MANAV RACHNA UNIVERSITY

END SEMESTER EXAMINATION

SCHOOL OF SCIENCES

DECEMBER – 2023

(3rd /5th)

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DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM	08·12·2023 (II)
COURSE NAME	INORGANIC CHEMISTRY II	COURSE CODE	CHH202B
PROGRAM	B.Sc.(Hons.) Chemistry	CREDITS	3
TIME DURATION	180min	MAX. MARKS	100
NAME OF FACULTY	Dr. Roopa Rani	NAME OF COURSE COORDINATOR	Dr. Roopa Rani

Note: Attempt all questions

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	P I
PART-A	Q1	a) Differentiate among electrolytic refining and electrolytic reduction.	3	CO1	BT4	
		b) Write the principle of zone refining.	2	CO1	BT2	
		c) Refer to the diagram below- The Y-axis and X-axis in the graph above represents .... and ...., respectively. Explain its uses.	3	CO1	BT2	
		d) Define the following terms – i. Gangue ii. Minerals iii. Ores	3	CO1	BT1	

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		e) What do you mean by the term standard electrode potential? How does it compares the reduction potential of a group of elements?	3	CO1	BT1

PART-B		a) Explain the stability of alkali metals with respect to
		  I. Sulphates
		  II. Carbonates
		  III. Nitrates
			3	CO2	BT3

		b) S-block elements has complex forming tendency. Explain the statement using an example.	4	CO2	BT4

		c) Compare the properties of alkali and alkaline earth metals with respect to –
		  I. Flame color
		  II. Reducing property
		  III. Ionization energy
			3	CO2	BT5

		d) Explain the reason for the anomalous behaviour of the first elements of I and II group.	3	CO2	BT2
	Q2	e) What do you mean by amphoteric oxides? Which elements form this type of oxides among the s block elements?	2	CO2	BT3

PART-C	**Q3**	a) Write short notes on the following
		  I. Diborane
		  II. Electronegativity trend for p-block elements
		  III. Diagonal relationship between B and Si
			3
			3
			
			2
				CO3	BT2

		b) Explain the phenomenon of catenation among group 14 elements. Elaborate the allotropes of carbon in detail	4+4+4	CO3	BT4
		c) Conclude the term "Inorganic benzene". Explain its structure, bonding and properties.	8	CO3	BT5
		d) Examine the properties and structure of silicones. Give its uses in details	7	CO3	BT5
PART-D	**Q4**	a) Discuss the structure and bonding in oxoacids of chlorine and phosphorus. Also arrange them in increasing order of their acidic strength.	6+4	CO4	BT6
		b) Compare the structure and properties of different interhalogen compounds.	5+5	CO4	BT5

		c) Write short notes on the following
		  I. Clathrate compounds
		  II. Halides of Silicon
		  III. Xenon Fluorides
			3
			3
			4
				CO4	BT2

		d) Explain the structure, bonding and properties of phosphonitrilic chloride in details.	5	CO4	BT4

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SEMESTER	IIIrd	DATE OF EXAM	11.12.2023
SUBJECT NAME	PHYSICAL CHEMISTRY-II	SUBJECT CODE	CHH201B-T
BRANCH	Chemistry	SESSION	II
TIME	8:30 to 11:30am	MAX. MARKS	100
PROGRAM	B.Sc.(H)	CREDITS	4
NAME OF FACULTY	Dr. Priti Gupta	NAME OF COURSE COORDINATOR	Dr. Priti Gupta

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	1(A)	How are work function and free energy related?	5	CO1	BT1
	1(B)	Why is the value of Cp and Cv is always greater than that of Cv? How are they related?	5	CO1	BT1
	1(C)	Compare Reversible and irreversible processes with example.	5	CO1	BT2
PART-B	Q2(A)	Derive Gibb's Helmholtz Equation in terms of Internal energy and work function.	5	CO2	BT3
	2(B)	Define the following terms: a) Inversion temperature b) Residual entropy	6	CO2	BT1
	2(C)	Justify that "All spontaneous processes lead to increase the entropy of the system"	4	CO2	BT4
PART-C	Q3(A)	Give reason why addition of non-volatile solute lowers the freezing point and elevates the boiling point of a solvent.	4	CO3	BT3
	3(B)	Derive an expression for the elevation in boiling point of a liquid when a solute is dissolved in and explain how the molecular mass of solute can be evaluated by the Boiling point method.	8	CO3	BT4
	3(C)	Compare Reverse Osmosis process with Osmosis. How Reverse osmosis is used in Desalination of sea water	7	CO3	BT2

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	3(D)	In an experiment air was drawn successfully through a solution of sugar (0.03889 Kg per 0.1 Kg water) and distilled water, and then through anhydrous calcium chloride. It was found that the water lost was $0.921*10^{-4}$ Kg and calcium chloride tubes gained $0.5163*10^{-2}$ Kg. find the molecular mass of sugar(Molar mass of $H_2O = 0.018kg$).	8	CO3	BT4
	3(E)	How Landsberger-Walker method is useful for the measurement of elevation in boiling point?	8	CO3	BT1
PART-D	4(A)	Derive the rate equation for first order reaction and show that Half-life is independent of initial concentration.	4+4	CO4	BT3
	4(B)	50% of the first order reaction is completed in 23 minutes. Calculate the time required to complete 90% of the reaction.	6	CO4	BT4
	4(c)	Derive Arrhenius equation and discuss how it is useful to calculate the energy of activation?	6	CO4	BT4
	4(D)	Explain Integrated rate equation and Graphical methods for determining the Order of reaction	8	CO4	BT2
	4(E)	Show that for a first order reaction, the time required for 99.9% completion of the reaction is 10 times that required for 50% completion.	7	CO4	BT3

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SEMESTER	III	DATE OF EXAM/SESSION	19/12/2023
COURSE NAME	ORGANIC CHEMISTRY-II	COURSE CODE	CHH203B-T (II)
PROGRAM	B.Sc. (Hons.) CHEMISTRY	CREDITS	4
TIME DURATION	03:00 hrs	MAX. MARKS	100
NAME OF FACULTY	ANJU SHARMA	NAME OF COURSE COORDINATOR	ANJU SHARMA

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1	Write classification of Isomerism. Explain all types with example.	5	CO1	BT2	
	2	What are haloalkanes and haloarenes. Explain with examples. Write the order of melting point of:- $CH_3I, CH_3Br, CH_3Cl, CH_3F, CH_4$ and give reason.	5	CO1	BT2	
	3	Differentiate SN^1 and SN^2 Reaction. Draw Energy profile diagram for both mechanism.	5	CO1	BT4	
PART-B	4	Deduce IUPAC name a) $Cl-CH_3-CH_2-CH_2-OH$ b) $CH_3-CH=CH-C(CH_3)_2-CH_2-OH$	3	CO2	BT2	
	5	Spell out the order of boiling point for $CH_3-C(CH_3)_2-OH, CH_3-CH_2(OH)-CH_2-CH_3, CH_3-CH_2-CH_2-CH_2-OH$ Also give reason for same.	3	C02	BT3	
	6	Elaborate the reaction and mechanism of conversion of tert. butyl alcohol to tert. butyl chloride	4	CO2	BT4	

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	7	Draw and explain pinacol- pinacolone rearrangement reaction with mechanism	5	CO2	BT5
	8	Describe acidic behaviour of phenols and write the order of acidic behaviour of ethanol, phenol and acetic acid. Explain that with reason.	6	CO3	BT3
	9	Complete the following reaction a) $CH_3CH_2OH + [O] \xrightarrow{K2Cr2O7\ H2SO4}$ b) $CH_3-C(CH_3)=CH_2 + O_3 \rightarrow$	4	CO3	BT4
PART-C	10	Deduce following name reaction with mechanism a) Aldol condensation b) Cannizzaro reaction	7.5 7.5	CO3	BT5
	11	Spell out the structure form of following IUPAC names a) 2 methyl benzaldehyde b) naphthalene c) oxalic acid d) Benzal chloride e) fumaric acid	2*5=10	CO3	BT2
	12	What will be the effect on acidity on increasing electronegativity. And what will be the order of increasing acidity in following compounds:- a) ICH_2-COOH , $BrCH_2-COOH$,$ClCH_2-COOH$ FCH_2-COOH. b) $H-COOH$, CH_2-COOH, CH_3CH_2COOH, $CH_3CH_2CH_2COOH$.	7	CO4	BT3
PART-D	13	Give a description of Oscillation rule or alternation effect. Draw graph to represent the behaviour of melting point on increasing no. of carbon atoms. Explain that behaviour with reason and example.	8	CO4	BT4
	14	Explain acidity behaviour of Fumaric acid and Maleic acid. Explain mechanism of Bromine on Fumaric acid and Maleic acid.	5,5	CO4	BT5
	15	Write IUPAC names and chemical structure formula of following:- 1)OXALIC ACID 2)SUCCINIC ACID 3)LACTIC ACID 4) MALEIC ACID 5)FUMARIC ACID	2*5=10	CO4	BT3

****************** END ******************

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SEMESTER	3rd / 7th	DATE OF EXAM	22.12.2023 (II)
COURSE NAME	INTRODUCTION TO FINANCE	COURSE CODE	MCH232
PROGRAM	B.Sc. Mathematics3rd/ B.Sc. Chemistry3rd/ B.Tech Mech. SMA (7th Sem)	CREDITS	2
TIME DURATION	1.5 HOURS (12:30 – 02PM)	MAX. MARKS	50
NAME OF FACULTY	DR POOJA KAPOOR	NAME OF COURSE COORDINATOR	DR POOJA KAPOOR

Note: All questions are compulsory. Each question carry 10 marks each.

	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
Q1	What are the three roles of financial intermediaries? Why banks are called financial Intermediaries? Also,State the difference between equity Shares and preference shares?	(05+05)	CO1	BT2	
Q2	Hi-Sounds, a small audio equipment retailer, has just completed the second year of trading. Profits are up, but the manager is slightly concerned. It is felt by the management that the firm could face liquidity problems in the near future. The data for this claim is as follows:	05+05	CO2	BT4	

Table for Q2:

As at 31 December:	2021	2022
	Rs	Rs
Stock	145000	75680
Debtors	66620	98710
Bank	32000	
Creditors	93100	78450
Bank overdraft		24890

Calculate Liquidity ratio and Current ratio and comment on the liquidity status of the business.

	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
Q3	Q5. A) Discuss the techniques of capital expenditure proposals? What is cost of capital?	05	C03	BT2	

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	B) An investment of Rs 200,000 is expected to generate the following cash inflows in 5 years: Year 1: Rs55,000 Year 2: Rs 60,000 Year 3: Rs 32,000 Year 4: Rs 35,000 Year 5: Rs 20,000 Compute payback period of the investment. Should the investment be made if management wants to recover the initial investment in 3 years or less?	05	CO3	BT4	
Q4	Explain the role of "TIME" in financial decision-making process. How to calculate future value of investment?	(05+0 5)	CO3/ CO4	BT3	
Q5	How to compute break-even point and margin of safety? Draw the detailed format of calculating Gross Taxable Income.	(05+0 5)	CO4	BT2	

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SEMESTER	V	DATE OF EXAM	12·12·2023 (I)
COURSE NAME	Physical Chemistry-IV	SUBJECT CODE	CHH301B-T
PROGRAM	B.Sc. (Hons.) Chemistry	CREDITS	4
TIME DURATION	180 Minutes	MAX. MARKS	100
NAME OF FACULTY	Dr. Arpit Sand	NAME OF COURSE COORDINATOR	Dr. Arpit Sand

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	1	Discuss any two postulates of Quantum Chemistry	2.5+2.5	CO1	BT3
	2	Deduce Expression for time dependent Schrodinger wave equation	5	CO1	BT4
	3	A cricket ball weighing 100g is to be located within 0.1 Å. What is the uncertainty in its velocity?	5	CO1	BT2
PART-B	4	Draw the correlation diagram of water molecule	5	CO1	BT3
	5	Explain LCAO approximation based on MOT	5	CO2	BT2
	6	Write a short note on variation theorem	5	CO2	BT4
PART-C	7	The pure rotational spectrum of gaseous HCl consist of a series of equally spaced lines separated by 20.80cm^{-1} Calculate the inter nuclear distance of the molecule The atomic masses are ^{1}H=1.673×10^{-26} ^{35}Cl=58.06 ×10^{-26} h=6.626×10^{-26} Js	5+5	CO3	BT4
	8	Homonuclear diatomic molecule are IR inactive while Hetronuclear diatomic molecule are IR active Explain	5	CO3	BT3

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PART-D	9	Discuss vibrational spectra of diatomic molecule (expression) & explain the term zero point energy (Z.P.E.) also explain Fundamental Vibrational Frequency.	5+5	CO3	BT3
	10	Discuss mechanism of working of microwave oven based on spectroscopy.	5	CO4	BT2
	11	Explain Morse Potential energy for an anhormonic diatomic oscillator.	5	CO4	BT3
	12	Discuss Bathochromic Effect and Hypsochromic effect with suitable examples	5+5	CO5	BT3
	13	Draw the sketch diagram of NMR spectrometer.	5	CO5	BT3
	14	Write a short note on hypefine splitting	5	CO5	BT4
	15	Write a short note on Chemical Shift and principal of ESR spectroscopy.	5+5	CO5	BT3
	16	Difference between Raman and infrared spectra	5	CO5	BT4

****************** END ******************

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SEMESTER	V	DATE OF EXAM/SESSION	16.12.2023 (I)
COURSE NAME	BIOMOLECULES AND NATURAL PRODUCTS	COURSE CODE	CHH302B-T
PROGRAM	B.Sc. (Hons.) Chemistry	CREDITS	4
TIME DURATION	03:00 hrs	MAX. MARKS	100
NAME OF FACULTY	ANJU SHARMA	NAME OF COURSE COORDINATOR	ANJU SHARMA

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1	What are the components of DNA and RNA name them.	2	CO1	BT2	
PART-A	2	Draw structure of THYMINE, CYTOSINE and URACIL.	3	CO1	BT2	
PART-A	3	Explain Different types of RNA. Write their roles.	4	CO1	BT4	
PART-B	4	How WATSON and CRICK proposed the structure of DNA. Explain the double helical model of DNA.	6	CO2	BT2	
PART-B	5	Draw structure of :- i) glycine ii) alanine iii) tryptophan AMINO ACIDS.	2*3=6	CO2	BT3	
PART-B	6	Draw and explain any one amino acid synthesis.	4	CO2	BT5	
PART-C	7	Define Peptides. Draw and explain the synthesis of peptides by SEEHAN Synthesis.	5	CO3	BT3	
PART-C	8	Define carbohydrates and draw structural formula for below mentioned carbohydrates. i) arabinose	10	CO3	BT4	

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		ii) Fructose iii) maltose iv) ribose			
	9	Define below mentioned terms:- i) anomers and anomerization ii) specific rotation .	2.5*2=5	CO3	BT5
	10	Draw and explain all reaction for the structure elucidation of fructose.	10	CO3	BT2
	11	Draw and explain Ruff's Degradation for conversion of higher aldose to lower aldose.	10	CO4	BT3
PART-D	13	Define natural dyes and artificial dyes. Draw and explain the structure elucidation of indigotin dye.	3,7	CO4	BT4
	14	Draw the synthesis of Methyl Orange and Malachite green Dyes. Write the applications.	5,5	CO4	BT5
	15	a) Explain two Witts theory of colour classification . b) Explain Mordant dyes. c) Vat dyes with applications.	3*5=15	CO4	BT3

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SEMESTER	Vth	DATE OF EXAM	18.12.2023 (I)
SUBJECT NAME	ANALYTICAL CHEMISTRY & SPECTROSCOPY	SUBJECT CODE	CHH303B T
BRANCH	Chemistry	SESSION	I
TIME	8:30 – 11:30 am	MAX. MARKS	100
PROGRAM	B.Sc.(H)	CREDITS	4
NAME OF FACULTY	Dr. Priti Gupta	NAME OF COURSE COORDINATOR	Dr. Priti Gupta

