LOGANATHA NARAYANASAMY GOVT. COLLEGE (Autonomous), PONNERI – 601 204
APRIL -2021 SEMESTER EXAMINATIONS
I SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM1J** Title of the Paper : **Real Analysis - I**

Date : **24.06.2021 AN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define a function of bounded variation on $[a, b]$.
2. If f is monotone on $[a, b]$. Prove that f is of bounded variation on $[a, b]$.
3. State Euler's summation formula.
4. Evaluate $\int_{-1}^{1}|x|\,dx$.
5. State the sufficient condition for existence of Riemann-Stieljes integrals.
6. State Second fundamental theorem of integral calculus.
7. State Berstien's theorem.
8. State Tauber's theorem.
9. Define Double sequence.
10. Define Cesaro summability.
11. State any two linear properties of Riemann - Stieltjes integral.
12. Define uniform convergence on sequence of functions.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. If f is continous on $[a, b]$, and if f' exists and is bounded in the interior say $|f'(x)| \le A$ for all x in (a, b) then prove that f is of bounded variation on $[a, b]$.
14. Assume that c ∈ (a, b), prove that $\int_a^c f\,d\alpha + \int_c^b f\,d\alpha = \int_a^b f\,d\alpha$.
15. If f is continous on $[a, b]$ and if α is of bounded variation on $[a, b]$ then prove that $f \in R(\alpha)$ on $[a, b]$.
16. Assume that $\sum a_n\,(z-z_o)^n$ converges for each z in $B(z_o;r)$.Prove the function f defined by the equation $f(z) = \sum_{n=0}^{\infty} a_n(z-z_o)^n \; if \; z \in B(z_o;r)$ has a derivative $f'(z)$ for each z in $B(z_o;r)$ given by $f'(z) = \sum_{n=1}^{\infty} na_n(z-z_o)^{n-1}$.
17. State and Prove Cauchy condition for products.
18. Let α be of bounded variation on [a, b] and assume that $f \in R(\alpha)$ on [a,b] . Then show that $f \in R(\alpha)$ every subinterval [c, d] of [a, b].
19. Assume that $f_n \to f$ uniformly on S. If each f_n is continuous at a point c of S, Prove that the limit function f is also continuous at C.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. Let f be of bounded variation on [a, b]. If x ∈ (a, b], let $V(x) = V_f(a, x)$ and put $V(a) = 0$. Prove that every point of continuity of f is also a point of continuity of V and its converse.
21. State and prove the theorem on integration by parts.
22. Assume that α is increasing on [a, b]. Then prove the following statements are equivalent :
    (i) $f \in R(\alpha)$ on [a, b].
    (ii) f satisfies Riemann's condition with respect to α on [a, b].
    (iii) $\underline{I}(f, \alpha) = \bar{I}(f, \alpha)$.
23. State and Prove Merten's theorem.
24. Let α be of bounded variation on [a,b]. Assume that each term of the sequence $\{f_n\}$ is a real- valued function such that $f_n \in R(\alpha)$ on [a, b] for each n = 1,2,… Assume that $f_n \to f$ uniformly on [a,b] and define
    $g_n(x) = \int_a^x f_n(t) d\alpha(t)$, if x ∈ [a, b] , n =1,2,..
    Then prove (i) $f \in R(\alpha)$ on [a, b] and
    (ii) $g_n \to g$ uniformly on [a, b] where $g(x) = \int_a^x f(t) d\alpha(t)$.

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APRIL -2021 SEMESTER EXAMINATIONS
I SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM1K** Title of the paper : **Ordinary Differential Equations**

