Course Code: MPH 1101

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

M. Sc. 1st Semester [01PG011]

Physics

Mathematical Physics-I

Time: 2 Hrs. **Max. Marks: 50**

Note:

Section A (20 marks)

Answer any 4 questions [04 x 05 marks=20 marks]

			M	CO	KL
1	a.	Prove that A= $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ is an orthogonal matrix.	5	CO1	K1
	b.	Compute the adjoint of $\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$	5	CO1	K2
	c.	Find whether the $f(x) = x^2y^2$ is analytic or not?	5	CO2	K3
	d.	Define Singularity and types of Singularity of a function. Find the poles or singularity of the following functions: (i) $\frac{1}{(z-2)(z-3)}$ (ii) $\frac{1}{\sin z - \cos z}$	5	CO2	K1
	e.	Find the product of the eigen value of the matrix $\begin{bmatrix} 3 & -3 & 3 \\ 2 & 1 & 1 \\ 1 & 5 & 6 \end{bmatrix}$	5	CO1	K2

Section B (30 marks)

Answer any 3 questions [03 x 10 marks=30 marks]

			M	CO	KL
2	a.	If A = $\begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$ find A^{-1}.	10	CO1	K3
	b.	Derive Cauchy Rieman equations and prove that $f(z) = z^2$ is analytic.	10	CO2	K2
	c.	Prove Laurent's theorem.	10	CO2	K3
	d.	Derive Cauchy's Integral theorem and find the integral $\int_C \frac{3z^2+7z+1}{z+1} dz$ where C is the circle $\|z\| = \frac{1}{2}$	10	CO2	K2

Course Code: MPH 1102

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

M.Sc. (Physics) 1st Semester [03PG011]

Department of Physics, School of Science

Classical Mechanics

Time: 2 Hrs. **Max. Marks: 50**

Note:

			M	CO	KL
Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]					
1	a.	Consider $L = \frac{1}{2}m\dot{r}^2 + \frac{P_\theta^2}{2m^2} - \frac{1}{2}kr^2$. Find out the equation of motion using Hamilton's canonical equations.	5	CO2	K2
	b.	Discuss canonical momentum and cyclic coordinates. Prove that generalized momentum conjugate to a cyclic coordinate is conserved.	5	CO1	K2
	c.	Consider a particle moving on real line. Suppose the dynamics of this particle is determined by Hamiltonian H = $\frac{q^4p^2}{2\mu} + \frac{\lambda}{q^2}$ Find a Lagrangian of this system.	5	CO2	K2
	d.	Derive Newton's 2nd law using Hamilton's theorem.	5	CO1	K2
	e.	Prove that generalized momentum conjugate to a cyclic coordinate is conserved.	5	CO1	K2
Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]					
2	a.	State Hamilton's principle. Derive Lagrange's equations of motion using Hamilton's principle.	10	CO1	K3
	b.	Derive Hamilton's canonical equation of motion.	10	CO2	K3
	c.	Determine the Hamiltonian of a charge particle moving under electromagnetic field.	10	CO2	K3
	d.	Consider a particle of mass m moving under a central force. If (r, θ) be the polar coordinates find out the equations of motion of the system.	10	CO1	K3

Course Code: **SOS-B- MPH 1103**

O P JINDAL UNIVERSITY

Mid Semester Examination, Oct.-2023

M.Sc. 1ST Semester

STATISTICAL MECHANICS

Time: 2 Hrs.

Max. Marks: 50

Note:

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	Explain Entropy and Thermodynamic Probability. Also, Prove that S = K log W.	05	CO-1	K3
	b.	Define Gibbs Paradox. Give an expression for it.	05	CO-1	K3
	c.	Define the Partition function and derivation for it.	05	CO-3	K1
	d.	Define the Postulates of Statistical Mechanics.	05	CO-1	K1
	e.	Define Phase Space and its Types.	05	CO-1	K1
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Prove that the mean square fluctuations in the energy in the grand canonical ensemble are equal to the value it would have in the canonical ensemble plus a contribution arising from the fact now the particle number N is also fluctuating.	10	CO-3	K3
	b.	What do you understand about Phase Space? State and Prove Liouville's Theorem.	10	CO-1	K2
	c.	Define Ensemble. What are the three types of Ensembles? Also, derive an expression for Partition Functions	10	CO-3	K2
	d.	Derive an expression for the Partition Function of Maxwell's Boltzmann Statistics.	10	CO-3	K3