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	1(A)	Calculate the normality of the solution obtained by dissolving 0.321 g of the salt sodium carbonate (Na_2CO_3) in 250 mL water. (Assuming the salt solution is being used in a complete neutralization by a strong acid.)	4	CO1	BT4
	1(B)	Classify thermal methods based upon their principle and property measured.	5	CO1	BT2
	1(C)	Discuss the role of Analytical Chemistry in Pharmaceuticals and Environmental fields.	6	CO1	BT1
PART-B	Q2(A)	Depending upon the symmetry and the value of £max discuss the classes of Transition Probability.	5	CO2	BT2
	2(B)	Aniline absorbs at 280 nm (ϵ_{max} = 8600) but in acidic solution, the main absorption band is seen at 203 nm (ϵ_{max}= 7500) which is comparable to benzene. Explain why?	5	CO2	BT3
	2(C)	How UV-visible spectroscopy is helpful in : 1) Detection of Functional group 2) Distinction in conjugated and non-conjugated compounds	5	CO2	BT1
	3(A)	Justify why a capillary column gives better efficiency as compared to packed column in a gas chromatography analysis (explain using Van Deemter terms)	5	CO3	BT4

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	3(B)	Why Gel chromatography is known as Exclusion Chromatography? Also discuss its applications in Molecular weight determination and purification of biological macromolecules.	7	CO3	BT4
	3(C)	How the resolution of chromatographic column increases with theoretical plates? With the help of block diagram discuss the instruementation of HPLC.	8	CO3	BT3
	3(D)	Differentiate between GLC and GSC. Also discuss the consideration points should be taken into account while selecting a carrier gas.	8	CO3	BT4
	3(E)	Discuss the principle of Thin –Layer Chromatography. In what way it is superior to paper chromatography?	7	CO3	BT1
PART-D	4(A)	Define the term Thermogravimetry and classify it into various types.	3+5	CO4	BT1
	4(B)	How TGA curve is affected by Sample characteristics like weight of the sample, Sample particle size and heat of reaction.	8	CO4	BT2
	4(c)	Using Thermogravimetric analysis, analyse the decomposition pattern of calcium oxalate.	6	CO4	BT4
	4(D)	Discuss the applications of DTA techniques in Physical and Analytical chemistry.	7	CO4	BT2
	4(E)	On the basis of size of sample, Specific heat measurement, Sensitivity of measurement of heat of transition and heating and cooling cycles compare DTA and DSC techniques.	6	CO4	BT3

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SEMESTER	V		DATE OF EXAM/SESSION	20.12.2023 (I)
COURSE NAME	CHEMISTRY IN AGRICULTURE		COURSE CODE	CHS304B
PROGRAM	B.Sc. (Hons.) CHEMISTRY		CREDITS	2
TIME DURATION	2:00 Hrs		MAX. MARKS	50
NAME OF FACULTY	ANJU SHARMA		NAME OF COURSE COORDINATOR	ANJU SHARMA

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1	Elucidate soil analysis. Write reason for doing it.	3	CO1	BT3	
	2	Write a short not on absorption of ions by soil and cation exchange capacity (CEC).	4	CO1	BT2	
	3	Describe Biofertilizers. Write classifications of Biofertilizers. Write constraints in Bi fertilizers technology.	8	CO2	BT4	
	4	Put down short notes on: i) DDT ii) BHC	5*2=10	CO2	BT2	
PART B	5	What are the measure and strategies applying in agriculture to control pest. Write classification of pesticide with example	6	CO3	BT3	
	6	Define Biopesticides. Write preparation environmental effect and human health risk of 2, 4D and 2, 4, 5-T	5,5	CO3	BT3	
	7	Spell out short notes on :- i) Plant growth promoters. ii) Gibberlin iii) Defoliants	3*3=9	CO4	BT4	

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SEMESTER	III	DATE OF EXAM/SESSION	11.12.2023 (II)
COURSE NAME	Real Analysis	COURSE CODE	MAH204B
PROGRAM	B.Sc.(Hons.) Mathematics	CREDITS	4
TIME DURATION	3 Hrs.	MAX. MARKS	100
NAME OF FACULTY	Dr. Ramapati Maurya	NAME OF COURSE COORDINATOR	Dr. Ramapati Maurya

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Prove that supremum of a set S of real numbers, whenever it exists, is unique.	5	CO1	BT4	1.1.1 2.1.1
	1(B)	For the following sets, Find the supremum and the infimum, if they exist: (i) $S = \left\{(-1)^n \left(\frac{1}{4} - \frac{4}{n}\right) : n \in N\right\}$ (ii) $S = \left\{1 - \frac{1}{n} : n \in N\right\}$	5	CO1	BT3	1.1.1 2.1.1
	1(C)	Find the derived set of the following sets: (i) $A = \left\{\frac{1}{n}, n \in N\right\}$ (ii) $A = \left\{1 + \frac{(-1)^n}{n}, n \in N\right\}$	5	CO2	BT3	1.1.1 2.1.1 4.3.1 4.1.1
PART-B	2(A)	State and prove sandwich theorem.	5	CO2	BT4	1.1.1 2.1.1
	2(B)	Show that $lim_{n \to \infty} \left[\frac{1}{\sqrt{n^2+1}} + \frac{1}{\sqrt{n^2+2}} + \cdots + \frac{1}{\sqrt{n^2+n}}\right] = \frac{1}{\sqrt{2}}$.	5		BT4	1.1.1 2.1.1 4.3.1
	2(C)	Show that the sequence $\{s_n\}$, where $s_n = \frac{1}{n+1} + \frac{1}{n+2} + \cdots + \frac{1}{2n}$ is convergent.	5		BT4	1.1.1 2.1.1 4.3.1

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PART-C	3(A)	Prove that a necessary condition for convergence of an infinite series $\sum u_n$ is that $lim_{n\to\infty} u_n = 0$.	5		BT3	1.1.1 2.1.1 4.3.1
	3(B)	Examine for the convergence of the series $1 + \frac{x}{1!} + \frac{2^2 x^2}{2!} + \frac{3^3 x^3}{3!} + \cdots, x > 0.$	12	CO3	BT4	1.1.1 2.1.1 4.3.1
	3(C)	State Cauchy's nth root test. Also test for the convergence of the series $\frac{x}{1} + \frac{x^2}{2} + \frac{x^3}{3} + \frac{x^4}{4} + \cdots, x > 0.$	9		BT4	1.1.1 2.1.1 4.3.1
	3(D)	Apply Cauchy integral test to test the convergence of the series $\sum_{n=1}^{\infty} \frac{1}{n^2+1}$.	9		BT3	1.1.1 2.1.1 4.3.1
PART-D	4(A)	Show that the series $1 - \frac{1}{3.4} + \frac{1}{5.4^2} - \frac{1}{7.4^3} + \cdots$ is convergent. Also, examine the series for absolute convergence.	12		BT4	1.1.1 2.1.1 4.3.1
	4(B)	Show that the series $\sum \frac{(-1)^{n+1}}{3n+2}$ is conditionally convergent.	9	CO4	BT4	1.1.1 2.1.1 4.3.1
	4(C)	Show that the sequence $\{f_n\}$, where $f_n(x) = \frac{x}{1+nx^2}$ is uniformly convergent in any closed interval I.	14		BT4	1.1.1 2.1.1 4.3.1

******************* END *******************

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Note: *All questions are compulsory.*

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	What conic does the equation $36x^2 + 24xy + 29y^2 - 72x + 126y + 81 = 0$ represents.	5	CO1	BT2	1.1. 1.1.
	1(B)	Find the coordinate of the center of the conic $x^2 - 3xy + y^2 + 10x - 10y + 21 = 0$.	5	CO1	BT2	1.1. 1.1.
	1(C)	Obtain the length of the axis for the conic $5x^2 - 6xy + 5y^2 + 22x - 26y + 29 = 0$	5	CO1	BT3	1.1.
PART-B	1(D)	Prove that one and only one conic of a confocal system will touch a given straight line.	5	CO2	BT2	1.1 1.1.
	1(E)	Explain Director circle and derive its equation to the conic $\frac{l}{r} = 1 = ecos\theta$.	5	CO2	BT2	1.1 3.1.
	1(F)	Derive the equation of the circle with radius a and the touching the initial line at pole in polar form.	5	CO2	BT2	1.1 3.1.
PART-C	Q2(A)	Obtain the equation of the sphere having the circle $x^2 + y^2 + z^2 + 7y - 2z + 2 = 0, 2x + 3y + 4z - 8 = 0$ as a great circle.	12	CO3	BT2	1.1 3.1.
	(B)	Find the centres of the two spheres which touch the plane $x + 2y + 2z - 5 = 0$ at the point (1,1,1) and the sphere $x^2 + y^2 + 2x + 4y + 6z - 11 = 0$.	12	CO3	BT3	1.1 1.1
	(C)	Find the equation of the right circular cone whose vertex is at the origin, axis the line	11	CO3	BT3	1.1 3.1

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		$\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$, and which has a vertical angle of 60°.				
PART-D	**Q3(A)**	Derive the equation of right circular cylinder of radius 3 and axis as the line $\frac{x-1}{2} = y - 2 = \frac{z-3}{2}$	12	CO4	BT3	1.1.1 1.1.2
	(B)	Obtain the equation of the two tangent planes which contain the lines given by $7x + 10y = 30, \ 5y - 3z = 0$ and touches the ellipsoid $7x^2 + 5y^2 + 3z^2 = 60$.	12	CO4	BT3	1.1.1 3.1.2
	(C)	Find the equation of enveloping cylinder of the sphere $x^2 + y^2 + z^2 - 4x + 6y - 8z - 4 = 0$ having its generator parallel to the line $\frac{x}{-3} = \frac{y}{5} = \frac{z}{1}$.	11	CO4	BT3	1.1.1 1.1.2

******************** END ********************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End-term Examination, Dec-2023"

SEMESTER -	III	DATE OF EXAM	18/12 2023
COURSE NAME	Group Theory	COURSE CODE	MAH206B (II)
PROGRAM	B.Sc. (Hons.) Mathematics	CREDITS	4
TIME DURATION	3 Hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Deepa Arora	NAME OF COURSE COORDINATOR	Dr. Deepa Arora

Note: *Attempt all questions.*

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1(A)	If in a group G, $a^5 = e, aba^{-1} = b^2$ for $a, b \in G$ then calculate $o(b)$?	5	CO1	BT3	1.1.1 3.1.2
	Q1(B)	Show that $H = \{nx : x \in Z\}$ is a subgroup of $\{Z, +\}$, $n \in Z$.	5	CO1	BT3	1.1.1
	Q1(C)	Find out all the right cosets of H in G, where $G = <a>$ is a cyclic group of order 10 and $H = <a^5>$.	5	CO2	BT3	1.1.1 3.1.2
PART-B	Q2(A)	Define quotient group. If G is a cyclic group and N is a subgroup of G, then prove that G/N is cyclic.	7	CO2	BT2	1.1.1 3.1.1
	Q2(B)	Show that $H = \{1, -1\}$ is a normal subgroup of the group $G = \{1, -1, i, -i\}$. Find all the elements of G/H.	8	CO2	BT3	1.1.1 3.1.2
PART-C	Q3(A)	If $f : G_1 \to G_2$ is homomorphism such that e_1 is the identity of G_1 and e_2 is the identity of G_2, then show that $f(e_1) = e_2$.	2	CO4	BT3	1.1.1 3.1.1
	Q3(B)	Show that an infinite cyclic group G is isomorphic to the additive group of integers.	5	CO4	BT2	1.1.1 3.1.1
	Q3(C)	Check whether the mapping $f : C \to R$ defined as $f(x + iy) = x$ is a homomorphism of the additive group of complex numbers onto the additive group of real numbers ?	3	CO4	BT4	1.1.1 3.1.1
	Q4(A)	State and prove the second theorem of isomorphism.	8	CO4	BT2	1.1.1 3.1.1

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PART-C	Q4(B)	(i) Compute $a^{-1}ba$ where $a = (1\ 3\ 4), b = (2\ 3\ 5\ 4)$. (ii) Determine whether the given permutation is even or odd $f = (1\ 2\ 3\ 4\ 5)(1\ 2\ 3)(4\ 5)$. (iii) Prove that every permutation can be expressed as the product of disjoint cycles.	3+1 +3	CO3	BT3	1.1.1 3.1.1
	Q5 .	(i) If H and K are two normal subgroups of a group G such that $\subseteq K,$ then prove that $G/K \cong \frac{G/H}{K/H}.$ (ii) State Cayley Theorem.	8+2	CO4	BT2	1.1.1 3.1.2
PART-D	Q6(A)	For any group G, show that $I(G)$ is a normal subgroup of $Aut(G)$.	8	CO5	BT3	1.1.1
	Q6(B)	Prove that Aut(G) is a subgroup of A(G).	7.	CO5	BT2	1.1.1
	Q7	(i) Show that if G is an infinite cyclic group, then Aut(G) is isomorphic to a cyclic group of order 2. (ii) Calculate $Aut(G)$, where $G = <a>, a^{10} = e.$	8+2	CO5	BT3	1.1.1 3.1.2
	Q8	Define conjugate elements. If G is a finite group, then show that $o(G) = \sum_{a\in G} \frac{o(G)}{o(N(a))}$ where the sum runs over one element a in each conjugate class.	2+8	CO5	BT3	1.1.1 4.1.1

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SEMESTER	3rd	DATE OF EXAM	20/12/2023
COURSE NAME	Partial Differential Equation	COURSE CODE	MAH207B (II)
PROGRAM	B.Sc.(Hons.)-Mathematics	CREDITS	4
TIME DURATION	3 hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Dinesh Tripathi	NAME OF COURSE COORDINATOR	Dr. Dinesh Tripathi

Note: Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	P
PART-A	1(A)	Find the integral surface of $x^2p + y^2q + z^2 = 0$, which passes through the hyperbola $xy = x + y, z = 1$.	5	CO1	BT4	1.1
	1(B)	Solve the PDE $(xz + y^2)p + (yz - 2x^2)q + 2xy + z^2 = 0$.	5	CO1	BT3	1.1
	1(C)	Derive the PDE for $z = a \log\left\{\frac{b(y-1)}{1-x}\right\}$ by eliminating arbitrary constants.	5	CO1	BT3	3.1
PART-B	2(A)	Find the deflection of the vibration of string of length π and fixed ends, corresponding to zero initial velocity and initial deflection $f(x) = k(\sin x - \sin 2x)$, for $c^2 = 1$.	5	CO2	BT4	3.1
	2(B)	Using Charpit's special cases solve the following PDE; $z^2(p^2 + q^2) = x^2 + e^{2y}$.	5	CO2	BT3	4.1
	2(C)	Show that the system of equations $xp - yq = x, x^2p + q = xz$ are compatible and solve them.	5	CO2	BT3	3.1
PART-C	Q3(A)	Find the complete integral of the equation $(D^3 - D^2D' - 2DD'^2)z = e^{x+2y}(x^2 + 4y^2)$.	9	CO3	BT4	4.1
	3(B)	Solve $(D^2 - D'^2 + D + 3D' - 2)z = x^2y$.	9	CO3	BT2	4.1.
	3(C)	Determine the solution of the PDE $r - s - 2t + 2p + 2q = e^{2x+3y} + xy + \sin(2x + y)$.	9	CO3	BT4	4.1.
	3(D)	Reduce the PDE $x^2r - 4y^2t - 4yq = z + x^2y^2 \log y$ in PDE with constant coefficient and solve it.	8	CO3	BT4	3.1. 4.1.

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PART-D	Q4(A)	Classify the DE $xyr - (x^2 - y^2)s - xy\,t + py - qx = 0$. Also reduce it in canonical form and solve it.	15	CO4	BT4
	4(B)	Using Monge's method solve the PDE $(r - t)xy - s(x^2 - y^2) = qx - py$.	10	CO4	BT3
	4(C)	Solve $rq^2 - 2pqs + p^2t = pt - qs$.	10	CO4	BT2

****************** **END** ******************

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(13)

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SEMESTER	V		DATE OF EXAM	12.12.2023 (I)
COURSE NAME	STATISTICAL INFERENCES		COURSE CODE	MAH306B
PROGRAM	B.Sc. (Hons.) Maths		CREDITS	4
TIME DURATION	3 Hours		MAX. MARKS	100
NAME OF FACULTY	Ms. Savitta Saini		NAME OF COURSE COORDINATOR	Ms. Savitta Saini

Note: *All questions are compulsory.*

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Differentiate between simple and composite statistical hypothesis with examples.	5	CO1	BT2	1.1.1 3.2.2
	1(B)	Discuss the concept of interval estimation and provide suitable illustration.	5	CO1	BT2	2.1.1
	1(C)	What are the properties of a maximum Likelihood Estimators?	5	CO1	BT1	1.1.1
PART-B	2(A)	Give an example of an estimator (i) which is consistent but not unbiased. (ii) which is unbiased but not consistent.	5	CO2	BT1	3.2.3 4.2.2
	2(B)	Explain the main difference between the parametric and non-parametric approaches to the theory of statistical inferences. Illustrate your answer by giving a suitable examples.	5	CO2	BT2	2.1.1 3.2.2 4.2.2
	2(C)	Define Minimum Variance Unbiased Estimators. Obtain the MVB estimator for μ in normal population $N(\mu, \sigma^2)$, where σ^2 is known.	5	CO2	BT1	1.1.1 3.2.1 4.1.2

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3(A)

To test the claim that the median age of mathematics faculty in the State community colleges is less than 42 years, a survey from a random sample of 32 mathematics faculty yields the following ages (in years):

56	62	61	54	52
32	24	35	50	42
52	49	26	31	31
54	38	36	45	53
37	40	38	31	29
25	45	52	48	39
30	38	-	-	-

Use the Wilcoxon signed - rank test at the 0.05 level of significance by:

(a) Classical Method
(b) P – Value Method

15 | CO3 | BT3 | 2.1.1 3.2.2

3(B)

Describe the mathematical model for ANOVA testing in one – way classification, stating clearly the assumptions involved.