Date : **25.06.2021 AN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Find all solutions of $y'' - 4y' + 5y = 0$.
2. Define Wronskian of (φ_1, φ_2).
3. Determine whether the following functions are linearly independent : $\varphi_1(x) = cosx, \varphi_2(x) = sinx$.
4. Find all the real valued solution of $y^4 - y = 0$.
5. Write the Legendre equation.
6. State the existence theorem for variable coefficients.
7. Prove that $P_2(x) = \frac{1}{2}(3x^2 - 1)$.
8. Find the singular point of the equation $x^2y''- 5y' +3x^2y = 0$.
9. Solve: $y' = x^2y$.
10. State Lipschitz condition.
11. Find all the real valued solutions of the equation $y' = x^2y$.
12. State Lipchitz condition.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. State and prove Existence theorem for initial value problem involving second order homogeneous ordinary differential equation with constant coefficients.
14. Find the Wronskian of the solution of the equation $y''' - y'' - y' + y + 1 = 0$.
15. Find the Wronskian of the solution of the equation $y''' - 4y' = 0$.
16. Show that $P_n(-x) = (-1)^n P_n(x)$ and hence $P_n(-1) = (-1)^n$.
17. Find the first four successive approximation of the equation $y' = 1 + xy$, $y(0) = 0$.
18. Find the first four approximations to the solutions of the equation of the problem $y' = 3y + 1$, $y(0) = 2$.
19. One solution of $x^2y'' - xy' + y = 0$ $(x > 0)$ is $\varphi_1(x) = x$ .Find the solution ψ of $x^2y'' - xy' + y = x^2$ satisfying $\psi(1) = 1$, $\psi'(1) = 0$.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. Find all solutions of $y'' - y' - 2y = e^{-x}$.
21. Using Annihilator method find particular solutions of the equation $y'' + y = x\,e^{x}\,cos\,2x$.
22. Prove that $P_n(x) = \frac{1}{2^n\,n!}\frac{d^n}{dx^n}(x^2-1)^n$.
23. Find a solution φ of the form $\varphi(x) = x^r\sum_{k=0}^{\infty} C_k x^k$ (x >0) for the equation $2x^2y'' + (x^2 - x)\,y' + y = 0$.
24. State and prove the necessary and sufficient condition for an equation $M(x,y)dx + N(x,y)dy = 0$ to be exact.

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APRIL -2021 SEMESTER EXAMINATIONS
II SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM2L** Title of the paper : **Classical Dynamics**

Date : **26.06.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. State the principle of work and kinetic energy.
2. Differentiate between scleronomic and rheonomic systems.
3. Express the kinetic energy of a system of particles in terms of the generalized coordinates.
4. What do you mean by ignorable coordinates?
5. State the principle of angular impulse and momentum.
6. What are ignorable coordinates?
7. Define the first and second variation of a function.
8. Define the Hamiltonian function.
9. State modified Hamilton's principle.
10. Define Hamiltonian function and show that it is the same as the Jacobi integral.
11. Define degrees of freedom of a system of N particles.
12. State the necessary and sufficient condition for an augmented function to be stationary.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. State and prove Konig's theorem.
14. Find the differential equation of motion for a spherical pendulum of length l.
15. Obtain the Jacobi integral for a conservative system.
16. Define Rayleigh's dissipation function and explain its usage in the analysis of small oscillations of a natural system.
17. State and prove Hamilton's principle.
18. Derive the Lagrange's equation using Routhian function.
19. Derive the modified Hamilton-Jacobi equation for a conservative holonomic system.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. State and prove principle of virtual work.
21. Derive the standard form of Lagrange's equation for non – holonomic system.
22. State and prove principle of linear impulse and momentum.
23. State and prove the principle of Least action.
24. State and prove Jacobi's theorem.

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APRIL – 2021 SEMESTER EXAMINATIONS
III SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM3I** Title of the paper : **Complex Analysis**

Date : **05.05.2021 AN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define Rectifiable Arcs.
2. Evaluate $\int_{|z|=1} \frac{e^z}{z} dz$.
3. Define the index of the point ‘a’ with respect to the closed curve γ.
4. Define meromorphic function in Ω.
5. State the maximum principle.
6. State schwarz lemma.
7. Define the conjugate differential of du.
8. Show that $a\, logr + b$, where $a\ and\ b$ are constants, is harmonic.
9. State Taylor’s theorem.
10. State Mittag-Leffler theorem.
11. Define Zero of order h.
12. Compute $\int_\gamma\ x\, dz$ where γ is the line segment from 0 to $1 + i$.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. Compute $\int_{|z|=2} \frac{dz}{z^2-1}$ for the positive sense of the circle.
14. State and prove Cauchy integral formula.
15. State and prove Rouche ‘s theorem.
16. State and prove the Mean value property.
17. Prove that $\frac{\pi}{sin\pi z} = \lim_{m\to\infty} \sum_{-m=\infty}^{m=\infty} (-1)^n \frac{1}{z-n}$.
18. State and prove Cauchy Residue theorem.
19. Derive Poisson’s formula.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. If the function $f(z)$ is analytic on R ,then $prove\ that$ $\int_{\partial R} f(z)dz = 0$.
21. Suppose that $\varphi(\zeta)$ is continuous on the arc γ. Then the function $F_n(z) = \int_\gamma \frac{\varphi(\zeta)d\zeta}{(\zeta - z)^n}$ is analytic in each of the regions determined by γ and its derivative is $F'_n(z) = nF_{n+1}(z)$.
22. Evaluate $\int_0^\pi \frac{d\theta}{a+cos\theta}$, $a > 1$.
23. Prove that the function $P_U(z)$ is harmonic for $|z| < 1$. and $\lim_{z\to e^{i\theta_0}} P_U(z) = U(\theta_0)$ Provided that U is continuous at θ_0.
24. State and prove Laurent’s series.