Course Code: MPH 1104

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

M.Sc. 1st Semester [Program Code: 03PG011]

Physics

Electronics

Time: 2 Hrs. **Max. Marks: 50**

Note:

			M	CO	KL
Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]					
1	a.	Write a short note on differential amplifier. Find the output voltage formula for differential amplifier.	5	CO 1	K2
	b.	What is output offset voltage, input offset voltage and input offset current.	5	CO 1	K2
	c.	(i) What is CMRR. (ii) What is thermal drift.	5	CO 1	K2
	d.	(i) Prove that operational amplifier as integrator. (ii) Prove that operational amplifier as differentiator.	5	CO 1	K2
	e.	(i) State De Morgan's theorem. (ii) Write the advantages and disadvantages of C-MOS.	5	CO 2	K2
Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]					
2	a.	Explain about ECL. Write its characteristics, advantages and disadvantages of ECL.	10	CO 2	K3
	b.	What do you mean by unipolar logic families. Describe about P-MOS. Write the applications, advantages and disadvantages of P-MOS.	10	CO 2	K3
	c.	What do you mean by wave form generator. Discuss about types of wave form generator and its applications.	10	CO 2	K3
	d.	(i) Discuss frequency response of operational amplifier. (ii) Write the applications of operational amplifier.	10	CO 1	K3

Course Code: MCH 1101

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

M.Sc. Chemistry 1st Semester (03PG012)

INORGANIC CHEMISTRY-I

Time: 2 Hrs. **Max. Marks: 50**

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	Write the postulates and limitations of VSEPR theory.	5	1	1
	b.	Determine the geometry of XeO_2F_2 and $POCl_3$.	5	1	2
	c.	Explain ***dsp²*** hybridization diagrammatically.	5	1	1
	d.	Determine the number and type of π-bond in SO_3 and CO_3^{2-}.	5	1	1
	e.	How charge by size ratio of metal ion effect the stability of metal complexes?	5	2	2
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Define Bent's rule with its application on bond angle and bond length.	10	1	2
	b.	Define hybridization? Explain ***sp³d***, ***sp³d²*** and ***sp³d³*** type of hybridization with the help of examples.	10	1	1
	c.	Explain the stepwise and overall formation constant with example and also define the relation between them.	10	2	2
	d.	Explain the factors affecting the stability of metal complexes with respect to ligands (only five factors).	10	2	2
	e.	Define Chelation in coordination complexes. Explain the thermodynamic aspect of stability in metal complexes due to chelation.	10	2	2

cCourse Code: MCH1102

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

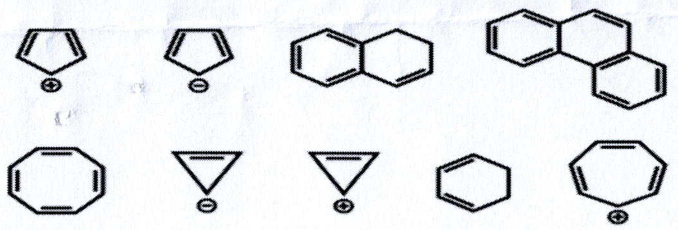
M.Sc. 1st Semester [Program Code: 03PG012]

Department of Chemistry

Organic Chemistry

Time: 2 Hrs. **Max. Marks: 50**

Note: All Questions are compulsory

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	The given compound is aromatic or non-aromatic, explain. 	5	CO 1	2
	b.	How will you differentiate resonance and tautomerism with suitable examples?	5	CO 3	1
	c.	Cyclopentadiene exhibits more acidic character as compared to cycloheptatriene. Explain.	5	CO 2	2
	d.	Explain why overall energy of two bonding butadiene molecular orbital is lower than that of two molecular orbitals for ethane?	5	CO 2	1
	e.	Resonance energy of benzene is much higher than 1,3-butadiene. Why?	5	CO 2	1
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Explain why energy of half chair conformation of cyclohexane is higher than chair, boat and twist boat conformation ?	10	CO 3	2
	b.	Despite of more angular strain in cyclohexane compared to cyclo-pentane, cyclo-hexane exhibit more stable conformation. Explain why?	10	CO 1	1
	c.	Heat of hydrogenation of cyclohexane to cyclohexene is -28.6 kcal/mole. The observed heat of hydrogenation of benzene to cyclohexane is -49.8 kcal/mole. Find out the resonance energy of benzene?	10	CO 2	3
	d.	Explain delocalized chemical bonding on the basis of VBT and MOT	10	CO 1	2