5 | CO3 | BT1 | 1.1.1 3.2.2 4.1.2

4

Five doctors each test five treatments for a certain disease and observe the number of days each patient takes to recover. The results are (recovery time in days) given in the table:

Doctors	Treatments				
	1	2	3	4	5
1	10	14	23	18	20
2	11	15	24	17	21
3	9	12	20	16	19
4	8	13	17	17	20
5	12	15	19	15	22

Discuss the difference between:
(a) The doctors and
(b) The treatments. Use $\alpha = 0.05$.

If the difference between (a) doctors or/and (b) treatments is significant, find which pairs of means differ significantly.

15 | CO3 | BT4 | 2.1.1

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| 5 | To test the hypothesis that the average number of days a patient is kept in the three local hospitals say, A, B and C is the same, a random check on the number of days that seven patients stayed in each hospital reveals the following: | 15 | CO4 | BT4 | 1.1.1 |

Hospital A	8	5	9	2	7	8	2
Hospital B	4	3	8	7	7	1	5
Hospital C	1	4	9	8	7	2	3

Test the hypothesis at $\alpha = 0.05$.

| 6(A) | The following data give the measurements of HDL Cholesterol level in a random sample of 120 individuals from the adult population of a city. Test the claim that the median HDL cholesterol level among the adult population of the city is less than 42. | 15 | CO4 | BT4 | 3.2.3 4.2.2 |

45	25	31	31	42	49	34	32	40	39
36	44	33	26	20	43	35	35	23	54
41	42	43	42	46	40	35	41	41	30
44	42	33	36	39	43	31	47	48	34
28	57	49	47	43	42	35	35	47	55
23	31	38	38	43	43	42	41	49	36
40	38	38	40	44	42	35	37	36	38
30	49	44	37	37	36	35	44	40	42
42	31	48	40	37	36	41	42	41	43
33	36	36	39	38	44	35	40	38	44
40	36	42	35	36	48	32	36	38	41
37	41	39	35	43	42	44	36	31	46

Use the sign test at the 0.01 level of significance.

| 6(B) | Explain how the sign test is used to compare two populations. | 5 | CO4 | BT2 | 3.2.3 4.2.2 |

***************** **END** *******************

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SEMESTER	V		DATE OF EXAM/SESSION	16.12.2023 (I)
COURSE NAME	Linear Algebra		COURSE CODE	MAH302B
PROGRAM	B.Sc.(Hons.) Mathematics		CREDITS	4
TIME DURATION	3 hrs		MAX. MARKS	100
NAME OF FACULTY	Dr. Ramapati Maurya		NAME OF COURSE COORDINATOR	Dr. Kamlesh Kumar

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Show that the set $\{x^2 + 3x - 2,\ 2x^2 + 5x - 3, -x^2 - 4x + 4\}$ is a basis of vector space $\mathcal{P}_2(\mathbb{R})$.	5	CO1	BT2	1.1. 1.2. 3.1.
	1(B)	Determine whether the following sets are subspace of $\mathbb{R}^3(\mathbb{R})$. Justify your answers. $W_1 = \{(x,y,z): 2x - 7y + z = 0\}$ $W_2 = \{(x,y,z): x = z + 2\}$.	5	CO1	BT1	1.1. 1.2. 3.1.
	1(C)	Prove that $(-\alpha).a = \alpha.(-a) = -(\alpha.a)$, where $\alpha \in \mathbb{F}$ and $a \in V$.	5	CO1	BT2	1.1. 3.1.
PART-B	2(A)	Show that the mapping $T: \mathbb{R}^3 \to \mathbb{R}^3$ defined by $T(x,y,z) = (2x,\ x - y,\ x + 2y + z)$ is a linear transformation.	5	CO2	BT2	1.2. 3.1.
	2(B)	Let $T: M_{2\times 3}(\mathbb{R}) \to M_{2\times 2}(\mathbb{R})$ be the linear transformation defined by $T\begin{pmatrix} a & b & c \\ u & v & w \end{pmatrix} = \begin{pmatrix} 2a - b & c + 2b \\ 0 & 0 \end{pmatrix}$. Verify the rank nullity theorem.	5	CO2	BT3	3.1
	2(C)	Let T be the linear operator on $\mathbb{R}^3$ defined by $T(x,y,z) = (2y + z, x - 4y, 3x)$.	5	CO2	BT2	1.1. 3.1.

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PART-C	3(A)	Determine all solutions of the following system of equations in $\mathbb{R}$ $$x_1 - 4x_2 - x_3 + x_4 = 3$$ $$2x_1 - 8x_2 + x_3 - 4x_4 = 9$$ $$-x_1 + 4x_2 - 2x_3 + 5x_4 = -6.$$	12	CO3	BT3	1.1 3.
	3(B)	Check whether the matrix $A = \begin{pmatrix} 5 & -6 & -6 \\ -1 & 4 & 2 \\ 3 & -6 & -4 \end{pmatrix}$ over the field of real number $\mathbb{R}$ is diagonalizable or not by finding the basis of eigen vectors.	14	CO3	BT3	1. 1.2
	3(C)	Let $A = \begin{pmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{pmatrix}$ be a matrix of order 3×3 over $\mathbb{R}$. Find the characteristic polynomial of A. Check whether the matrix A is diagonalizable or not with the concept of algebraic multiplicity and geometric multiplicity of eigen values.	9	CO3	BT4	1. 1.2 3.
PART-D	4(A)	Show that the map $\langle , \rangle : \mathbb{C}^3 \times \mathbb{C}^3 \to \mathbb{C}$ defined as $\langle (z_1, z_2, z_3), (w_1, w_2, w_3) \rangle = z_1\overline{w_1} + z_2\overline{w_2} + z_3\overline{w_3}$ is an inner product space in $\mathbb{C}^3$.	9	CO4	BT3	1. 1.2
	4(B)	Find the orthogonal basis using the Gram-Schmidt process to given subset $S = \{(2, -1, -2, 4), (-2, 1, -5, 5), (-1, 3, 7, 11)\}$ of the standard inner product space $\mathbb{R}^4$.	14	CO4	BT2	1. 1.2 3.
	4(C)	Prove that $16 \leq (a + b + c + d)\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}\right)$ for all positive numbers a, b, c and d.	12	CO4	BT4	1.2 3.

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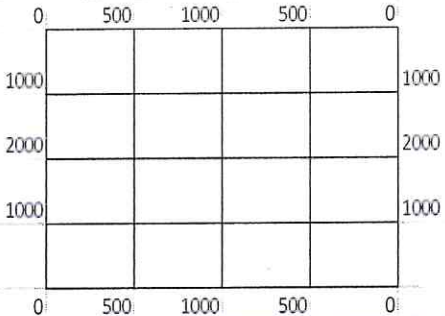
SEMESTER	V	DATE OF EXAM/SESSION	18.12.2023 (I)
COURSE NAME	Numerical Analysis	COURSE CODE	MAH301B
PROGRAM	B.Sc. (Hons.)Mathematics	CREDITS	4
TIME DURATION	3 Hr.	MAX. MARKS	100
NAME OF FACULTY	Dr. Ruchi Gupta	NAME OF COURSE COORDINATOR	Dr. Ruchi Gupta

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1	Find the value of y when $x = 10$; if the following value of x and y are given below, by Using (i) Lagrange's interpolation formula (ii) Newton's divided difference formula: x: 5 6 9 11 y: 12 13 14 16	7.5+7.5	CO1	BT2	4.3.1
PART-B	Q2	The following data gives corresponding values of pressure and specific volume of a super-heated system. 	v	2	4	6	8	10
p	105	42.7	25.3	16.7	13 | Compute the rate of change of (i) Pressure with respect to volume when v=2 (ii) Volume with respect to pressure when p=10.	7.5+7.5	CO2	BT4	1.1.3
PART-C	Q3(a)	Apply Jacobi iteration method to solve the equations : $8x - 3y + 2z = 20$ $4x + 11y - z = 33$ $6x + 3y + 12z = 35$.	8.5	CO3	BT3	4.3.1

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(b)	Apply Factorization method to solve the equations : $2x-3y+10z =3$ $-x+4y+2z=20$ $5x+2y+z=-12$	9	CO3	BT3	4.3.1
Q4(a)	Using Jacobi's method ,compute all the eigen values and eigen vectors of the matrix $$A = \begin{bmatrix} 1 & 1 & 0.5 \\ 1 & 1 & 0.25 \\ 0.5 & 0.25 & 2 \end{bmatrix}$$	9	CO3	BT3	4.3.1
(b)	Compute the largest eigen value and the corresponding eigen vector of the matrix $$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}.$$	8.5	CO3	BT3	4.3.1
Q6	Using Runge-Kutta method of order 4, find y for x= 0.1, 0.2 ,0.3 given that $\frac{dy}{dx}=xy + y^2, y(0) = 1$. Continue the solution at x=0.4 using Milne's Method.	12+5.5	CO4	BT4	3.1.1
Q7(a)	Solve the Poisson equation $u_{xx} + u_{yy} = -81xy,\ 0 < x < 1, 0 < y < 1$ given that $u(0,y) = 0, u(x,0) = 0, u(1,y) = 100$ and h =1/3.	9	CO4	BT3	3.1.1
(b)	Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in Fig below.	8.5	CO4	BT3	3.1.1

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SEMESTER	V	DATE OF EXAM	20.12.2023 (I)
COURSE NAME	Metric Spaces	COURSE CODE	MAH303B
PROGRAM	B.Sc.(Hons.)Mathematics	CREDITS	04
TIME DURATION	180 Mins.	MAX. MARKS	100
NAME OF FACULTY	Dr. Aparna Vyas	NAME OF COURSE COORDINATOR	Dr. Advin Masih

Note: All Parts are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Let X be any non-empty set and let d be the function defined as $d(x,y) = \begin{cases} 0, & if\ x = y, \\ 1, & if\ x \neq y. \end{cases}$ Show that (X, d) is a metric space.	05	CO1	BT02	1.1.1 1.2.1
	1(B)	Prove that a subset of a metric space (X, d) is closed if it contains all its limit points.	05	CO1	BT02	1.1.1 1.1.2
	1(C)	Show that in a metric space, finite intersection of open set is open	05	CO1	BT02	1.1.1, 1.1.2
PART-B	1(D)	Show that if $< x_n >$ is a Cauchy sequence , then any cluster point $< x_n >$ of is a limit of $< x_n >$.	05	CO2	BT02	1.1.1, 1.1.2
	1(E)	Find the fixed points of the mapping $T: R \to R$ defined as $T(x) = x^2 \quad \forall x \in R$	05	CO2	BT03	1.2.1, 3.1.2
	1(F)	Find the completion]0,1].	05	CO2	BT04	1.1.1, 1.1.2
PART-C	Q2(A)	Check whether an open interval]0,1[with the usual metric is compact or not ?	12	CO3	BT03	1.2.1, 3.1.2
	(B)	Let (X, d) be a metric space and $S \subset X$. Show that S is compact subset of X if only if every d-open cover of S has a finite subcover.	12	CO3	BT03	1.1.1, 1.1.2
	(C)	Show that every totally bounded metric space is bounded. However, the converse need not be	11	CO3	BT03	1.1.1, 1.2.1

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		true.				
PART-D	**3(A)**	Show that a subset of the real line $\mathbb{R}$ containing at least two points is connected if and only if it is an interval.	12	CO4	BT03	1.1. 1.1.
	(B)	Show by an example that a compact set need not be connected	12	CO4	BT04	1.2 3.1.
	(C)	If S and T are connected subsets of a metric space (X,d) which are not separated , prove that $S \cup T$ is also a connected set.	11	CO4	BT03	1.1 1.2.

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SEMESTER	3rd		DATE OF EXAM/SESSION	11.12.2023 (II)
SUBJECT NAME	Quantum Mechanics		COURSE CODE	PHH201B-T
PROGRAM	B. Sc.(H) Physics		CREDITS	4
TIME DURATION	3 hrs.		MAX. MARKS	100
NAME OF FACULTY	Dr. D. K. Sharma		NAME OF COURSE COORDINATOR	Dr. D. K. Sharma

Set-B

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q. 1	State Heisenberg uncertainty principle. Explain it with two simple examples. Give its physical significance.	6, 5, 4	CO1	BT2, BT4	
PART-B	Q. 2	Derive Schrodinger's time-independent wave equation for a particle. Give the physical interpretation of the wave function.	9, 6	CO2	BT3	
PART-C	Q. 3	Discuss the hydrogen atom to find eigen function and hence to determine the probability of finding the electron around the nucleus in ground state.	8, 9	CO3	BT2	
PART-C	Q. 4	Apply the Schrodinger equation for a linear harmonic oscillator to obtain its eigen values and eigen functions.	9,9	CO3	BT3	
PART-D	Q. 5	Explain in details the tunneling effect for which the propagation of a particle through a region where the particle's energy is smaller than the potential energy.	9,8	CO4	BT1	
PART-D	Q. 6	Discuss the electron dipole selection rule and hence prove that $\Delta n=\pm 1$.	9, 9	CO4	BT3	

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"End Semester Examination, Dec-2023"

SEMESTER ·	III	DATE OF EXAM/SESSION	16.12.2023 (II)
COURSE NAME	MATHEMATICAL PHYSICS III	COURSE CODE	PHH202B – T
PROGRAM	B.Sc. (H) Physics	CREDITS	4
TIME DURATION	3 hours	MAX. MARKS	100
NAME OF FACULTY	Dr. Moditma	NAME OF COURSE COORDINATOR	Dr. Moditma

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q.1	Determine the roots of the equation $z^3 = 1$ and depict them on the complex plane.	4+1=5	CO1	BT2	5.4.1
	Q.2	Consider a complex function $f(z) = u(x,y) + iv(x,y)$. Given $u(x,y) = e^x \cos y$, determine a function $v(x,y)$ such that $f(z)$ is analytic. **OR** Consider the function $f(z) = \frac{1}{z^6+1}$. Examine its residues at the three points which lie in the 1st and 2nd quadrants.	10	CO1	BT4	5.4.1, 7.1.1
PART-B	Q.3	Find the Fourier cosine integral of $f(x) = \begin{cases} 0; & 0 < x < 2 \\ k; & 2 < x < 3 \\ 0; & x > 3 \end{cases}$	7	CO2	BT2	5.4.1
	Q.4	Solve for the Fourier sine transform of $f(x) = x^2; 0 \le x \le 1$.	8	CO2	BT3	5.4.1
PART-C	Q.5	Define the following terms: (i) Random experiment (ii) Sample space	2+2=4	CO3	BT1	7.1.1
	Q.6	A bag contains 4 black and 5 red balls. Two balls are drawn from the bag one by one, without replacement. What is the probability that (i) first ball is red (ii) second ball is red given that the first ball drawn was red (iii) second ball is red given that the first ball drawn was black	1+2+2=5	CO3	BT2	5.4.1, 7.1.1, 10.2.1
	Q.7	Two dice are thrown simultaneously. Consider a Binomial experiment where success is defined such that sum of the two numbers obtained is equal to 7. (i) What is the probability of success and failure in this experiment? (ii) If 5 trials are performed, what is the probability of 3 successes?	3+3=6	CO3	BT2	5.4.1, 7.1.1, 10.2.1

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	Q.8	Show that for any probability distribution, the variance can be expressed as: $$\sigma = \sqrt{\langle x^2 \rangle - \langle x \rangle^2}$$ Hence obtain an expression for the variance of (i) Gaussian distribution **OR** (ii) Binomial distribution	5+15=20	CO3	BT4	5. 7