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APRIL -2021 SEMESTER EXAMINATIONS
III SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM3K** Title of the paper : **Differential Geometry**

Date : **07.05.2021 AN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define Osculating plane.
2. Write the Serret- Frenet Formula.
3. Define representation of a surface.
4. Define helicoid.
5. Define Isometric.
6. Define Geodesics.
7. Write Liouville's formula for κ_g.
8. State Minding Theorem.
9. State the Principle curvature.
10. Define Umbilic.
11. Define regular function.
12. What are the second fundamental coefficients of a surface?

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. Calculate the curvature and torsion of the cubic curve given by $\vec{r}=(u,u^2,u^3)$.
14. Find $\sqrt{EG-F^2}$ for the paraboloid $x=u$, $y=v$, $z=u^2-v^2$.
15. Prove that the curves of the family $\frac{v^3}{u^2}=$constant are geodesics on a surface with metric $v^2du^2-2uvdudv+2u^2dv^2$, $(u>0, v>0)$.
16. If $F=0$, prove that the Gaussian curvature $K=-\frac{1}{2H}\left[\frac{\partial}{\partial u}\left(\frac{G_1}{H}\right)+\frac{\partial}{\partial v}\left(\frac{E_2}{H}\right)\right]$, where $H=\sqrt{EG}$.
17. State and prove Rodrigue's formula.
18. A helicoid is generated by the screw motion of a straight line skew to the axis. Find the curve coplanar with the axis which generates the same helicoid.
19. Derive the Second fundamental form.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. State and prove Serret – Frenet formula.
21. State and prove the fundamental existence theorem for space curves.

22. Prove that on the general surface a necessary and sufficient condition that the curve v = c be a geodesic is $EE_2 + FE_1 - 2EF_1 = 0$, where v = c for all values of u.
23. State and prove Gauss – Bonnet theorem.
24. Prove that a necessary and sufficient condition for a surface to be a developable is that its Gaussian curvature shall be zero.

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APRIL - 2021 SEMESTER EXAMINATIONS
IV SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM4I** Title of the Paper : **Functional Analysis**

Date : **05.05.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define Normed linear space.
2. Prove that $|\|x\| - \|y\|| \leq \|x - y\|$.
3. State Hahn-Banach theorem.
4. When do we say that a normed linear space is reflexive?
5. State Banach-Steinhaus theorem.
6. Define Hilbert space.
7. Define orthonormal set.
8. Prove that $\|x + y\|^2 + \|x - y\|^2 = 2\|x\|^2 + 2\|y\|^2$.
9. Define normal operator and unitary operator.
10. Prove that $(T_1T_2)^* = {T_2}^*{T_1}^*$.
11. Define Kronecker delta.
12. Define total matrix algebra of degree n.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. If $o(G) = p^n$,where p is a prime number, Show that $Z(G) \neq (e)$.
14. Let M be a closed linear subspace of a normed linear space N,and let x_0 is a vector not in M. Show that there exists a functional f_0 in N^* such that $f_0(M) = \|x_0\|$ and $f_0(x_0) \neq 0$.
15. State and prove Eisenstein criterion.
16. If x and y are any two vectors in a Hilbert space, then prove that $|(x, y)| \leq \|x\|\|y\|$.
17. Show that the linear transformation T on V is unitary if and only if it takes an orthonormal basis of V into an orthonormal basis of V.
18. If P is a projection on H with range M and null space N,then prove that $M \perp N$ if and only if P is self adjoint.
19. If $T \in A(V)$ is such that $< vT, v >$=0 for all $v \in V$, show that $T = 0$.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. Let M be a closed linear subspace of a normed linear space N.In N/M ,define $\|x+M\| = inf\{\|x+m\| \; ; m\epsilon M \}$ then prove that $N/M$is normed linear space and also prove that N/M is a banach space if N is a banach space.
21. State and prove open mapping theorem.
22. If $\{e_i\}$is an orthonormal set in a Hilbert space H,and if x is an arbitrary vector in H, then prove that $x - \sum(x, e_i)e_i \perp e_j$ for each j.
23. (i) If T is an operator on H for which $(Tx, x) = 0$ for all x,then prove that $T = 0$.