Course Code: MCH 1103

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

OPJU

M.Sc. 1st Semester [03PG012]

Chemistry

PHYSICAL CHEMISTRY -I

Time: 2 Hrs. **Max. Marks: 50**

Note:

			M	CO	KL
Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]					
1	a.	To write "Conservation of Energy" law and 3rd law of thermodynamics.	5	1	1
	b.	What is equilibrium constant ? Discuss temperature-dependence of equilibrium constant.	5	1	2
	c.	To derive Maxewell relation from internal energy.	5	1	2
	d.	To derive Helmholtz and Gibbs free energies.	5	1	2
	e.	Proof that S = K log W	5	5	2
Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]					
2	a.	To derive Maxwell relations of thermodynamics.	10	1	2
	b.	What is second law of thermodynamics? To write System, surrounding and thermodynamic process.	10	1	1
	c.	Derive an expression for partition function of Bose Einstein statistics.	10	5	2
	d.	Distinguish between Maxwell – Boltzmann, Bose- Einstein and Fermi-Dirac statistics.	10	5	2

Course Code: MMA-23-1105

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

M.Sc. Mathematics 1st Semester [Program Code: 03PG013]

Introduction to Python

Time: 2 Hrs. **Max. Marks: 50**

Section A (20 marks)

Answer any 4 questions [04 x 05 marks=20 marks]

			M	CO	KL
1	a.	Write a program to accept the number from a user and find the factorial of a number using a function.	5	1	1
	b.	Write a program to read a temperature in Celsius from the user and Convert it into Fahrenheit.	5	1	1
	c.	Write a program to check whether the number entered is an Armstrong number or not. **153 = $1^3+5^3+3^3$**	5	2	1

	d.	Write a program to display the pattern of stars given as follows:
		`    *`
		`   * * *`
		`  * * * * *`
		` * * * * * * *`
		`* * * * * * * * *`
			5	2	1

	e.	Write a Python program to read the marks of 5 subjects through the keyboard. Calculate the total marks, percentage and grade of marks obtained by the student. Assume maximum marks that can be obtained by a student in each subject us calculate the total marks, percentage and grade of a student.	5	2	1

Section B (30 marks)

Answer any 3 questions [03 x 10 marks=30 marks]

			M	CO	KL
2	a.	Explain looping control statements in Python with syntax and example to each.	10	2	2
	b.	Describe Operator. What are the types of operators in Python? Explain the types of Operator in detail.	10	1	2
	c.	Explain the function of Python and describe it with syntax and example. What are the types of arguments in Python function definition in detail?	10	3	2
	d.	Explain Data Types in Python and describe them with syntax and example. What are the types of Data Type in Python? Explain in detail.	10	1	2

Course Code: MMA-23-1101

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

M.Sc. 1st Semester (03PG013)

Mathematics

Real Analysis

Time: 2 Hrs. **Max. Marks: 50**

Note:

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	Define Metric Space and Show that if $d: R \times R \rightarrow R$ be defined as $d(x, y) = \frac{\lvert x-y \rvert}{1+\lvert x-y \rvert}$ then (R,d) is Metric Space.	5	2	2
	b.	Show that every convergence sequence in metric space converge to a unique limit.	5	2	2
	c.	Write Formula for Continuity and check Continuity of the given Function at x=0 $f(x) = x \sin\frac{1}{x}, \ f(0) = 0$	5	1	2
	d.	Check Continuity of the given function at x=0 $f(x) = \frac{e^{\frac{1}{x}}}{1+e^{\frac{1}{x}}}$	5	1	2
	e.	If A and B are Separated Set of (X,d) and $A \cup B$ is closed set then show that A and B are closed.	5	2	2
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Prove that in Metric Space every Closed Sphere is Closed Set.	10	2	3
	b.	If A be a subset of Metric Space (X,d) then prove that (a) $A^0 \subseteq A$ (b) A^0 is Open Set. (c) A is open if and only if $A^0 = A$	10	2	3
	c.	Define Cantor Set and Prove that if P is Cantor Set ,then it is (a) Compact Set ,(b) Perfect Set	10	2	3
	d.	Define Complete Metric Space and if (X,d) be a Metric Space and Y be a subspace of X then prove that Y is Complete if and only if Y is Closed.	10	2	3