PART-D

Q.9	What do you understand by an abelian group? Demonstrate that: (i) Set R_0 of all non-zero real numbers forms an abelian group under multiplication. (ii) The three cube roots of unity form an abelian group under multiplication.	2+5+5=12	CO4	BT4	5
Q.10	Write the expression of rotation matrix in 3 dimensions about the z-axis. Use this rotation matrix to show that rotation of the vector $\hat{\imath}$ by 90° about the z-axis yields the vector $\hat{\jmath}$.	2+8=10	CO4	BT2	5. 7
Q.11	Classify the following differential equations as linear/non-linear: (i) $y'' + y' + yx = 0$ (ii) $y'' + y' + y^2x = 0$ (iii) $y'' + y' + x^2y = 0$ (iv) $y'' + y'y + xy = 0$ (v) $y'' + y = 0$	1× 5 = 5	CO4	BT2	5.
Q.12	Consider the first order differential equation $\dot{x} = sinx$. (i) Identify whether this a linear or non-linear differential equation. (ii) Identify the fixed points and determine their stability. (iii) Hence analyze the variation of $x(t)$ graphically. **OR** Consider the equation for population growth in an ecosystem being defined as: $\dot{N} = rN(1 - \frac{N}{k})$, where r, k are constants. (i) Identify whether this a linear or non-linear differential equation. (ii) Identify the fixed points and determine their stability. (iii) Hence analyze the variation of $N(t)$ graphically.	1+2+5=8	CO4	BT3	5. 7. 10

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DEPARTMENT OF SCIENCES
Physics Program
"End Term Examination, Dec 2023"

SEMESTER	III	DATE OF EXAM	19.12.2023
SUBJECT NAME	Electromagnetic theory	SUBJECT CODE	PHH203B-T
BRANCH	Physics	SESSION	II
TIME	3 hrs	MAX. MARKS	100
PROGRAM	B.Sc (H) Physics	CREDITS	4
NAME OF FACULTY	Dr. Shiv Kumar Dixit	NAME OF COURSE COORDINATOR	Dr. Shiv Kumar Dixit

Note: All questions are compulsory from part A and part B.   Set A

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q.1	(i) State Divergence and Stokes theorem and calculate divergence of the function $P = x^2yz\ a_x + xz\ a_z$ (ii) For the given point P (-2, 6, 3), express point P in cylindrical and spherical coordinates.	5+5	CO1	BT3	2.1.1
	Q.2	Given vectors $A = 3a_x + 4a_y + a_z$ and $B = 2a_y - 5a_z$, determine the angle between A and B.	5	CO1	BT4	2.1.1
	Q.3	(i) Explain Maxwell equation for a time varying field and determine an expression for displacement current (J_d). (ii) Derive an expression for electric field dielectric - conductor boundary condition for both tangential and normal component with diagram.	5+5	CO2	BT4	1.1.1

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	Q.4	If $A = 10a_x - 4a_y + 6a_z$ and $B = 2a_x + a_y$, find: (a) the component of A along a_y, (b) the magnitude of 3A - B, (c) a unit vector along A + 2B.	5	CO2	BT3	2.1.1
	Q.5	Explain Poynting theorem and Poynting vector with expression and diagram.	5+5+5	CO3	BT2	1.2.
	Q.6	What are intrinsic impedance and propagation constant? Calculate both parameters for free space and lossless dielectrics.	7+8	CO3	BT2	2.1.
PART-B	Q.7	Explain skin depth, how it is dependent on frequency?	5	CO3	BT3	1.2
	Q.8	What are the applications of transmission lines? Explain any three.	10	CO4	BT3	1.2
	Q.9	What is transmission line? Explain its parameters for coaxial line.	3+7	CO4	BT2	1.
	Q.10	What is characteristics impedance of a transmission line? Derive an equation for lossless and distortion less transmission line.	7+8	CO4	BT4	1.

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES (PHYSICS)
"End Semester Examination, Dec-2023"

SEMESTER	V		DATE OF EXAM	12.12.2023 (I)
COURSE NAME	Statistical Physics		COURSE CODE	PHH301B-T
PROGRAM	B.Sc (H) Physics		CREDITS	4
TIME DURATION	3 hrs		MAX. MARKS	100
NAME OF FACULTY	Dr. Aditya Sharma		NAME OF COURSE COORDINATOR	Dr. Aditya Sharma

*Note: **Part A & B**: All questions are compulsory. **Part C & D**: 2 (A) and 3 (C) are having an optional question.* **(SET-A)**

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Find the number of ways in which 10 distinguishable particles can be arranged in an order.	3	CO1	BT3	
	1(B)	Deduce the relation for partition function with Gibb's potential.	3	CO1	BT9	
	1(C)	Give relations for all four thermodynamic potentials.	3	CO1	BT3	
	1(D)	Define macrostates and microstates and give an example for distributing four particles in two boxes.	3	CO1	BT3	
	1(E)	Briefly distinguish between different kinds of ensembles.	3	CO1	BT3	
PART-B	1(F)	Calculate the average energy of an oscillator of frequency $5.6 \times 10^{12} \, S^{-1}$ at 330 K, treating it as a classical oscillator.	3	CO2	BT3	
	1(G)	A black body is placed in an enclosure whose walls are kept at 300 K. Compare the rate at which heat is gained or lost by the body when its temperature is (i) 500 K and (ii) 200 K	3	CO2	BT3	
	1(H)	Write the Saha's ionization formula stating the meaning of all symbol used.	3	CO2	BT3	
	1(I)	Show that Rayleigh Jean's law is incorporated in Planck's radiation law.	3	CO2	BT3	
	1(J)	A body at 1500 K emits maximum energy at a wavelength 20000 angstrom. If the sun emits maximum energy at wavelength 5500 angstrom, what	3	CO2	BT3	

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PART-C		would be the temperature of the sun ?			
	Q2(A)	Derive the expression for the most probable distribution of particles among various energy levels of a system obeying Bose- Einstein Statistics.	15	CO3	BT4, BT3
	Or	Derive the expression for the distribution of bosons as function of temperature for below and above the Bose-Einstein Condensation temperature.	2+3+ 5+5 = 15	CO3	BT4, BT3, BT2
	Q2(B)	What is Larmor precession? Determine the Larmor frequency for an election under the presence of Magnetic field.	2+8 =10	CO3	BT3, BT2
	Q2(C)	Derive mathematical expression for Orbital Magnetic dipole Moment, Spin Magnetic Moment and Bohr Magnetron.	10	CO3	BT4, BT3
PART-D	Q3(A)	What is Fermi-Dirac distribution law? Using the Fermi-Dirac distribution function, Derive a relation for Fermi energy.	15	CO4	BT3
	Q3(B)	Apply the Fermi-Dirac distribution and establish a relation for calculating Energy distribution of electrons in a metal.	15	CO4	BT2, BT3
	Q3(C)	Calculate E_{F0} for electrons in a Metal.	5	CO4	BT4
	Or	Write a detailed comparison of three known Statistics.	5	CO4	BT2, ~~BT4~~

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES (PHYSICS)
"End Semester Examination, Dec-2023"

SEMESTER	V	DATE OF EXAM	16/12/2023 (I)
COURSE NAME	Modern Physics	COURSE CODE	PHH304B-T
PROGRAM	B.Sc (H) Physics	CREDITS	4
TIME DURATION	3 hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Aditya Sharma	NAME OF COURSE COORDINATOR	Dr. Aditya Sharma

Note: Part A: *All questions are compulsory.* **Part B:** *2 (A) and 3 (C) are having an optional question.* **(SET-B)**

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	What is the theory of Relativity? Write the need of this theory, its types and Einstein postulates.	3	CO1	BT3	
	1(B)	What is the frame of references? Explain the types of frame of references with suitable examples.	3	CO1	BT3	
	1(C)	Derive the Galilean Transformation equations for position, velocity and acceleration.	3	CO1	BT3	
	1(D)	What are the proper time and proper length concepts? Write equations for relating the proper and relativistic time and length.	3	CO1	BT3	
	1(E)	Derive the Einstein's Mass-Energy relation from the theory of Relativity.	3	CO1	BT3	
PART-B	1(F)	Write postulates of the Bohr's atomic theory and explain the origin of various spectral lines from the electronic transitions.	3	CO2	BT3	
	1(G)	Write the equations for different series of spectral lines observed in the Hydrogen atom case.	3	CO2	BT3	
	1(H)	Calculate the radius of First atomic shell in case of H atom and also evaluate the velocity of electron in this shell.	3	CO2	BT3	
	1(I)	Evaluate the ionization potential of Hydrogen atom.	3	CO2	BT3	
	1(J)	How many revolutions an electron can make before dropping from $n=5$ to $n=1$, within the time of 20×10^{-4} seconds.	3	CO2	BT3	

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PART-C	Q2(A)	What is Raman Effect? Provide the experimental set-up details to observe the Raman effect. Why the stoke and anti-stoke lines are observed in Raman experiment. Derive mathematical expressions for explaining the Raman effect using classical theory.	2+5+3+5 = 15	CO3	BT4, BT3	
	Or	What is the Quantum mechanical Origin of Raman effect. Derive mathematical expression for the quantum theory of Raman effect and explain the findings which were not interpreted by classical theory.	5+5+5 = 15	CO3	BT4, BT3, BT2	
	Q2(B)	What is Larmor precession? Determine the Larmor frequency for an election under the presence of Magnetic field.	2+8 =10	CO3	BT3, BT2	
	2(C)	Derive mathematical expression for Orbital Magnetic dipole Moment, Spin Magnetic Moment and Bohr Magnetron.	10	CO3	BT4, BT3	
PART-D	Q3(A)	Write the description of nuclear stability under the; (i) Liquid Drop model, (ii) Fermi Gas model	10	CO4	BT4	
	3(B)	How the nuclear Shell model predict the stability of nuclei by introducing the magic numbers? Explain the need of total angular quantum number and thus calculate the magic numbers for (at least) N = 3.	15	CO4	BT3	
	Q3(C)	Why do we need nuclear detectors? Demonstrate the, principle, construction and working of G.M. Counter.	10	CO4	BT2, BT4	
	Or	Write principal, Construction and working of Scintillation Counter. Also explain the merits/demerits of scintillation counters over the G.M. counter.	10	CO4	BT4	

******************* END *******************

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MANAV RACHNA UNIVERSITY
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DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	V	DATE OF EXAM/SESSION	18/12/2023 (I)
COURSE NAME	Condensed Matter Physics-I	COURSE CODE	PHH303B-T
PROGRAM	B.Sc. (H) Physics	CREDITS	4
TIME DURATION	3 Hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Deepti Maikhuri	NAME OF COURSE COORDINATOR	Dr. Deepti Maikhuri

***Note*:** *All questions are compulsory. Use of scientific calculator is allowed during the exam.*
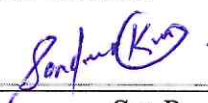
[SET –A]

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	
PART-A	1	(a)Define the following terms used in crystallography. (i) Crystal lattice and unit cell (ii) primitive cell (iii) packing factor (iv) coordination number (b)Obtain lattice constant and radius of the atom having simple lattice and volume density of $3\times10^{22}/cm^3$ assuming that the atoms are hard sphere with each atom touching its nearest neighbour.	8+7	CO1	BT1, BT2, BT3	
PART-B	2	(a)Density of Cu is 8.94gm/cm^3 and its atomic weight is 63.5. Calculate the Fermi energy of Cu by assuming that each atom gives one electron. (b) What is the temperature at which there is 1% probability that an energy state lying 0.2 eV below the Fermi level is empty	7.5+7.5	CO2	BT3	
PART-C	3	Discuss the vibrations of diatomic lattice and describe its optical and acoustic modes. What is the difference between the two branches and why are they named so? Analyse the vibrational motion of a diatomic periodic linear chain and obtain expressions for the vibration frequencies ω as a function of wavenumber k or Obtain the dispersion relation for elastic waves in a linear chain of atoms with nearest neighbour interaction and show that group velocity vanishes at the zone boundaries. Sketch the dispersion curve.	8+4+8	CO3	BT2, BT4	
	4	Show that Einstein's relation for the specific heat capacity per Kmol of a solid reduces to the classical value of 3R when $k_BT \geq h\nu$. Discuss the variation of Einstein's specific heat with temperature or Derive an expression for specific heat of solids on the basis of Debye model. How does Debye model differ from the Einstein model. Discuss the variation of Debye's specific heat with temperature.	9+6	CO3	BT2, BT4,	
PART-D	5	Provide detailed explanations for two methods used to reveal the structure of substances, namely (a) Nuclear Magnetic Resonance (NMR)	10+10	CO4	BT1, BT2, BT4	

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		(b) XRD (c) Fourier Transform Infrared Spectroscopy (FTIR)			
	6	Provide a concise explanation of non-bonding electron excitation and its relationship to UV spectra. How does delocalization of electron helped in getting a molecule to absorb UV-Visible radiation and displaying the UV-Visible absorption spectra?	5+10	CO4	BT2, BT3, BT4

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DEPARTMENT OF SCIENCES
Physics Program
"End Term Examination, Dec 2023"

SEMESTER	V	DATE OF EXAM	20.12.2023
SUBJECT NAME	Digital Electronics	SUBJECT CODE	PHH302B-T
BRANCH	Physics	SESSION	I
TIME	180 min	MAX. MARKS	100
PROGRAM	B.Sc (H) Physics	CREDITS	4
NAME OF FACULTY	Dr. Shiv Kumar Dixit	NAME OF COURSE COORDINATOR	Dr. Shiv Kumar Dixit

Note: *All questions are compulsory from part A and part B.*   Set B

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q.1(a)	Implement the AND gate using NAND and NOR gate only.	5	CO1	BT3	1.1.1
	Q.1(b)	What are inverting and non inverting amplifiers? Explain the concept of virtual ground in OP-AMP.	5	CO1	BT2	1.2.1
	Q.1(c)	Convert $(1011.01)_2 = ($ $)_{10}$	5	CO1	BT4	1.3.1
	Q.2(a)	Verify the following (i) $A + \bar{A}B = A + B$ (ii) $(A+B)(A+C) = A + BC$ (iii) Define DeMorgan's Theorem	7	CO2	BT3	1.2.1
	Q.2(b)	Define encoders? Explain 8 line to 3 line octal to binary encoder with truth table and logic circuit diagram.	8	CO2	BT1	1.1.1

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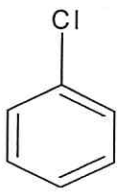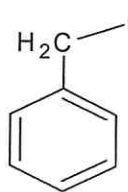|					
PART-B	Q.3	(i) Explain clocked JK flip flop with truth table and logic circuit diagram. (ii) What is race around condition in JK flip flop? Explain how it occurs? Suggest a method to overcome the race around difficulty.	4+8+8	CO3	BT2	1.1.1
	Q.4	Explain half and full subtractor with truth table and diagram? Derive half adder using two input NAND gate.	7+8	CO3	BT3	2.1.1
	Q.5	(i) What are counters? Explain asynchronous ripple counter with logic diagram and truth table. (ii) Explain the important points of EPROM, EEPROM and computer memories.	4+8+8	CO4	BT3	2.1.1
	Q.6	What are shift registers? Write their classifications and explain them with diagram.	5+5	CO4	BT3	2.1.1
	Q.7.	Write four differences between parallel and serial transfer.	5	CO4	BT2	2.1.1