    (ii)If N_1 andN_2 normal operators on a Hilbert space H such that either commutes with the adjoint of the other, then prove that N_1+N_2 and N_1 N_2 are normal.
24. State and prove the spectral theorem.

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APRIL - 2021 SEMESTER EXAMINATIONS
IV SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM4J** Title of the Paper : **Calculus of Variations and Integral Equations**

Date : **06.05.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define a linear functional.
2. Write the Euler-Poisson equation.
3. Find the transversality condition for the functional of the form $v = \int_{x_0}^{x_1} A(x,y)\sqrt{1+y'^2}\,dx$.
4. Find the broken-line extremals of the functional $v = \int_0^a \left(y'^2 - y^2\right)dx$.
5. Write the isoperimetric conditions.
6. Define holonomic constraints.
7. Define a singular integral equation.
8. Define a symmetric kernel and give an example.
9. Write the necessary and sufficient condition for a symmetric L_2-kernal to be degenerate.
10. Write the general solution of the singular integral equation $f(s) = \int_a^s \frac{g(t)}{\left[h(s)-h(t)\right]^\alpha}dt, \quad 0<\alpha<1,$

    where $h(t)$ is strictly monotonically increasing and differentiable in (a,b) and $h'(t)\neq 0$ in (a,b).
11. Write the shortest distance between two points $A(x_0,y_0,z_0)$ and $B(x_1,y_1,z_1)$ on the surface $\varphi(x,y,z)=0$.
12. Find the resolvent kernel $\Gamma(s,t;\lambda)$ for the integral equation,

    $g(s) = f(s) + \lambda\int_0^1 e^{s-t}g(t)\,dt$ with $K_m(s,t) = e^{s-t}$.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. On what curves can the functional $v\left[y(x)\right] = \int_0^1 \left[(y')^2 + 12xy\right]dx$, $y(0)=0$, $y(1)=1$ be extremized?
14. Test for an extremum the functional $\int_0^{x_1} \frac{\sqrt{1+y'^2}}{y}dx$ given that $y(0)=0$ and $y_1 = x_1 - 5$.
15. Find the extremals of the isoperimetric problem $v\left[y(x)\right] = \int_{x_0}^{x_1} y'^2 dx$ given that $\int_{x_0}^{x_1} y\,dx = a$, where a is a constant.
16. Solve the homogeneous Fredholm integral equation $g(s) = \lambda\int_0^1 e^{s+t}g(t)\,dt$.
17. Solve the integral equation $s = \int_0^s \frac{g(t)}{(s-t)^{1/2}}dt$.

18. Determine the extremal of the functional $v\left[y(x)\right]=\int_0^1\left[720x^2y-(y'')^2\right]dx$ that satisfies the conditions,

$y(0)=y'(0)=y(1)=0,\ y'(1)=6$.

19. Evaluate the resolvent kernel for the integral equation $g(s)=f(s)+\lambda\int_0^s e^{s-t}g(t)\,dt$.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. Find the extremals of the functional $v\left[y(x),z(x)\right]=\int_0^{\pi/2}\left(y'^2+z'^2+2yz\right)dx$, $y(0)=0$, $y\left(\frac{\pi}{2}\right)=1$,

$z(0)=0$, $z\left(\frac{\pi}{2}\right)=-1$.

21. Find the extremal distance between two surfaces $z=\varphi(x,y)$ and $z=\psi(x,y)$.

22. Find the extremals of the isoperimetric problem $v\left[y(x)\right]=\int_0^1\left(y'^2+x^2\right)dx$ given that $\int_0^1 y^2dx=2$,

$y(0)=0,\ y(1)=0$.

23. Solve $g(s)=e^s-\frac{1}{2}e+\frac{1}{2}+\frac{1}{2}\int_0^1 g(t)\,dt$ by the method of successive approximations.

24. Solve the symmetric integral equation $g(s)=s^2+1+\frac{3}{2}\int_{-1}^{1}\left(st+s^2t^2\right)g(t)\,dt$.

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APRIL - 2021 SEMESTER EXAMINATIONS
IV SEMESTER – M.Sc., MATHEMATICS

Paper Code : **17PGM4K** Title of the Paper : **Fluid Dynamics**

Date : **07.05.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define stream lines.
2. Define velocity potential
3. Define equipotential surfaces.
4. What is meant by Pitot tube?
5. Define simple sink.
6. Examples of axi-symmetric flows.
7. Define two dimension flow.
8. Write the Cauchy Riemann equations.
9. What is laminar flow?
10. Write the components of stress parallel to the axes.
11. Write the six components of rate of strain.
12. What are different Types of Vortices?