Course Code: MMA-23-1102

OP JINDAL UNIVERSITY

Mid Semester Examination, November-2023

M.Sc. First Sem

Offers to M. Sc. (Mathematics and Computing)

ADVANCED ALGEBRA

Time: 2 Hrs. **Max. Marks: 50**

Note:

Section A (20 marks)

Answer any 4 questions [04 x 05 marks=20 marks]

			M	CO	KL
1	a.	Prove that the necessary and sufficient condition for a non-empty subset W of a vector space V (F) to be a vector space V is $a,b \in F$ and $\alpha,\beta \in W \Rightarrow a\alpha + b\beta \in W$.	5	CO1	2
	b.	State and Prove Triangle Inequality and Parallelogram Law for an inner product space.	5	CO2	2
	c.	Find the Range, Null Space, Rank and Nullity of T, if **T: $\mathbf{R}^2$ -> $\mathbf{R}^3$** defined by **T (a, b) = (a-b, b-a, -a).**	5	CO1	2
	d.	Prove that the intersection of any two subspace of a vector space V (F) is also a subspace of V (F).	5	CO1	2
	e.	If W is a subspace of a finite dimensional vector space V(F), then prove that $\dim \frac{V}{W} = \dim V - \dim W$.	5	CO2	1

Section B (30 marks)

Answer any 3 questions [03 x 10 marks=30 marks]

			M	CO	KL
2	a.	Define Skew Hermitian Matrix with suitable example. Find the Eigen Value and Eigen Vector of the given matrix: $A=\begin{bmatrix} 3 & 2 & 4 \\ 2 & 0 & 2 \\ 4 & 2 & 3 \end{bmatrix}$.	10	CO1	2
	b.	Find the matrix representation of linear transformation T on $V_3(R)$ defined as T(a, b, c)=(2b+c, a-4b, 3a) on the basis B={(1,1,1), (1,1,0), (1,0,0)}.	10	CO1	2
	c.	Show that the following matrix A is diagonalizable $A=\begin{bmatrix} -3 & 4 \\ 2 & -1 \end{bmatrix}$.	10	CO2	2
	d.	Reduce the quadratic form A(x,x)= X'AX to canonical form where $A=\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.	10	CO2	2

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Course Code: MMA-23-1103

OP JINDAL UNIVERSITY

OPJU University of Steel Technology and Management

Mid Semester Examination, November-2023

M.Sc. 1st Semester [Program Code: 03PG013]

Mathematics

Advanced Differential Equation

Time: 2 Hrs. **Max. Marks: 50**

Note:

			M	CO	KL

Section A (20 marks)

Answer any 4 questions [04 x 05 marks=20 marks]

			M	CO	KL
1	a.	Illustrate by an example that a continuous function may not satisfy a Lipschitz condition on rectangle.	5	CO 1	K2
	b.	Consider $f(x,y) = x^3\|y\|$. Prove that f satisfies a Lipschitz condition on $R: \|x\| \leq 2,\ \|y\| \leq 2$ eve[n] though $\frac{\partial f}{\partial y}$ does not exist at $(x,0)$ if $x \neq 0$.	5	CO 1	K2
	c.	Define orthogonal set of functions with respect to a weight function and orthonormal set of function[s] with respect to a weight function.	5	CO 2	K1
	d.	For the initial value problem $\frac{dy}{dx} = y^2 + cos^2 x,\ y(0) = 0$, determine the interval of existence of it[s] solution given that R is the rectangle containing origin, $R: \{(x,y): 0 \leq x \leq a,\ \|y\| \leq b,\ a > \frac{1}{2},\ b > 0\}$.	5	CO 1	K1
	e.	Show that the set of functions $\{cosnx\},\ n = 0,1,2,3,\ldots$ is orthogonal on the interval $-\pi \leq x \leq \pi$ and find the corresponding orthonormal set of functions.	5	CO 2	K1