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MANAV RACHNA UNIVERSITY
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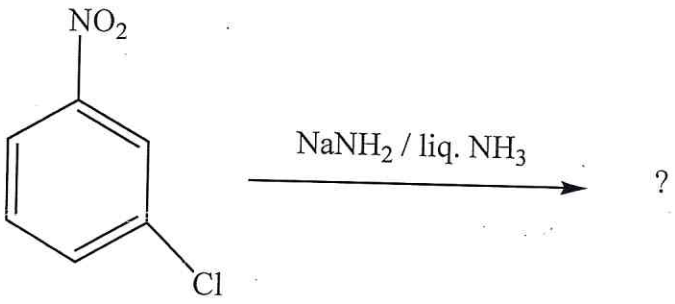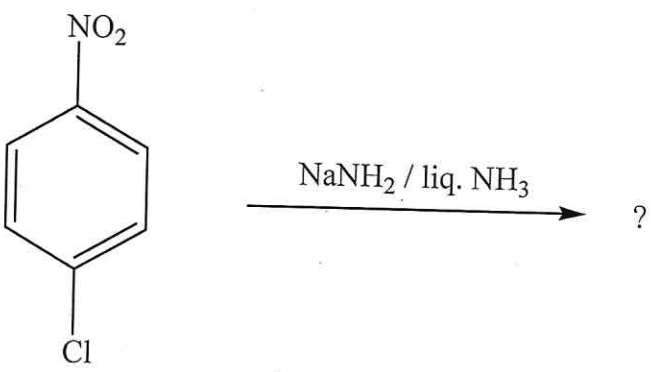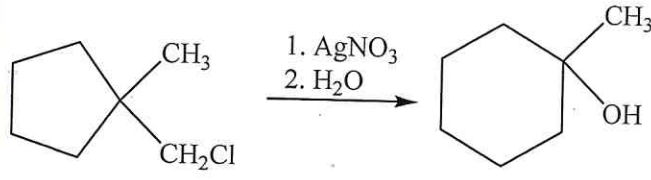
SEMESTER	I		DATE OF EXAM/SESSION	11/12/2023
COURSE NAME	ORGANIC CHEMISTRY-I		COURSE CODE	CHH503B (I)
PROGRAM	MSc (CHEMISTRY)		CREDITS	4
TIME DURATION	3 HOURS		MAX. MARKS	100
NAME OF FACULTY	Dr. S.K. Shukla		NAME OF COURSE COORDINATOR	Dr. S.K. Shukla

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(a)	In general free radicals shows sp^2 hybridization, but the bridged structures of free radicals not follow the Sp^2 hybridization. Why? Explain in detail.	6 Marks	CO1	BT2	
	1(b)	Differentiate the classical and non-classical carbocation with suitable examples.	5 marks	CO1	BT1	
	1(c)	Define the term carbine. How to convert Benzene in to tropylium chloride	4 marks	CO1	BT3	
PART-B	2(a)	Give detailed S_N1 mechanism and explain why retention product is lesser than inversion product.	5 marks	CO2	BT3	
	2(b)	Which of the following compound gives nucleophilic substitution reaction. Explain with detailed reasoning. (a) Cl (b) H_2C—Cl	5 Marks	CO2	BT4	
	2(c)	Explain the S_N1' mechanism with suitable example	5 Marks	CO2	BT3	

3 (a)	What are the substrate effects on the elimination-addition reaction?	5 Marks	CO3	BT4		
3(b)	Explain the benzyne mechanism in detail.	4 marks	CO3	BT2		
3 (c)	What is the difference between the products in following reactions, if both follows the benzyne mechanism?	6 Marks	CO3	BT4		
4(a)	In pyridine, the arenium ion formed due to attack of the electrophile on all the three possible positions gives equal number of resonating structures, but the attack favours only on 3-position. Why? Explain with detailed chemical representations.	7 marks	CO3	BT3		
4(b)	Write a note on π-complex intermediate with a suitable example.	7 Marks	CO3	BT1		
4(c)	Alkyl group do not have any lone pair of electron to donate but it shows ortho-para directing behavior. Why? Explain with detailed chemical reactions	6 Marks	CO3	BT4		

5(a)	How the C-C single bond influences the product formation in acetolysis of the exo- and endo-2 norborinyl system.	8 Marks	CO4	BT3	
5(b)	Give detailed reason why 4-methyl-pent-3-enyl tosylate gives a cyclic product along with major linear product, when it undergoes acetolysis.	6 marks	CO4	BT4	
5(c)	What are the neighboring group participation? Explain with suitable schematic representation. Why it generally gives retention of product, instead of the inversion product in SN2 mechanism.	6 marks	CO4	BT1	
6(a)	Deduce the suitable mechanism of the following reaction.	8 Marks	CO4	BT4	
6(b)	Write the role of negative charge acquired by oxygen in neighboring group participation with suitable example.	7 marks	CO4	BT2	

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCE
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"End Semester Examination, Dec-2023"
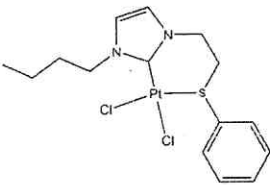
SEMESTER	I	DATE OF EXAM/SESSION	14.12.2023 (I)
COURSE NAME	Inorganic Chemistry-I	COURSE CODE	CHH502B
PROGRAM	MSc	CREDITS	4
TIME DURATION	3 Hr	MAX. MARKS	100
NAME OF FACULTY	Dr. A. Jayamani	NAME OF COURSE COORDINATOR	Dr. A. Jayamani

Note: All questions are compulsory

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1A	Explain how Δ_o and Nephelauxetic effect calculated theoretically with examples	5	CO1	3	
	1B	Write short not on classification of Jahn-Teller distortion with examples for each	5	CO1	4	
	1C	Explain the metal-ligand bonding in transition metal complexes using molecular orbital theory	5	CO1	2	
PART-B	2A	What are Russel-Saunders states and Spectroscopic ground states?	5	CO2	1	
	2B	A Cr^{3+} metal complex has strong transitions and λ_{max} at 431.03 nm, 781.25 nm, and 1,250 nm. Determine the Δ_{oct} and B for this complex. 	5	CO2	4	
	2C	Explain in detail on the classification of charge transfer spectra	5	CO2	5	

Table within question 2B:

Δ_{oct}/B	10	20	30	40
Height $E(\nu_3)/B$	29	45	64	84
Height $E(\nu_2)/B$	17	30	40	51
Height $E(\nu_1)/B$	10	20	30	40
Ratio $E(\nu_3)/E(\nu_1)$	2.9	2.25	2.13	2.1
Ratio $E(\nu_2)/E(\nu_1)$	1.7	1.5	1.33	1.275

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PART-C	3A	[CpMoCl$_2$]$_2$ obeys the 18 electron rule, the correct structure of this compound is (atomic no. of Mo 42)	4	CO3	3
	3B	How are organometallic compounds classified based on position, composition, hapticity and bonding	8	CO3	2
	3C	Calculate the number of M-M bonds in [Ir$_4$(CO)$_{12}$] and [Co$_2$Fe$_2$(CO)$_{11}$(μ^4-PPh)$_2$] if both the compounds obey 18 electron rule.	6	CO3	5
	3D	(i) Draw the structure of (μ-Di- tert-butyl-silanediolato)bis-[bis-(η^5-cyclo-penta-dien-yl)methyl-zirconium] (ii) Write the name of the following organometallic compound 	8	CO3	5
	3E	Illustrate the mechanism of hydroformylation process using an organometallic compound catalyst	4	CO3	3
	3F	Write short notes on (i) σ-bonded organometallic compounds (ii) π-bonded organometallic compounds	5	CO3	1
PART-D	4A	Elaborately explain on the preparation of metal carbonyls with reactions	7	CO4	2
	4B	Which of the following provides experimental evidence for π-back donation in a metal carbonyl complex such as [Fe(CO)$_5$]? a) The CO molecule has a vacant π^* MO. b) The C–O bonds in the complex are shorter than in free CO. c) Covalent Fe–C bonds are present in complex. d) The wavenumbers corresponding to the C–O stretches in the complex are lower than that for free CO.	4	CO4	4
	4C	Explain the structure of metal carbonyl using proper illustration	6	CO4	2
	4D	Differentiate homoleptic and heteroleptic metal carbonyls. Explain how to identify the above carbonyls using vibrational spectroscopy	8	CO4	3
	4E	Which complex among Ni(CO)$_3$PMe$_3$ and Ni(CO)$_3$PF$_3$ will have the higher CO stretching frequency? Explain. Which one has the stronger M-CO bond?	5	CO4	3
	4F	Explain in detail on tertiary phosphine ligands acting as spectator and actor ligands	5	CO4	1

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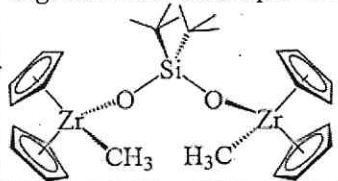
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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCE
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	I	DATE OF EXAM/SESSION	14.12.2023 (I)
COURSE NAME	Inorganic Chemistry-I	COURSE CODE	CHH502B
PROGRAM	MSc – CHEMISTRY	CREDITS	4
TIME DURATION	3 Hr	MAX. MARKS	100
NAME OF FACULTY	Dr. A. Jayamani	NAME OF COURSE COORDINATOR	Dr. A. Jayamani

Note: All questions are compulsory

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1A	Differentiate Spectrochemical series and nephelauxetic series	5	CO1	3	
	1B	Compare the two mechanisms of Jahn-Teller distortion and justify the most appropriate distortion.	5	CO1	4	
	1C	Describe in detail on the postulates of molecular orbital theory with explanation for Transition Metal Complexes	5	CO1	2	
PART-B	2A	Explain in detail on selection rules for electronic transitions in transition metal compounds.	5	CO2	1	
	2B	For Ni^{2+} octahedral complex, three absorption bands are observed at 921.66 nm, 568.18 nm and 353.36 nm, determine Δ_o and Racah parameter (B). Δ_o/B 10 20 30 40 E_3/B 27 46 65 85 E_2/B 16 29 41 51 E_1/B 10 20 30 40	5	CO2	4	
	2C	The color of $[MnO_4]^-$ is deep purple whereas $[ReO_4]^-$ is colorless even though both the metals are in same group, Justify with explanation on the concept	5	CO2	5	

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PART-C	3A	Explain in detail on classification of organometallic compounds with examples.	8	CO3	1, 2	
	3B	Calculate the number of Ni-Ni bonds in $[CpNi(\mu-PPh_2)]_2$ complex which is obeying 18 electron rule.	4	CO3	4	
	3C	(i) Draw the structure of cis-{1-Butyl-3-[2-(phenyl-sulfan-yl)eth-yl]-4-imidazolin-2-yl-κ^2 C^2,S'}di-chlorido-platinum(II) (ii) Write the name of the following organometallic compound	8	CO3	5	
	3D	Write examples of the following (i) η^2 Organometallic compound (ii) η^5 Organometallic compound (ii) Hydrogenation in catalyst (iii) Hydroformylation catalyst	7	CO3	2	
	3E	Compare and contrast on the stability of σ bonded organometallic compounds and Π bonded organometallic compounds with examples	8	CO3	3	
PART-D	4A	Explain the classification of metal carbonyls elaborately with examples	7	CO4	2	
	4B	Which statement is incorrect about CO ligands (i) A CO ligand can accept electron into its π^* molecular orbital, this weakens the CO band (ii) CO ligands can adopt terminal, μ^2 and μ^3 bonding modes, the amount of back donation depends on the bonding mode (iii) In IR spectra of $Fe(CO)_5$, the absorptions assigned to M-CO stretching are at higher wavenumber than that of free CO (iv) fluxional behaviour is common in metal carbonyl compounds and can be investigated by ^{13}C NMR spectroscopy	4	CO4	4	
	4C	Describe in detail about the factors affecting back bonding in metal carbonyls	6	CO4	2	
	4D	How to elucidate the structure of metal carbonyls from vibrational spectra. Explain with examples of homoleptic and heteroleptic metal carbonyls.	8	CO4	3	
	4E	Describe how the terminal and bridging carbonyl groups are differentiated using vibrational spectroscopy with examples	6	CO4	3	
	4F	Write down the distinct features of tertiary phosphine ligands	4	CO4	1	

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCINECES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	I		DATE OF EXAM	18/12/2023
COURSE NAME	Physical Chemistry-I		SUBJECT CODE	CHH501B (I)
PROGRAM	M.Sc. Chemistry		CREDITS	4
TIME DURATION	180 Minutes		MAX. MARKS	100
NAME OF FACULTY	Dr. Arpit Sand		NAME OF COURSE COORDINATOR	Dr. Arpit Sand

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	1	Give an account for the Debye-Hückel theory of strong electrolytes	5	CO1	BT3
	2	Calculate the ionic strength of a solution prepared by mixing 50 ml 0.2 M KNO_3, 20 ml 0.15 M K_2SO_4, 30 ml 0.05 M $Cu(NO_3)_2$.	5	CO1	BT4
	3	Discuss Gouy Chapman Diffusion Model in with figure	5	CO1	BT2
PART-B	4	Discuss thermodynamics approach to CMC	5	CO1	BT3
	5	Give and account for surface active agents with suitable example of interface.	5	CO2	BT3
	6	With the help of graph explain krafft point in detail	5	CO2	BT4
PART-C	7	Deduce Expression for particle in 1D box and draw the graphs between various energy levels	5+5	CO3	BT4
	8	Explain the equation $\hat{A}(\chi_i)\, f(\chi_i) = pf(\chi_i)$ and term involved.	5	CO3	BT3
	9	Discuss Normalized, Orthogonal, Radial and Angular wave function mathematically	5+5	CO3	BT3
	10	Show that $[\hat{A}, \hat{E}] = -[\hat{E}, \hat{A}]$	5	CO4	BT2

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PART-D	11	Show relation for first few Harmite up to 5	5	CO4	BT3
	12	Discuss application of Perturbation method in case of He atom particle in 1D, 3D and perturbed harmonic oscillator	5+5+5	CO5	BT3
	13	Calculate energy in ID Box with the help of variation method	5	CO5	BT3
	14	Deduce expression for Rodrigues formula for the Hermit polynomials.	5	CO5	BT4
	16	Deduce expression for Recursion relation.	5	CO5	BT4
	17	Write a short note on approximation method	5	CO5	BT4

****************** END ******************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End-term Examination, Dec.-2023"

SEMESTER	I	DATE OF EXAM	20/12/2023 (I)
COURSE NAME	Analytical Chemistry	COURSE CODE	CHH504B
PROGRAM	M.Sc. Chemistry	CREDITS	4
TIME DURATION	3 hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Pradeep K. Varshney	NAME OF COURSE COORD.	Dr. Pradeep K. Varshney

Note: *Part A is compulsory. Part B- Questions will be of descriptive type or numerical.*

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Which analytical technique is used to do quantitative analysis of soil samples.	2	CO1	BT1	
	1(B)	Write the role of atomization chamber in Atomic Absorption Spectroscopy.	2	CO1	BT2	
	1(C)	Write major steps of a typical Quantitative sample analysis.	2	CO1	BT3	
	1(D)	How can you decide precision and accuracy in your experimental work?	2	CO2	BT4	
	1(E)	Calculate the bond order of N_2 and N_2^{2-}.	2	CO2	BT1	
	1(F)	Write full form of ICP-OES. How many elements can be detected at a time?	2	CO2	BT1	
	1(G)	Why hyphenated techniques are prefered by industries and research organization.	2	CO4	BT4	
	1(H)	Define an auger electron? Write its significance.	2	CO2	BT3	
	1(I)	Write any two remarkable differences between GC-MS and LC-MS.	2	CO2	BT2	
	1(J)	What is the role of plasma in hyphenated techniques?	2	CO4	BT3	
PART-B	Q2(A)	Draw a block diagram of Atomic Emission Spectroscopy (AES).	5	CO1	BT3	
	2(B)	Distinguish between AAS and AES. Write any two limitations	3+2	CO1	BT4	

	of AAS.				
Q3(A)	What are Auger electrons? Which surface chemical analysis is similar to Auger electron spectroscopy. Explain.	5	CO2	BT5	
3(B)	XPS and ESCA instruments are same or different. What information is obtained from these instruments?	5	CO2	BT3	
Q4(A)	A "photon' shows the photoele effect? Explain with diagram.	5	CO1	BT2	
4(B)	If you are given a chance to setup an instrumentation centre, which five equipments you will purchase first. What information you will get from each.	5	CO1	BT4	
Q5(A)	If you are given a chance to work in a pharmaceutical industry, what strategy you will adopt to Design a drug using natural resources for the welfare of mankind.	5	CO1	BT4	
5(B)	Which analytical instruments you will use to test your drug synthsized using natural resources and **why?**.	5	CO2	BT5	
Q6(A)	Explain the principle of atomic absorption spectroscopy. Write limitations of AAS?	5	CO3	BT2	
6(B)	Briefly describe the types and advantages of hyphenated techniques used with mass spectrometry.	5	CO3	BT2	
Q7(A)	What essential requirements must be satisfied in a good interface to the mass spectrometer?	5	CO3	BT2	
7(B)	Explain the principle of X-ray Diffraction. Write its applications.	5	CO4	BT3	
Q8(A)	Compare between SEM and TEM analytical techniques.	5	CO4	BT3	
8(B)	What is the principle of Voltametry. Why three electrodes are used in it. Write applications of cyclic voltametry.	2+1+2	CO4	BT3	
Q9(A)	What information is obtained from Capillary electrophoresis.Explain its principle with a diagram.	2+3	CO4	BT3	
9(B)	Write Principle and applications of SEM.	2+3	CO4	BT3	

