every large trail with very small probability. i.e. $f(x; \lambda)=\lim_{\substack{n\to\infty \\ p\to 0}} b(x;n,p)$ such that $\lambda=np$=constant.

(e) Calculate $\int_C F(r(t)).dr(t)$, where $F=[y^2,-x^2]$ and C the straight line from (0, 0) to (1, 4).

(*f*) Find the directional derivative and unit normal vector of f at p in direction of the vector a where, $f = x^2 + y^2 - 25$, $p(1, 1, 1)$ and $a=i+j+k$.

(*g*) If $L\{f(t)\}=F(s)$ then prove that $L\left\{\frac{f(t)}{t}\right\} = \int_s^{\infty} F(u)du$.

3. Answer the following questions (any *five*): **5×5=25**

(*a*) Show that $\iint_S (F.n)ds = 0$, where F represents the velocity of a liquid and S is the surface of the bounded by the plane x=0, x=1; y=0, y=1; z=0, z=1, $F = 4xzi - y^2 j + yzk$.

(*b*) Apply Stoke's theorem to calculate $\int (x+2y)dx + (x-z)dy + (y-z)dz$ where C is the boundary of the triangle with vertices (2, 0, 0), (0, 3, 0) and (0, 0, 6) oriented in the anticlockwise direction.

(*c*) Find the Fourier series representing

$$f(x) = x, \quad 0 < x < 2\pi.$$

(*d*) Find the variance of binomial distribution.

(*e*) Using convolution theorem, obtain the inverse Laplace transform of $\frac{7}{(\lambda - 7)(\lambda^2 + 25)}$.

(*f*) Find Z-transform of $\sin(3k + 5)$.

(*g*) Find the Fourier series of the function,

$$f(x) = \begin{cases} -1 \, for -\pi < x < \frac{-\pi}{2} \\ 0 \, for \frac{-\pi}{2} < x < \frac{\pi}{2} \\ 1 \, for \frac{\pi}{2} < x < \pi \end{cases}$$

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(The figures in the margin indicate full marks for the questions)

Duration: 20 minutes **Marks – 20**

PART A- Objective Type

. Choose the correct answer: **1×20=20**

1. The value of $P(\varphi)$ is
   (a) 0 (b) 1 (c) 0.05 (d) 0.9

2. For any event A of S,
   (a) $P(A^C) \leq 0$ (b) $P(A^C) \leq 1$ (c) $P(A^C) \leq 0.5$ (d) $P(A^C) \leq 0.9$

3. The value of $P(S)$ is, where S is a sample space
   (a) 0 (b) 1 (c) 0.05 (d) 0.9

4. $P(B/A) = ?$
   (a) $\dfrac{P(A \cup B)}{P(A)}$, $P(A) \neq 0$ (b) $\dfrac{P(A \cap B)}{P(A)}$, $P(A) \neq 0$
   (c) $\dfrac{P(A \cup B)}{P(B)}$, $P(B) \neq 0$ (d) $\dfrac{P(A \cap B)}{P(B)}$, $P(B) \neq 0$

5. If Laplace Transform L{$f(t)$}=$F(S)$ then L{$-tf(t)$}=?
   (a) $f(t)$ (b) $F(t)$ (c) $\dfrac{d}{ds}f(s)$ (d) $\dfrac{d}{ds}F(s)$

6. Laplace Transform of unit step function, L{$u(t-a)$}=?
   (a) $\dfrac{e^{-as}}{s}$ (b) $\dfrac{s}{e^{-as}}$ (c) $\dfrac{se^{-as}}{a}$ (d) $\dfrac{ae^{-as}}{s}$

7. (1) Laplace Transform solves non-homogeneous D.E. without the necessity of 1^{st} solving the corresponding homogeneous D.E.
   (2) Laplace Transform is applicable not only to continuous function but also to piecewise continuous function.
   Which of the following options is correct:

   (a) (1) is true (b) (2) is true
   (c) Both (1) and (2) are true (d) Both (1) and (2) are false.

8. If Z[{$f(k)$}]=F(z) then Z[{$kf(k)$}]=?

(a) $-z\frac{d}{dz}F(z)$ (b) $z\frac{d}{dz}F(z)$ (c) $-\frac{d}{dz}F(z)$ (d) $\frac{d}{dz}F(z)$

9. For mutually exclusive events A and B

(a) $P(AUB) = 0$ (b) $P(AUB) = P(A)$ (c) $P(AUB) = P(A)+P(B)$ (d) $P(AUB) = 1$

10. If L^{-1} is the inverse Laplace Transform of Laplace Transform L then $L^{-1}L = LL^{-1}$ is

(a) 1 (b) $\frac{1}{L}$ (c) L (d) L^2

11. Convulution of two functions $f(x)$ and $g(x)$ is

(a) $(f*g)(x) = \int_{-\infty}^{\infty} f(s)g(s)ds$ (b) $(f*g)(x) = \int_{-\infty}^{\infty} f(x-s)g(s)ds$

(c) $(f*g)(x) = \int_{-\infty}^{0} f(x-s)g(s)ds$ (d) $(f*g)(x) = \int_{0}^{\infty} f(x-s)g(s)ds$

12. The value of Curl(grad f) is

(a) 0 (b) 1 (c) grad f (d) Curl f

13. The value of grad f is

(a) 0 (b) 1 (c) Curl(grad f) (d) ∇f

14. The value of div(Curl v) is

(a) 0 (b) 1 (c) div v (d) Curl$v$

15. The value of div(grad f) is

(a) ∇f (b) $\nabla^2 f$ (c) $\nabla^3 f$ (d) $\nabla^4 f$

16. The integral $\int_C F(r).dr$, where $F=[F_1, F_2, F_3]$ is independent of path in domain D if

(a) Curl F=0 (b) div F=0 (c) (a) grad F=0 (d) none of these

17. The value of $\int_C kF.dr$, (k =constant) is

(a) $k\int_C F.dr$ (b) $\frac{1}{k}\int_C F.dr$ (c) $\int_C F.dr$ (d) none of these

18. In Fourier integral $f(x) = \int_0^{\infty}[A(w)Coswx + B(w)Sinwx]dw$ if $f(x)$ is an even function then

(a) $A(w)$=0 (b) $B(w)$=0 (c)$A(w)$=$B(w)$=0 (d) none of these

19. For any two functions f and g, $\nabla(fg)$ is

(a) $\nabla(f+g)$ (b) $\frac{g\nabla f + f\nabla g}{g^2}$ (c) $f\nabla g + g\nabla f$ (d) none of these

20. The directional derivative $D_b f$ of f in the direction of a unit vector b,

(a)$b.\nabla f$ (b) ∇f (c) 0 (d) 1

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