Section B (30 marks)

Answer any 3 questions [03 x 10 marks=30 marks]

			M	CO	KL
2	a.	State and prove Cauchy-Peano existence theorem.	10	CO 1	K2
	b.	Find all eigenvalues and eigenfunctions of the Strum-Liouville problem $X'' + \lambda X = 0,\ X(0) = 0,\ X'(\frac{\pi}{2}) = 0$.	10	CO 2	K2
	c.	Find the third approximation of the solution of the equation $\frac{d^2y}{dx^2} = x^3(y + \frac{dy}{dx})$, where $y = 1$ and $\frac{dy}{dx} = \frac{1}{2}$ when $x = 0$.	10	CO 1	K2
	d.	Define periodic boundary conditions. Attempt to find the solutions of the boundary value problem $y'' + 9y = 0,\ y'(0) = 0,\ y'(\frac{\pi}{2}) = 6$. State whether the problem has no solutions, one solution o[r] infinitely many solutions.	10	CO 2	K3

Course Code: MMA-23-1104

OP JINDAL UNIVERSITY

Mid Semester Examination, October-2023

M.Sc 1st Semester [03PG013]

Mathematics

Discrete Mathematics

Time: 2 Hrs. **Max. Marks: 50**

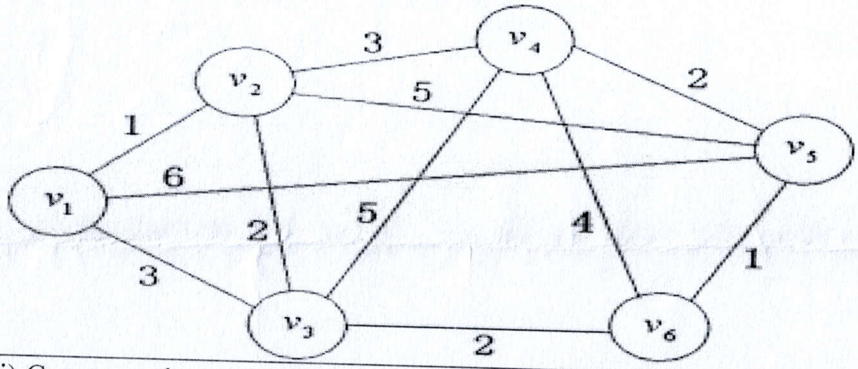
Section A (20 marks)

Answer any 4 questions [04 x 05 marks=20 marks]

			M	CO	KL
1	a.	Define Isomorphic graph and walk with example.	5	1	K1
	b.	Define Spanning Tree with suitable example. Also define Minimum spanning tree.	5	1	K1
	c.	Prove that for any positive integer n, $1^2+2^2+3^2+\ldots\ldots\ldots+n^2=\dfrac{n(n+1)(2n+1)}{6}$	5	4	K2
	d.	Solve $a_n-6a_{n-1}+9a_{n-2}=n$.	5	4	K2
	e.	Solve $a_n+5a_{n-1}+6a_{n-2}=3n^2$.	5	4	K2

Section B (30 marks)

Answer any 3 questions [03 x 10 marks=30 marks]

			M	CO	KL
2	a.	(i) State and Prove Handshaking Theorem. (ii) Prove that an undirected graph has an even number of odd degree vertices.	10	1	K1
	b.	Write notes on different types of tree. Find the minimal spanning tree using Prim's algorithm for the following graph: 	10	1	K2
	c.	(i) Construct the truth table of $[(p\wedge q)\vee(\neg r)]\Leftrightarrow p$. (ii) Prove that for every natural number $6^{n+2}+7^{2n+1}$ is divisible by 43.	10	4	K2
	d.	Solve $a_n-7a_{n-2}-6a_{n-3}=0$ with $a_0=9, a_1=10, a_2=32$.	10	4	K2
	e.	Solve $a_n-2a_{n-1}-a_{n-2}+2a_{n-3}=0$ with $a_0=3, a_1=6, a_2=0$.	10	4	K2