****************** END ******************

MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM/SESSION	12·12·2023 (II)
COURSE . NAME	SYMMETRY AND GROUP THEORY	COURSE CODE	CHH601B
PROGRAM	M.Sc. Chemistry	CREDITS	4
TIME DURATION	180 min	MAX. MARKS	100
NAME OF FACULTY	Dr. Roopa Rani	NAME OF COURSE COORDINATOR	Dr. Roopa Rani

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	
PART-A	Q1	a) Define the order and sub-order of a group.	2	CO1	BT1	
		b) Using C_6H_6 as an example, discuss the concept of equivalent symmetry elements, operations and atoms.	4	CO2	BT2	
		c) Explain the following terms i. Character ii. Similarity transform iii. Dimension	3	CO2	BT3	
		d) Identify the point group of – IF_7 molecule.	3	CO1	BT4	
		e) Justify the statement "dipole moment value vary with the symmetry of a molecule". Use suitable example	3	CO2	BT4	
PART-B	Q2	a) Reduce the following representations into irreducible representations referring to the character table of C_{2v} point group E C2 σ(xz) σ(yz) 10 -4 -10 4	3	CO3	BT2	
		b) C_{3v} point group comprises a group, illustrate this and define the symmetry elements present in this point group using any one suitable example.	4	CO4	BT1	
		c) How many irreducible representations shall be present in C_{2v} point group and why?	2	CO4	BT4	

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		d) Consider a three atom system of D_{3h} point group and refer to the image below – Symmetry elements $\quad E \quad 2C_3 \quad 3C_2 \quad \sigma_h \quad 2S_3 \quad 3\sigma_v$ Reducible representation $\quad 3 \quad 0 \quad -1 \quad -3 \quad 0 \quad 1$ Irreducible components: $A_2'' + E''$ Determine atleast one wave function using the above data.	3	CO4	BT6
		e) Explain mulliken symbols for nomenclature of irreducible representations.	3	CO3	BT2
PART-C	**Q3**	a) Consider a three atom system, generate the secular equation, secular determinant and matrix only, to evaluate the energy of the system. Also write the integral approximations introduced by Huckel.	6+4	CO4	BT6
		b) Briefly elaborate the difference among the concept of VBT and MOT. Which was more useful and why?	5	CO4	BT4
		c) What do you mean by energy terms of any electronic configuration? How the energy terms are being written? Explain the splitting of energy terms of S, P, D and F terms as per mulliken.	3+3+4	CO5	BT5
		d) How many types of co-relation diagrams have u studied? Draw the co-relation diagram for d^3 configuration. Explain its utility.	5+5	CO5	BT5
PART-D	**Q4**	a) Briefly explain the concept of degrees of freedom and their classification. Construct the hybridization of H_2O molecule using the principles of group theory. Write all the steps involved.	6+4	CO6	BT5
		b) Analyze the vibrational degrees of freedom for any molecule of CH_4 point group and classify the vibrational modes into IR and Raman active signals.	5+5	CO6	BT5
		c) Differentiate and demonstrate perpendicular and parallel ways of pi bond formation in a molecule. How the hybridization of these molecules can be determined using group theory? Take example of BF3 molecule. Refer character table of D3h point group.	6+4	CO6	BT1
		d) Illustrate, how quantum mechanics can be used to determine the angle between two bonds in CH4 and NH3 molecule?	5	CO6	BT5

****************** **END** ******************

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D$_{3h}$ character table

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$		
A_1'	1	1	1	1	1	1		x^2+y^2, z^2
A_2'	1	1	-1	1	1	-1	R_z	
E'	2	-1	0	2	-1	0	(x, y)	(x^2-y^2, xy)
A_1''	1	1	1	-1	-1	-1		
A_2''	1	1	-1	-1	-1	1	z	
E''	2	-1	0	-2	1	0	(R_x, R_y)	(xz, yz)

T$_d$ character table

Table 1: Character table for T_d point group

T_d	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$		
A_1	1	1	1	1	1		$x^2+y^2+z^2$
A_2	1	1	1	-1	-1		
E	2	-1	2	0	0		$(2z^2-x^2-y^2, x^2-y^2)$
T_1	3	0	-1	1	-1	(R_x, R_y, R_z)	
T_2	3	0	-1	-1	1	(x, y, z)	(xz, yz, xy)

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCE
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III		DATE OF EXAM/SESSION	16.12.2023 (II
COURSE NAME	Inorganic Special-I Organometallic Chemistry of Transition Metals & Bio Inorganic Chemistry		COURSE CODE	CHH608B
PROGRAM	M.Sc. Chemistry		CREDITS	4
TIME DURATION	3 Hr		MAX. MARKS	100
NAME OF FACULTY	Dr. A. Jayamani		NAME OF COURSE COORDINATOR	Dr. A. Jayamani

Note: All questions are compulsory

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	
PART-A	1A	Explain the η, κ and μ conventions in nomenclature of organometallic compounds with examples	5	CO1	2	
	1B	Compare the properties of organometallic compounds with carbonyl ligands and phosphine ligands	5	CO1	4	
	1C	Justify salient features in structure, bonding and stability of organometallic compounds of Butadiene, cyclobutadiene ligands	5	CO1	2	
PART-B	2A	Discuss on the different methods on preparation of d-Block metal carbonyls	5	CO2	1	
	2B	The complex $[Cr(CO)_4(PPh_3)_2]$ has one very strong IR absorption band at 1889 cm^{-1} and two other very weak bands in the CO stretching region. What is the probable structure of this compound? (The CO stretching frequencies are lower than in the corresponding hexacarbonyl because the phosphine ligands are better donors and poorer π acceptors than CO.)	5	CO2	4	

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PART-C	**2C**	Write short note on (i) 1,1-Migratory insertion reactions (ii) Hydride eliminations	5	CO2	2
	3A	Explain elaborately on existence of essential and non-essential elements in bio-systems	6	CO3	1, 2
	3B	Compare the roles of s-block elements and 3d elements in bio-systems	7	CO3	5
	3C	(i) Discuss in detail about specific structural features used in Designing of chelating agents for medicine. (5) (ii) Illustrate a chelating agent of your own that could interact on various sites of biomolecules and probably used in medicine (3)	8	CO3	2,4
	3D	Write short note on environmental bioinorganic chemistry	6	CO3	2
	3E	Explain in detail about the mechanism of oxygen transport using metal ions in human body with proper illustrations	8	CO3	3
PART-D	**4A**	How is competitive and non-competitive inhibitors influence on the activity of enzymes? Explain with proper illustrations	8	CO4	4
	4B	Explain the role of metalloprotiens in bio-systems	5	CO4	1
	4C	In what way the metal ions involve in the replication and transcription process of Nucleic acids, explain in detail.	7	CO4	4
	4D	Explain in detail about the factors that influence on stability of DNA	7	CO4	3
	4E	Writ short notes on (i) Neurotransmitter (ii) bioinorganic chips and biosensors	8	CO4	1
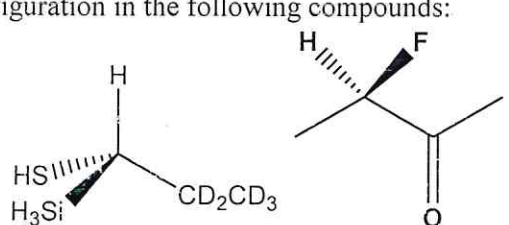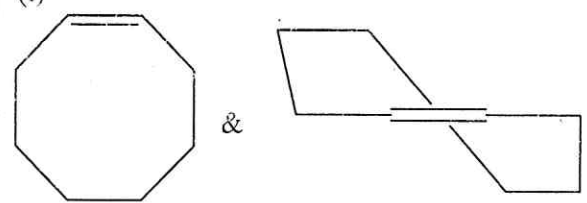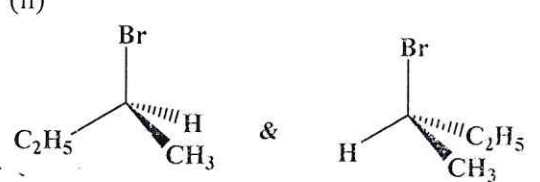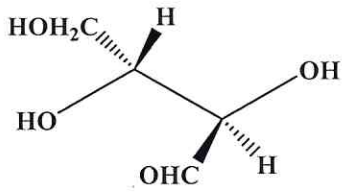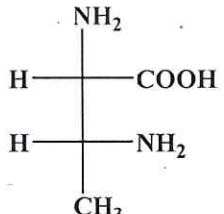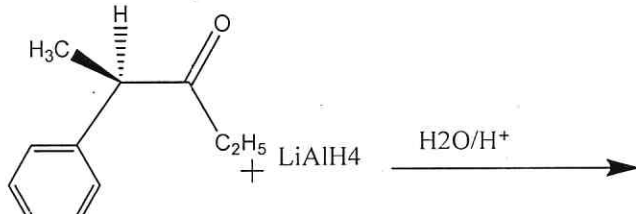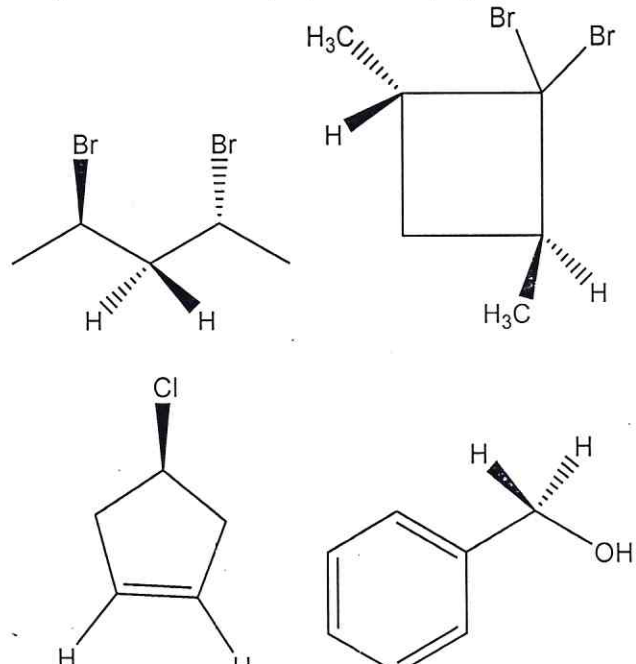
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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"
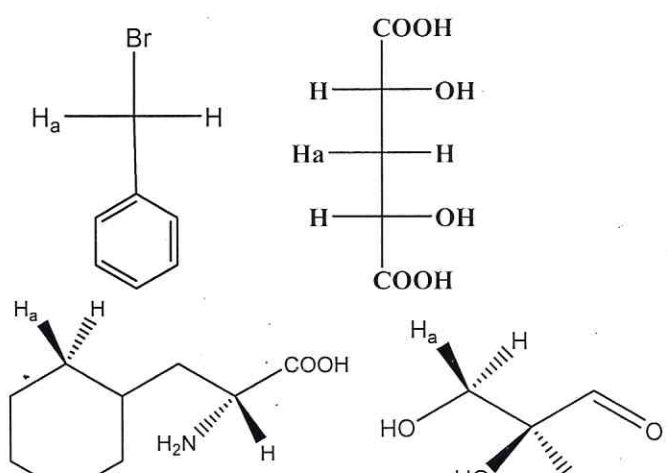
SEMESTER	III	DATE OF EXAM/SESSION	16.12.2023 (II)
COURSE NAME	Organic Special-I: Statistical Stereochemistry & Asymmetric Synthesis	COURSE CODE	CHH613B
PROGRAM	M.Sc. Chemistry	CREDITS	4
TIME DURATION	3 Hours	MAX. MARKS	100
NAME OF FACULTY	Dr. Ekta Rawat	NAME OF COURSE COORDINATOR	Dr. Ekta Rawat

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	Q1(A)	Comment on the statement that a molecule with one stereoisomer is always chiral but with more than one may not be chiral. Explain with suitable examples.	5	CO1	BT2
	Q1(B)	Write short notes on: (i) Epimers (ii) Mesocompounds	2.5+2.5=5	CO1	BT2
	Q1(C)	Specify the CIP priorities of the substituents and assign configuration in the following compounds:	2.5+2.5=5	CO1	BT3
PART-B	Q2(A)	The following structures represent pair of: (i) (ii)	3+3=6	CO2	BT4

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Q2(B)	Draw the structures of the following compounds: (i) Fischer projection of (2S,3R)-2,3-Butanediol (ii) (S)-2-Butanamine	2+2=4	CO2		BT4
Q2(C)	Identify relative configuration of the following : (i) (ii)	2.5+2.5=5	CO2		BT3
Q3(A)	Explain the following term with examples: (i) Enantiomeric excess (ii) Stereospecific reaction	2+3=5	CO3		BT2
Q3(B)	Why Bisect form is preferred over eclipsed form in Cram's Rule? On the basis of Cram's Rule, predict which form of the diastereomer will predominate? 	2+8=10	CO3		BT4
Q3(C)	Determine whether the two protons present in each compound are homotopic, enantiotopic, or diastereotopic: 	2.5x4=10	CO3		BT3

Note: the PART-C label appears in the left margin.

PART-C

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	Q3(D)	Assign prochirality to the given molecules (w.r.t. H_a):	2.5x4=10	CO3	BT3
PART-D	Q4(A)	What role does (±)-diethyl tartarate paly in the configuration of product in Sharpless asymmetric epoxidation. Discuss the Sharpless asymmetric epoxidation of allylic alcohol to obtain both enantiomers of the product epoxide.	3+7=10	CO4	BT4
	Q4(B)	Give applications of Noyori catalyst for- (i) Isomerisation of allylic amines to produce menthol (ii) Introducing chiral centre β-ketoester.	3.5+3.5=7	CO4	BT3
	Q4(C)	How does Ender's chiral auxiliaries SAMP and RAMP results into the formation of different stereoisomers in the asymmetric α-alkylation of aldehydes and ketones. Outline the mechanism.	8	CO4	BT4
	Q4(D)	(i) Why IPC₂BH have the enantioselectivity higher for *cis*-alkenes compared to *trans*-alkenes. Explain with transition state. (ii) Explain the mechanism of enantioselective hydroboration using chiral borane IPC₂BH.	5+5=10	CO4	BT4

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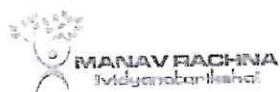
DEPARTMENT OF SCIENCES (Chemistry)

End Term Examination, Dec-2023"
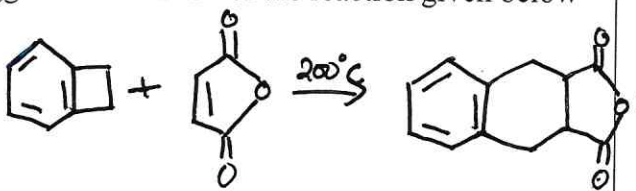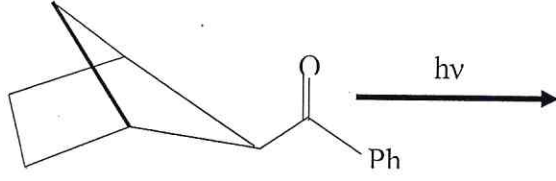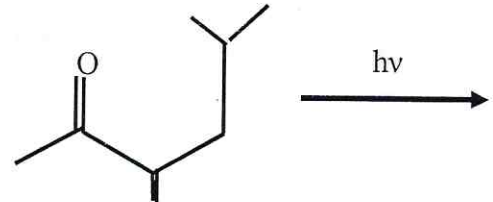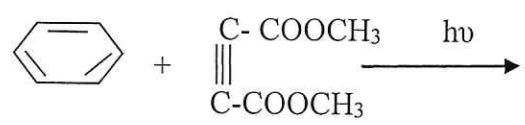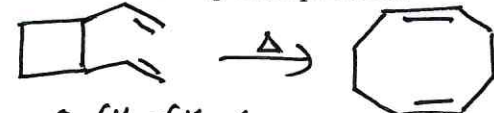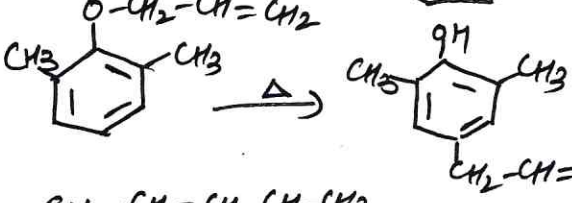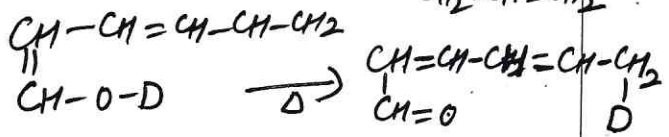
SEMESTER	3rd	**DATE OF EXAM**	19.12.2023
SUBJECT NAME	Photochemistry & Pericyclic Reaction	**SUBJECT CODE**	CHH614-B
BRANCH	Chemistry	**SESSION**	II
TIME	3 hrs	**MAX. MARKS**	100
PROGRAM	MSc	**CREDITS**	4
NAME OF FACULTY	Sangita Banga	**NAME OF COURSE COORDINATOR**	Sangita Banga