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. Derive the equation of Continuity.
14. A long pipe is of length l and has slowly tapering cross section. It is inclined at angle α to the horizontal and water flows steadily through it from the upper to the lower end. The section at the upper end has twice the radius of the lower end. At the lower end, the water is delivered at atmospheric pressure. If the pressure at the upper end is twice atmospheric, find the velocity of delivery.
15. Find the stoke's stream function for a uniform stream.
16. State and prove the Milne-Thomson Circle theorem.
17. Discuss the translational motion of fluid element.
18. Test whether the motion given q = $\frac{k^2(xj - yi)}{x^2+y^2}$ (k –constant) is a possible motion for an incompressible.
19. Discuss the flow due to a uniform line doublet at O of strength μ per unit length, its axis being along $\widetilde{OX}$.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. Test whether the motion given by $q = \frac{k^2(xj - yi)}{x^2+y^2}$ is a possible motion of incompressible fluid. If so determine the equation of streamline.
21. Derive Bernoulli's equation of motion.
22. Find the Stoke's stream function for a uniform line source along $\overset{\frown}{OZ}$.
23. A vortex circulation 2πR is at rest at the point z = na(n>1) in the presence of a plane circular boundary |z|=a around which there is a circulation 2πλk. Show that $\lambda = \frac{1}{n^2 - 1}$.
24. Find the relation between stress and rate of strain.

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APRIL – 2021 SEMESTER EXAMINATIONS
II SEMESTER – M.Sc., MATHEMATICS

Paper Code : **20PG2EC** Title of the paper : **Extra Disciplinary Course: Physics for Competitive Examinations – I**
(Register No : 001 To 024)

Date :**29.06.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)
Answer Any **TEN** Questions from the following

1. Why is the binary number system used in computer?
2. Convert binary into hexa decimal.
3. List the names of universal gates. Why it is named so?
4. Give the truth table of subtractor.
5. What is D flip flop?
6. Define sequential circuit.
7. What is amplitude?
8. Define frequency modulation.
9. What is the necessity of cladding for an optical fiber?
10. Define acceptance angle.
11. What is meant by satellite communication?
12. State the absorption law of Boolean algebra.

PART – B (5 X 5 = 25 Marks)
Answer Any **FIVE** Questions from the following

13. Explain, with illustration, the method of conversion from decimal to binary numbers.
14. Prove that ABC + ABC' + AB'C + A'BC = AB + AC + BC.
15. Explain shift register.
16. Write a note on detector of signals.
17. Describe the telemetry of a satellite communication system with neat diagram.
18. Write a note on BCD counter.
19. Mention the applications of fiber optic communication system.

PART – C (3 X 10 = 30 Marks)
Answer Any **THREE** Questions from the following

20. Convert:
    a) Binary number 1 1 0 1 1 1 1 0 into its decimal.
    b) Binary number in decimal form represented by 101101.10101 to decimal.
    c) Perform 2s complement subtraction of 010110-100101.
    d) hexadecimal number E3FA to binary.
    e) Octal number 643_8 to binary.
21. Prove that NAND and NOR are Universal gates.
22. Describe the R-S flip flop and explain its operation, giving truth table. Why is R = 1, S= 1 disallowed in an R-S flip flop?
23. Explain in detail frequency and phase modulation.
24. Discuss the Tracking and Command facilities of a satellite system with a neat diagram.

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APRIL - 2021 SEMESTER EXAMINATIONS

II SEMESTER – M.Sc., MATHEMATICS

Paper Code : **20PG2ED** Title of the Paper : **Extra Disciplinary Course: Hardware and Networking**

(Register No : 025 To 048)

DATE **: 29.06.2021 FN** Time : **3 Hours** Maximum Marks : **75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer any **TEN** Questions from the following

1. Define: “Hardware”.
2. Write a note on DVD.
3. Define the term “BIOS”.
4. What do you mean by Internetwork?
5. Mention the key elements of a protocol.
6. Write down the classification of network.
7. What is twisted-pair cable?
8. Mention the types of errors in error detection and correction.
9. Define: “Multiplexing”.
10. What is circuit switching?
11. What are the functions of transparent bridges?
12. Define the term “Gateway”.