Note:Part A: Each question is of 10 marks, attempt any two of three.
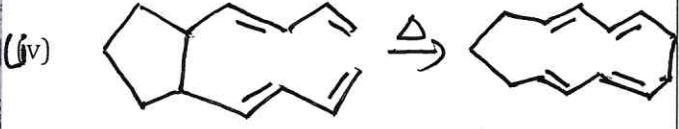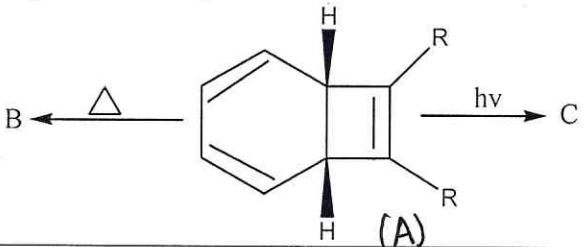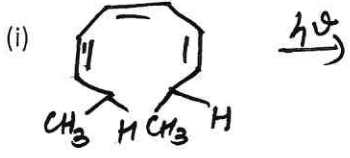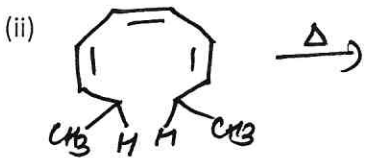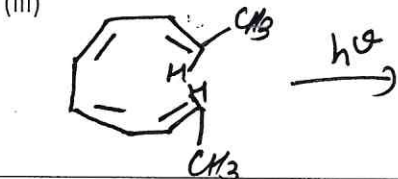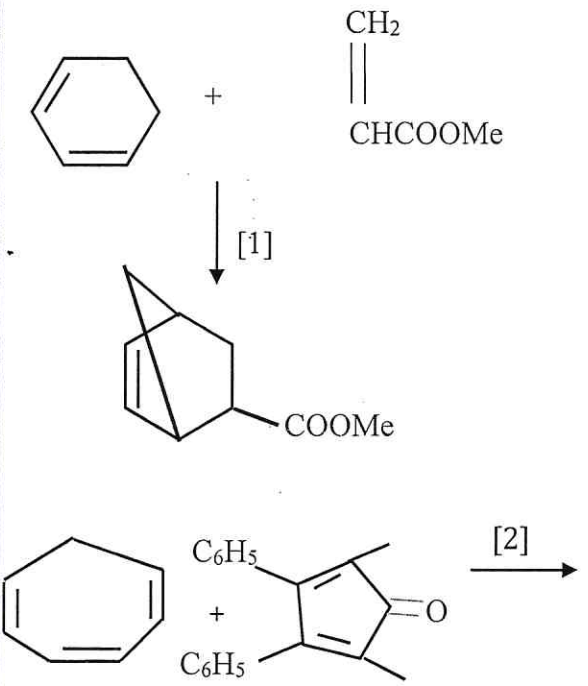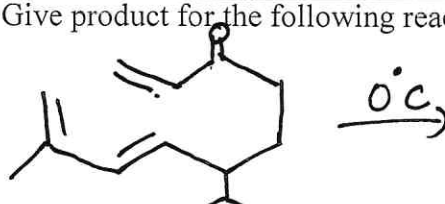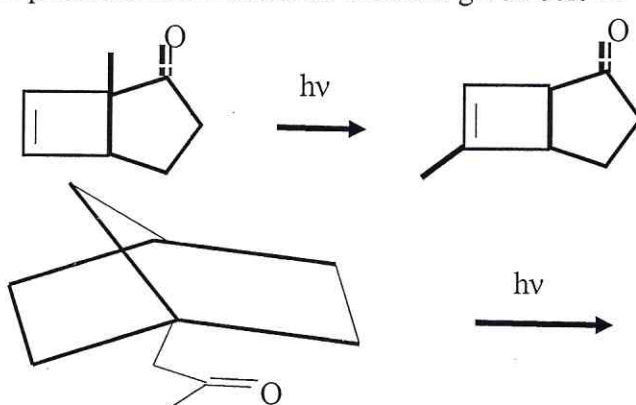
Part B: Each question will be of 20 marks in Part B.

Meena Lapalu
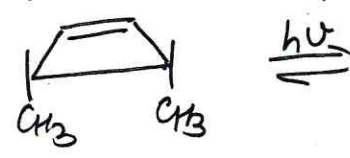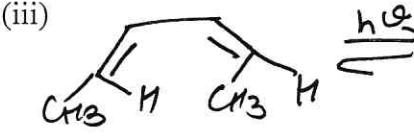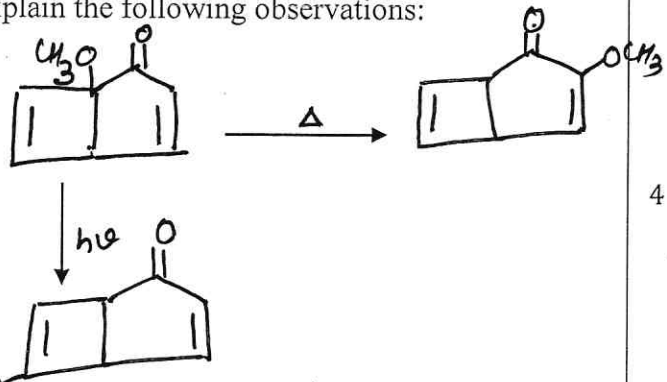
	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Explain why NO_2 is meta directing for photo induced aromatic nucleophilic substitution reaction.	2.5	CO2	BT2	2.1.1
	1(B)	Trans isomer are geometrically more stable then why the ratio of Cis-isomer would always be higher than Trans in mixture on irradiation	2	CO2	BT2	2.1.1
	1(C)	How pericyclic reaction differs from normal reaction. Give some important characteristics of pericyclic reaction.	2.5	CO4	BT1	1.1.1
	1(D)	Give reason for your answer with suitable example, wherever applicable (i) α Cleavage of cyclobutanone is 10 times more efficient as compared to cyclopentanone. (ii) Photoenolization is favored by ortho not para substituted aryl ketones	3	CO2	BT1	5.1.1
	2(A)	Explain the mechanism of dimerization of 1,3-butadiene in solution in the presence of acetophenone and benzil sensitiser	2.5	CO2	BT2	2.1.1
	2(B)	What is Paterno Buchi reaction? Give an example in support of your answer.	2.5	CO2, CO3	BT2	5.1.1
	2(C)	What is meant by conrotatory & disrotatory movement? Explain with example.	2.5	CO4	BT2	5.1.1

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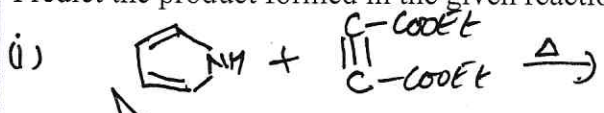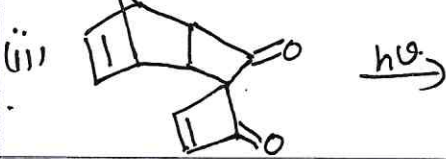
2(D)	Write a note on the photodimerization of α-β unsaturated ketones	2.5	CO2, CO3	BT2	2.1.:
3(A)	Suggest mechanism for the reaction given below	2.5	CO2	BT3	1.1.1
3(B)	Complete the reactions: (i) (ii) (iii)	2.5X3	CO3, CO4	BT3	9.1.2, 11.2.
Q4(A)	[1,3] Sigmatropic shift of hydrogen is photochemically allowed whereas [1,5] Sigmatropic shift of can occur thermally. Explain why?	5	CO4	BT3	5.1.1
4(B)	Write a note on the following: (i) Cope rearrangement (ii) Claisen rearrangement	5	CO4	BT3	2.2.1
4 (C)	From the given product explain the detailed mechanism through which the reaction is carried out and mention the sigmatropic shift: (i) (ii) (iii)	4X2.5	CO4	BT4	9.1.2, 10.3.1

PART-B

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(iv)					
Q5(A)	With the help of FMO show that [2+2] cycloaddition reaction is photochemically allowed whereas [4+2] cycloaddition is photochemically forbidden.	5	CO4	BT3	2.2.1
5(B)	With the support of suitable example explain: 1,3 dipolar reactions & Cheleotropic reactions.	5	CO4	BT2	2.2.1 10.3.
5(C)	Predict whether the [4+2] cycloaddition could be photoinduced if the dienophile, instead of diene were the excited reactants. Explain your answer.	5	CO2, CO4	BT4	2.2.1 11.2.
5(D)	With the help of Huckel Mobius approach explain under what conditions (4n+2) pi electron system will be thermally allowed and photochemically allowed.	2.5	CO2, CO4	BT3	2.2.1 10.3.
5(E)	Draw the HOMO of ground state in the case of a conjugated diene and triene and compare the HOMO states of both the molecules	2.5	CO2, CO4	BT3	2.2.1 10.3.
Q6(A)	Complete the reaction given below& give proper explanation for your answer.	4	CO2, CO4	BT4	2.2.1 10.3.
6(B)	Predict the stereochemistry of products for the following reaction.	6	CO2, CO4	BT3	2.2.1

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6(C)	What type of cycloaddition occurs in Reaction [1]? Draw the product of a similar process I Reaction [2]. Would you predict that these reactions occur under thermal or photochemical conditions?	3	CO2, CO4	BT4	2.2.1 10.3.
6(D)	How would you carry out conversion of cis 3,4-dimethyl cyclobutene to trans 3,4-dimethyl cyclobutene? Explain & give mechanism.	5	CO2 &CO3	BT5	2.1.2
6 (E)	Give product for the following reaction:	2	CO2 &CO3	BT3	2.1.2
Q7(A)	Explain the mechanism for reaction given below:	5	CO2, CO4	BT3	2.4.2

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7(B)	With the help of FMO approach, explain whether the following reaction will be allowed thermally or photochemically.	5	CO4	BT4	2.3.1
7(C)	Write the products of following electrocyclic reactions & write whether the reaction will proceed in conrotatory or disrotatory fashion. Also give the stereochemistry of the products. (i) (ii) (iii) (iv)	2.5X4	CO4, CO3	BT4	2.3.1, 10.3.1

OR

Q7(A)	In case of ring closure reaction of 1,3-butadiene, explain the selection rules by Huckle Mobius method & Woodward Hoffmann Rule.	5	CO4	BT3	2.4.2
7(B)	Explain the following observations:	4	CO2	BT4	2.1.2
7(C)	With the support of proper diagram explain the formation of Endo product as main product during cycloaddition.	2.5	CO2	BT2	2.1.1

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7(D)	Reactivity of Diels Alder reaction increases by introduction of electron withdrawing substituent in dienophile and electron donating groups in diene. Give reason for your answer through an example.	2.5	CO2	BT2	2.1.1
7(E)	Predict the product formed in the given reaction: (i) (ii)	2.5X2	CO3 & CO4	BT3	2.2.1 10.3.

******************** **END** *******************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES (PROGRAM-CHEMISTRY)
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM/SESSION	19.12.2023 (II)
COURSE NAME	Supramolecular Chemistry & Metal Clusters	COURSE CODE	CHH609B
PROGRAM	M.Sc Chemistry	CREDITS	4
TIME DURATION	3 hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Harsha Devnani	NAME OF COURSE COORDINATOR	Dr. Harsha Devnani Aopitsand 8 ore/6012

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	1	Give an example of chelate effect.	3	CO1	BT2
	2	Specify the characteristic properties of a guest molecule.	3	CO1	BT1
	3	Illustrate cavitand complex formation using a schematic.	3	CO1	BT3
	4	Distinguish between spherands and cryptands.	3	CO1	BT4
	5	Explain selectivity of crown ethers for K^+ ion.	3	CO1	BT4
PART-B	6	Differentiate between crystal self-assembly and solution self-assembly.	3	CO2	BT2
	7	Define synthon and support with an example.	3	CO2	BT2
	8	Write the equations for crystal growth and explain critical nucleus size.	3	CO2	BT2
	9	Comment on acidity of hydrogen bonding.	3	CO2	BT4

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	10	What are homotopic and heterotopic receptors?	3	CO2	BT1
PART-C	11	Draw and discuss orthosilicates and neosilicates.	5+5	CO3	BT4
	12	How can borazines be prepared?	8	CO3	BT2
	13	Present the chemical properties of phosphazenes with help of suitable reactions.	8	CO3	BT2
	14	Apply the Wade's rule to predict the structure of following compounds: B_5H_9 $C_2B_9H_{11}{}^{2-}$ $CPB_{10}H_{11}$	3+3+3	CO3	BT3
PART-D	15	Present the classification of clays and highlight pillared clays.	5+5	CO4	BT1
	16	Discuss the synthesis of pillared clays.	8	CO4	BT2
	17	How can the surface area, pore size and distribution be evaluated for zeolites?	3+3+3	CO4	BT3
	18	With respect to catalysis specifically, discuss the application of zeolites.	8	CO4	BT4

***************** END *******************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III		DATE OF EXAM	21.12.2023 (II)
COURSE NAME	Inorganic and Biological Catalysis		COURSE CODE	CHH611B
PROGRAM	M.Sc. Chemistry (Inorganic sp.)		CREDITS	4
TIME DURATION	3 Hours		MAX. MARKS	100
NAME OF FACULTY	DR. EKTA RAWAT		NAME OF COURSE COORDINATOR	DR. EKTA RAWAT

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	Q1(A)	What do you mean by back biting mechanism in ring opening metathesis polymerization (ROMP)?	5	CO1	BT3
	Q1(B)	Outline the catalytic cycle of Wacker process.	6	CO1	BT3
	Q1(C)	Distinguish between singlet and triplet carbene with suitable examples.	4	CO1	BT2
PART-B	Q2(A)	Give general mechanism of olefin metathesis reactions.	4	CO2	BT2
	Q2(B)	Explain in detail applications of using I and II generation of Grubb's catalyst.	6	CO2	BT3
	Q2(C)	What is the role of electron rich metals in C-H activation?	5	CO2	BT3
PART-C	Q3(A)	Draw a well labeled diagram of the catalytic cycle of Negishi coupling. Why Negishi coupling is preferred over Sonogashira and Stille coupling?	6+8=14	CO3	BT4
	3(B)	Depict the mechanism of the Heck reaction. Differentiate between inter and intra molecular Heck reaction. Give examples of each.	8+6=14	CO3	BT4
	Q3 (C)	Indicate the features of Hiyama coupling and the sequence of reaction.	7	CO3	BT3
PART-D	Q4(A)	Describe the nature and significance of the dose–response curve. What does LD50 mean in this curve?	8	CO4	BT4
	Q4(B)	What are the three major chelating ligands present in human body? Describe any two.	8	CO4	BT3
	Q4(C)	In what respect does lead's chemical similarity to calcium possibly contribute to the toxicity of lead? Which organ in the body is most susceptible to lead poisoning?	8	CO4	BT4
	Q4(D)	List and discuss the major routes and sites of exposure, distribution, and elimination of cadmium in the body.	11	CO4	BT4

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF CHEMISTRY
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM	21.12.2023 (II)
COURSE NAME	Modern Organic Synthesis Techniques	COURSE CODE	CHH615 B
PROGRAM	M.Sc. Chemistry (Organic)	CREDITS	4
TIME DURATION	3 hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Vinod Kumar	NAME OF COURSE COORDINATOR	Dr. Vinod Kumar