PART – B (5 X 5 = 25 Marks)

Answer any **FIVE** Questions from the following

13. Summarize the main Components of computer.
14. Describe the different functions of motherboard.
15. What are the components of data communications? Explain.
16. Elaborate the various categories of networks.
17. Distinguish between the parallel transmission and serial transmission.
18. Explain the frequency-division multiplexing with neat diagram.
19. Write down the repeater connects segments of a LAN.

PART – C (3 X 10 = 30 Marks)

Answer any **THREE** Questions from the following

20. What are the different types of floppy drive? Explain.
21. Draw and explain the various types of layers in the OSI model.
22. Illustrate the purpose of coaxial cable with neat diagram.
23. Compare the packet switching and message switching.
24. Discuss the complete architecture of WWW.

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LOGANATHA NARAYANASAMY GOVT. COLLEGE (Autonomous), PONNERI – 601 204
APRIL – 2021 SEMESTER EXAMINATIONS
II SEMESTER – M.Sc., MATHEMATICS

Paper Code : **20PGE2A** Title of the paper : **Discrete Mathematics**

Date : **28.06.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define disjunction and write truth table for disjunction.
2. Write in symbolic form the statement "*The crop will be destroyed if there is a food*".
3. Define functionally complete set.
4. Define string of formulae.
5. Explain rule of specification.
6. Define lattices as algebraic systems.
7. Define order-isomorphic and order preserving.
8. When we say that directed graph is weekly connected.
9. State shortest path algorithms.
10. Give an example of a graph which contains
    (i) an Eulerian circuit that is also a Hamiltonian circuit.
    (ii) an Eulerian circuit but not a Hamiltonian circuit.
11. Define tree and give an example.
12. State any two properties of trees.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. Explain the procedure to obtain the disjunctive normal form of a given formula.
14. Show that $R\wedge(P\vee Q)$ is a valid conclusion from the premises $P\vee Q, Q\to R, P\to M$, and $\neg M$
15. State and prove the distributive inequalities in lattice.
16. If $\langle L,\leq\rangle$ is a lattice, then for any a, b, c $\in$L, prove that $a\leq c \Leftrightarrow a\oplus(b*c)\leq(a\oplus b)*c$.
17. Explain Dijkstra's algorithm.
18. Explain Konigsberg bridge problem. Represent the problem by means of a graph. Does the problem have a solution?
19. Prove that the number n of vertices of a full binary tree is odd and the number of pendant vertices of the tree is equal to $\frac{(n+1)}{2}$.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

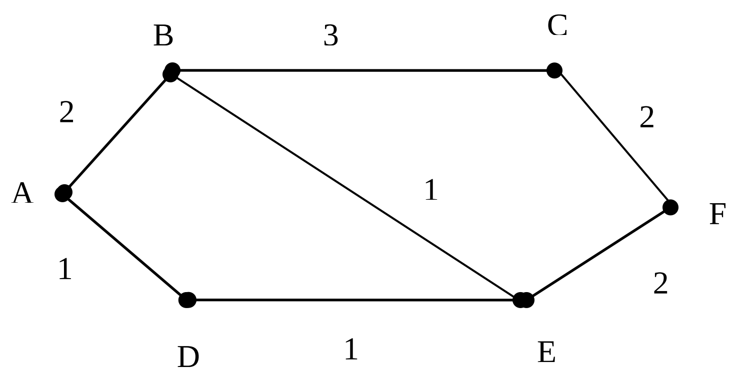
20. Show that the following are equivalent formulas:
    (a) $P\vee(P\wedge Q)\Leftrightarrow P$
    (b) $P\vee(\neg P\wedge Q)\Leftrightarrow P\vee Q$
21. Show that $(x)(P(x)\vee Q(x))\Rightarrow(x)P(x)\vee(\exists x)Q(x)$.

22. (a) State and prove Demorgan's laws in Boolean algebra.

(b) Explain the following terms:

(*i*) Direct product of two Boolean algebras (*ii*) Lattice Homomorphism.

23. Find the shortest distance matrix and the corresponding shortest path matrix for all the pairs of vertices in the undirected graph given below, using Warshall's algorithm.



24. Explain Prim's algorithm and Kruskal's algorithm.

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APRIL – 2021 SEMESTER EXAMINATIONS
II SEMESTER – M.Sc., MATHEMATICS

Paper Code : **20PGM2A** Title of the paper : **Algebra II**

Date :**23.06.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define algebraic over F.
2. Define algebraic number.
3. Define splitting field over F.
4. State Remainder's theorem.
5. Define simple extension of F.
6. Prove that the fixed field of G is a subfield of K.
7. Define normal extension of F.
8. Prove that any two finite fields having the same number of elements are isomorphic.
9. Let K be a field and let G be a finite subgroup of the multiplicative group of non-zero elements of K, then prove that G is a cyclic group.
10. Define solvable group.
11. Define Galois group.
12. Define a root of $p(x)$.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. If L is an algebraic extension of K and if K is an algebraic extension of F, then prove that L is an algebraic extension of F.
14. If F is a field and $f(x)$, $g(x) \in \mathrm{F}[x]$ and $\alpha \in F$ then show that,

$$(i)\left[f(x)+g(x)\right]' = f'(x)+g'(x)$$

$$(ii)\left[\alpha f(x)\right]' = \alpha f'(x)$$

$$(iii)\left[f(x)g(x)\right]' = f'(x)g(x)+f(x)g'(x).$$

15. Let $f(x) \in F[x]$ be of degree $n \geq 1$. Then prove that there is an extension E of F of degree at most $n!$ in which $f(x)$ has n roots.
16. Prove that if K is a normal extension of F if and only if K is the splitting field of some polynomial over F.
17. For every prime number p and every integer m then prove that there exists a field having p^m elements
18. Prove that the general polynomial of degree $n \geq 5$ is not solvable by radicals.
19. If F is a finite field, $\alpha \neq 0$ and $\beta \neq 0$ are two elements of F then prove that we can find elements a and b in F such that $1+\alpha a^2+\beta b^2 = 0$.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. If K is a finite extension of F and L is a finite extension of K, then prove that L is a finite extension of F and $\left[L:F\right]=\left[L:K\right]\left[K:F\right]$
21. If F is of characteristic 0 and if a, b are algebraic over F, then prove that there exists an element $c\in F\left(a,b\right)$ such that $F\left(a,b\right)=F\left(c\right)$.
22. State and prove the fundamental theorem of Galois theory.
23. State and Prove Wedderburn's theorem on finite division rings.
24. If $p\left(x\right)\in F\left[x\right]$ is solvable by radicals over F, then prove that the Galois group over F of $p\left(x\right)$ is a solvable group.

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APRIL – 2021 SEMESTER EXAMINATIONS
II SEMESTER – M.Sc., MATHEMATICS
Paper Code : **20PGM2B** Title of the paper : **Real Analysis II**
Date : **24.06.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Define Lebesque outer measure.
2. When do you say that a set E is measurable? Show that if $m^*(E) = 0$, E is measurable.
3. Show that $\int_1^\infty \frac{dx}{x} = \infty$.
4. Define Simple function.
5. Define Orthonormal system.
6. Define Fourier series of f relative to S.
7. Define Jacobian matrix.
8. If $\boldsymbol{f}$ is differentiable at **c**, show that $\boldsymbol{f}$ is continuous at **c.**
9. Define Saddle point.
10. State Inverse function theorem.
11. Define Gradient vector of $\boldsymbol{f}$ at **c.**
12. State Fatou's lemma.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. Prove that the outer measure of an interval equals its length.
14. Let f and g be non-negative measurable functions. Then prove that $\int f dx + \int g dx = \int (f + g) dx$.
15. State and prove Riemann Lebesque lemma.
16. Prove that if both partial derivatives $D_r f$ and $D_k f$ exist in an n-ball $B(c; \delta)$ and if both are differential at c then $D_{r,k} f(c) = D_{k,r} f(c)$.
17. State Second derivative test for extrema.
18. State and prove Mean value theorem.
19. State and prove Dini's theorem.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. Show that the class of all Lebesgue measurable sets is σ – algebra.
21. State and Prove Lebesque's Monotone Convergence theorem.
22. State and prove Riesz Fischer theorem.
23. State and prove chain rule.
24. State and prove Implicit function theorem.

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APRIL – 2021 SEMESTER EXAMINATIONS
II SEMESTER – M.Sc., MATHEMATICS

Paper Code : **20PGM2C** Title of the paper : **Partial Differential Equations**

Date : **25.06.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Form the PDE by eliminating the arbitrary function from $z = f\left(\frac{xy}{z}\right)$.
2. Form the PDE by eliminating the arbitrary constant from $z = (x^2 + a)(y^2 + b)$.
3. Find the complete integral of the Partial Differential Equations $\sqrt{p} + \sqrt{q} = 1$.
4. Define the order of the PDE and give the example of third order PDE.
5. Classify the partial differential equation $3u_{xx} + 10u_{xy} + 3u_{yy} = 0$.
6. Solve : $(D^3 - 3D^2D' + 4D'^3)u = 0$.
7. Write the Robin's boundary condition in diffusion equation.
8. Define Dirac delta function.
9. Define wave function.
10. Write the Riemann-Volterra solution for the non-homogeneous wave equation.
11. Explain the method of images.
12. Write the Poisson integral formula.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. Find the general integral of the linear PDE $y^2p - xyq = x(z - 2y)$.
14. Show that the following Partial Differential Equations $xp - yq = x$ and $x^2p + q = xz$ are compatible.
15. Solve : $(D^2 - 4DD' + 4D'^2)u = e^{2x+y}$.
16. Let $f(t)$ be any continuous function ,then prove that $\int_{-\infty}^{\infty} \delta(t-a)f(t)dt = 0$.
17. Derive the D'Alembert's solution of one-dimensional wave equation.
18. Show that the Green's function $G(r, r')$ has the symmetric property.
19. Find the solution of $(D^2 + DD' - 6D'^2)u = ycosx$.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. Find the complete integral of $(p^2 + q^2)y = qz$.
21. Reduce the partial differential equation $u_{xx} - 2\sin x\, u_{xy} - cos^2 x u_{yy} - \cos x\, u_y = 0$ to a canonical form.
22. Solve the one-dimensional diffusion equation in the region $0 \le x \le \pi, t \ge 0$ subject to the conditions

    (i) T remains finite as $t \to \infty$

    (ii) $T = 0$,if $x = 0$ and π for all t.

    (iii) At $t = 0, T = \begin{cases} x, 0 \le x \le \frac{\pi}{2} \\ \pi - x, \frac{\pi}{2} \le x \le \pi \end{cases}$

23. A stretched string of finite length L is held fixed at its ends and is subjected to an initial displacement $u(x,0) = u_0 \sin\left(\frac{\pi x}{L}\right)$.The string is released from this position with zero initial velocity.Find the resultant time dependent motion of the string.

24. Determine the Green's function for the Dirichlet problem for a circle given by,

$$\nabla^2 u = 0 \quad r < a$$

$$u = f(\theta) \text{ on } = a \text{ .}$$

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APRIL – 2021 SEMESTER EXAMINATIONS
II SEMESTER – M.Sc., MATHEMATICS

Paper Code : **20PGM2D** Title of the paper : **Classical Dynamics**

Date : **26.06.2021 FN** Time : **3 Hours** Maximum Mark:**75 Marks**

PART – A (10 X 2 = 20 Marks)

Answer Any **TEN** Questions from the following

1. Write down the holonomic and non – holonomic constraints.
2. State the Principle of conservation of energy.
3. Define Routhian function.
4. State Kepler's problem.
5. Define Hamilton's Principle.
6. State Euler – Lagrange equation.
7. Define Pfaffian differential forms.
8. State Stackel's theorem.
9. Define Point transformation.
10. Define Poisson brackets.
11. Define Lagrange's brackets.
12. Define configuration space.

PART – B (5 X 5 = 25 Marks)

Answer Any **FIVE** Questions from the following

13. Define D'Alembert's Principle and obtain its Lagrangian form.
14. Derive Lagrange's equation for holonomic system
15. Discuss Kepler's Problem using ignorable co-ordinates.
16. Find the stationary values of the function $f = z$ subject to the constraints,
    $x^2 + y^2 + z^2 = 4 \; and \; xy = 1.$
17. Using the Jacobi form of the Principle of least action, obtain the path of a projectile is a uniform gravitational field.
18. Prove Stackel's theorem.
19. Derive the relationship between Lagrange and Poisson brackets.

PART – C (3 X 10 = 30 Marks)

Answer Any **THREE** Questions from the following

20. A particle of mass m is suspended by a massless wire of length $r = a + bcos\omega t \;\; (a > b > 0)$ to form a spherical Pendulum. Find the equation of motion.
21. Derive Lagrange's equation for non – holonomic system.
22. Obtain the path of the shortest length between two points in the two – dimensional surface of a sphere of radius r.
23. State and Prove Jacobi's theorem.
24. Prove that the transformation $Q = log\left(\frac{sinp}{q}\right), P = q\;cotp$ is canonical form and obtain the four major types of generating functions associated with transformations.

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