Note: Part A is compulsory. Part B- Questions will be of descriptive type or numerical.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	What is the final organic product of reaction 1. CH_3OH, H^+ 2. $LiAlH_4$ 3. H^+ 4. PCC 5. $(PH_3)P=CH_2$	4	CO1	BT4	
	1(B)	State 2 coupling reaction with suitable examples.	4	CO1	BT2	
	1(C)	How biaryl product is synthesized?	3	CO1	BT4	
	1(D)	Demonstrate the reactivity difference between Lithium aluminium hydride or Sodium borohydride.	4	CO1	BT4	
	2(A)	Explain reductive cleavage of C=O double bond.	4	CO2	BT4	
	2(B)	State suitable reagent for synthesis of diketone.	4	CO2	BT4	
	2(C)	Illustrate a method to oxidize C level 3 to C level 4.	3	CO2	BT2	
	2(D)	Evaluate the 2 best methods for synthesizing selectively aldehyde from primary alcohols?	4	CO2	BT4	

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3(A)	Draw the mechanism for the reaction of sulphur ylide with α,β-unsaturated aldehydes and ketones?	5	CO3	BT4	
3(B)	Discuss the stabilized and unstabilized P ylides with suitable example and propose the application of P-ylides in organic synthesis.	5	CO3	BT3	
3(C)	Why crown ethers are very important in medicine and organic synthesis.	5	CO3	BT3	
4(A)	What are the types of phase-transfer catalyst, Explain in detail?	5	CO3	BT3	
4(B)	Design synthesis of alkenes with high regioselectivity and stereoselectivity.	5	CO3	BT4	
5(A)	Which is more reactive enol or enolate and why?	3	CO3	BT4	
5(B)	How can you differentiate the kinetically stable and thermodynamically stable enols?	4	CO3	BT4	
5(C)	Under which condition $KMnO_4$ is soluble in benzene?	3	CO3	BT2	
6(A)	Which reaction will not provide a synthesis of the	7	CO4	BT4	
6(B)	What is retrosynthetic route? Discuss the role of functional group interconversion (FGI) in retero-synthesis with suitable examples?	2+8	CO4	BT3	
7(A)	Which combination of reagents is wrong for disconnections (a)-(d) in the following	8	CO4	BT3	

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Ph —(a)—(b)—(c)—(d)— structure

(a) benzene + acyl chloride

(b) 2-phenyl-1,3-dithiane + Br-hexyl

(c) Ph—CO—CH₂—CO—OEt + Br-propyl

(d) Ph—CO—CH=CH₂ + BrMg-ethyl
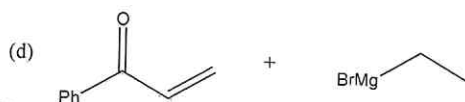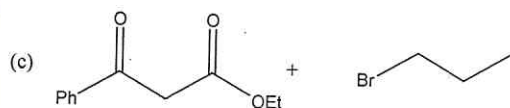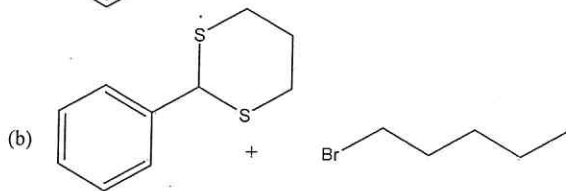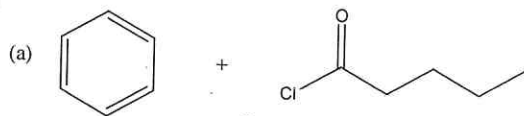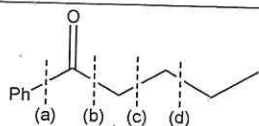
What is retrosynthetic analysis?
Propose a retrosynthetic analysis of the following compound. Your answer should include both the synthons, showing your thinking, and the reagents that would be employed in the actual synthesis.

(three structures with CO_2H)

| 7(B) | | 2+8 | CO4 | BT4 | |

******************** END ********************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	Ist	DATE OF EXAM	18.12.2023 (I)
COURSE NAME	Differential Equations	COURSE CODE	MAH503B
PROGRAM	M.Sc.-Mathematics	CREDITS	4
TIME DURATION	3 Hours	MAX. MARKS	100
NAME OF FACULTY	Dr. Advin Masih	NAME OF COURSE COORDINATOR	Dr. Y K Sharma

Note: *All Questions compulsory.*

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Apply Picard's method, find the second iteration of the IVPs $\frac{dy}{dx} = x + y^2$, Where y (0) = 0.	5	CO1	BT3	1.1.1 1.1.2 2.1.1 2.2.1
	1(B)	Convert the linear differential equation in to a system of first order equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 5\, y = 0$	5	CO1	BT1	1.1.1 1.1.2 2.1.1 2.2.1
	1(C)	Show that $f(x,y) = x^2 + y^2$ on R: -a< x< a, $-b < x < b$, satisfies the Lipchitz's conditions.	5	CO1	BT2	1.1.1 1.1.2 2.1.1 2.2.1
PART-B	1(D)	Determine nature of the critical point (0, 0) of the system $\frac{dx}{dt} = x + 3y$; $\frac{dy}{dt} = 3x + y$.	5	CO2	BT2	1.1.1 1.1.2 2.1.1 2.2.1
	1(E)	Explain autonomous system.	5	CO2	BT2	1.1.1 1.1.2 2.1.1 2.2.1

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	1(F)	Discuss the nature of the nonlinear system $$\frac{dx}{dt} = 4x + 2y - 4xy \; ; \; \frac{dy}{dx} = x + 6y - 8x^2y$$	5	CO2	BT1	1.1.1 1.1.2 2.1.1 2.2.1
PART-C	Q2	Apply Monge's method, solve $r = a^2t$.	12	CO3	BT3	1.1.1 1.1.2 2.1.1 2.2.1
	Q3	State and derive the method of separation of variables.	11	CO3	BT3	1.1.1 1.1.2 2.1.1 2.2.1
	Q4	Find the complete integral of $$p_3x_3(p_1 + p_2) + x_1 + x_2 = 0 \, .$$	12	CO3	BT3	1.1.1 1.1.2 2.1.1 2.2.1
PART-D	Q 5	Find the solution of the problem $\frac{\partial^2 u}{dx^2} + \frac{\partial^2 u}{dy^2} = 0$ for the boundary conditions $u(0, y) = u(a, y) = u(x, 0) = 0$ and $u(x, b) = f(x)$.	12	CO4	BT3	1.1.1 1.1.2 2.1.1 2.2.1
	Q6	Derive the Drichlet interior problem for a circle.	11	CO4	BT3	1.1.1 1.1.2 2.1.1 2.2.1
	Q7	State and prove "One dimensional wave equation".	12	CO4	BT1	1.1.1 1.1.2 2.1.1 2.2.1

****************** END ******************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIECNES (Program-Physics)
"End Term Examination, Dec-2023"

SEMESTER	1st	DATE OF EXAM/SESSION	14.12.2023 (I)
COURSE NAME	Quantum Mechanics -I	COURSE CODE	PHH503B
PROGRAM	M.Sc. (Physics)	CREDITS	4
TIME DURATION	3hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Jaiparkash	NAME OF COURSE COORDINATOR	Dr. Jaiparkash

Note: All questions are compulsory.

Set- A

Q. No.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(a)	Explain the significance of the continuity equation in the context of quantum mechanics and hence derive continuity equation.	3+7		BT2	2.1.1, 2.2.1, 3.1.1
	1(b)	Find the normalization constant A of a particle described by the Gaussian wave packet with wave function $\psi = Ae^{-\frac{\alpha^2 x^2}{2}} e^{ikx}$ in all space. Also find the average value of position of the particle.	5	CO1	BT3	2.1.1, 2.2.1, 3.1.1
PART-B	2(a)	Applying Schwarz inequality relation, show that $\Delta p\, \Delta x \geq h/4\pi$.	8		BT3	2.1.1, 2.2.1, 3.1.1
	2(b)	Find the value of $[H, p_x]$, where H and p_x represent the Hamiltonian and x component of linear momentum operators respectively.	5	CO2	BT2	2.1.1, 2.2.1, 3.1.1
	2 (c)	Show that $[A, BC] = [A, B]\, C + B\, [A, C]$; where A, B, and C are operators.	2		BT3	2.1.1, 2.2.1, 3.1.1

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PART-C	3	Apply the Schrodinger wave equation for a particle trapped in attractive delta potential and hence derive expressions for Eigen function and Eigen value.	15		BT3	2.1.1, 2.2.1, 3.1.1
	4	Apply the Schrodinger wave equation for a molecule to derive the expression for rotational energy values of the molecule assuming it as a rigid rotator.	15	CO3	BT3	2.1.1, 2.2.1, 3.1.1
	5	The OH – radical has a moment of inertia of 1.5×10^{-40} kg m^2. Calculate its internuclear distance. Also calculate its angular momentum and angular velocity for $l = 5$.	5		BT3	2.1.1, 2.2.1, 3.1.1
PART-D	6	Outline the key assumptions and conditions under which perturbation theory is applicable. Derive the expression for the first-order correction to the energy using time-independent perturbation theory for a non-degenerate case.	15		BT2	3.3.3
	7	Find out the solution for first order correction in energy for a degenerate case.	15	CO4	BT2	3.3.3
	8	Find the first order correction in energy of hydrogen atom placed in an external electric field E such that the perturbed Hamiltonian H' = - eEr cosθ if it is in ground state given by $\psi_{100} = \dfrac{e^{-\frac{r}{a_o}}}{\sqrt{\pi a_o^3}}$.	5		BT3	3.3.3

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PART-C	3	Apply the Schrodinger wave equation for a particle trapped in attractive delta potential and hence derive expressions for Eigen function and Eigen value.	15		BT3	2.1.1, 2.2.1, 3.1.1
	4	Apply the Schrodinger wave equation for a molecule to derive the expression for rotational energy values of the molecule assuming it as a rigid rotator.	15	**CO3**	BT3	2.1.1, 2.2.1, 3.1.1
	5	The OH – radical has a moment of inertia of 1.5×10^{-40} kg m^2. Calculate its internuclear distance. Also calculate its angular momentum and angular velocity for l = 5.	5		BT3	2.1.1, 2.2.1, 3.1.1
PART-D	6	Outline the key assumptions and conditions under which perturbation theory is applicable. Derive the expression for the first-order correction to the energy using time-independent perturbation theory for a non-degenerate case.	15		BT2	3.3.3
	7	Find out the solution for first order correction in energy for a degenerate case.	15	**CO4**	BT2	3.3.3
	8	Find the first order correction in energy of hydrogen atom placed in an external electric field E such that the perturbed Hamiltonian H' = - eEr cosθ if it is in ground state given by $$\psi_{100} = \frac{e^{-\frac{r}{a_o}}}{\sqrt{\pi a_o^3}}.$$	5		BT3	3.3.3

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	I	DATE OF EXAM/SESSION	11.12.2023 (I)
COURSE NAME	Measure Theory	COURSE CODE	MAH504B
PROGRAM	M.Sc. Mathematics	CREDITS	4
TIME DURATION	3 hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Dinesh Tripathi	NAME OF COURSE COORDINATOR	Dr. Kamlesh Kumar

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Let $S = \{E \subseteq \mathbb{R}: \text{either } E \text{ or } E^c \text{ is finite}\}$. Is S an algebra ? Is S an σ −algebra ? Explain.	5	CO1	BT2	1.1.1
	1(B)	Show that open sets are measurable.	5	CO1	BT2	1.1.1
	1(C)	Let X be a set and S be a family of subsets of X. Then show that the intersection of all σ −algebras containing S is a σ −algebra on X, and it is the smallest σ −algebra on X containing S.	5	CO1	BT3	3.1.2
PART-B	2(A)	Show that interval of the form $[a, \infty)$ is measurable.	5	CO2	BT4	1.1.1
	2(B)	If $f, g: E \rightarrow \mathbb{R}$ are measurable functions. Then show that $\{x: f(x) > g(x)\}$ is measurable.	5	CO2	BT4	1.1.1
	2(C)	Let f and g be real Borel measurable functions on set E. Then prove that $f + g$ and f^2 are Borel measurable.	5	CO2	BT3	3.1.2
PART-C	3(A)	State and prove Monotone convergence theorem.	12	CO3	BT2	3.1.3
	3(B)	If f and g are in $\mathbb{L}(\mathbb{R})$ and $c \in \mathbb{R}$, then show that $f + g$ and cf are in $\mathbb{L}(\mathbb{R})$, and moreover $\int_{\mathbb{R}} f + g = \int_{\mathbb{R}} f + \int_{\mathbb{R}} g$, $\int_{\mathbb{R}}(cf) = c \int_{\mathbb{R}} f$	12	CO3	BT2	3.1.2

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PART-D	3(C)	Consider the following functions from $\mathbb{R}$ to $\mathbb{R}$, where $\mathbb{R}$ is with Lebesgue measure. $f(x) = \begin{cases} 1 & \text{if } x \leq 0 \\ 0 & \text{if } x > 0 \end{cases}$ $g(x) = \begin{cases} 1 & \text{if } x \in \mathbb{Q} \\ x & \text{if } x \notin \mathbb{Q} \end{cases}$ and $h(x) = \begin{cases} 1 & \text{if } x = 0 \\ x & \text{if } x \neq 0 \end{cases}$ Then prove or disprove the following statement f is continuous a. e. on $\mathbb{R}$ $`g(x) = x$ a. e. on $x \in \mathbb{R}$ $h(x) = x$ except $x = 0$ so that $g(x) = x$ for almost all $x \in \mathbb{R}$.	11	CO3	BT4	2.3.1
	4(A)	Let f and g be real measurable functions on X and $1 \leq p \leq \infty$. Then show that $$\|f + g\|_p \leq \|f\|_p + \|g\|_p$$	12	CO4	BT3	3.1.2
	4(B)	Let (f_n) be sequence of extended real valued measurable functions on a measurable space $(X, \mathcal{S}, \mu)$ and $f_n \to f$ a. e. on X. If μ is complete measure then show that f is measurable.	12	CO4	BT4	3.1.3
	4(C)	Let $f_n \xrightarrow{\mu} f$ and $g_n \xrightarrow{\mu} g$ on a measurable space $(X, \mathcal{S}, \mu)$. Then show that $f_n + g_n \xrightarrow{\mu} f + g$ and $\alpha f_n \xrightarrow{\mu} \alpha f$, $\alpha \in \mathbb{R}$.	11	CO4	BT2	3.1.2

****************** END ******************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	I	**DATE OF EXAM**	14.12.2023 (I)
COURSE NAME	Topology-I	**COURSE CODE**	MAH502B
PROGRAM	M.Sc. Mathematics	**CREDITS**	4
TIME DURATION	3 Hrs.	**MAX. MARKS**	100
NAME OF FACULTY	Dr. Aparna Vyas	**NAME OF COURSE COORDINATOR**	Dr. Aparna Vyas

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	If $\{\tau_\alpha, \alpha \in A\}$ is a family of topologies on a set X, then show that $\cap_{\alpha \in A} \tau_\alpha$ is also a topology on X.	2	CO1	BT1	1.1.1, 1.1.2
	1(B)	Let $X = \{a, b, c, d\}$ and $\tau = \{\emptyset, \{a\}, \{b\}, \{a, b\}, X\}$. In the space (X, τ), find the interior and the closure of $A = \{a, c\}$.	2	CO2	BT2	1.1.1, 1.1.2
	1(C)	Is $f: (1, \infty) \to (a, \infty)$ defined by $f(x) = ax, a > 0$, a homeomorphism?	2	CO4	BT2	1.2.1, 3.1.2
	1(D)	Define co-countable topology and co-countable space with example.	2	CO3	BT1	1.1.1, 1.1.2
	1(E)	Let A be a set in space (X, τ). Then show that $\tau A = \{H = G \cap A \mid G \in \tau\}$.	2	CO3	BT2	1.2.1, 3.1.2
PART-B	Q2(A)	Let S be a sub-basis for a topology τ on a set X. Then show that the collection B consisting of finite intersections of members of S is a basis for τ.	7	CO2	BT3	1.1.1, 1.1.2
	2(B)	Show that a second countable space is separable.	5	CO3	BT2	1.1.1, 1.1.2
	2(C)	Let Y be a subspace of a space X and let A be a set in Y. Then show that (a) $Cl_Y A = Cl_X A \cap Y$, (b) $D_Y(A) = D_X(A) \cap Y$, (c) $Int_Y A \supset Int_X A \cap Y$, (d) $Bd_Y A \subset Bd_X A \cap Y$.	8	CO3	BT3	1.1.1, 1.1.2

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	Q3(A)	State and prove Tietze's Extension Theorem.	12	CO5	BT4	1.2.1, 3.1.2
	3(B)	Let f: X → Y be a mapping from T_1-space X onto a space Y. (a) If f is a closed mapping, then show that Y is also T_1-space. (b) If f is a homeomorphism, then show that Y is also a T_1-space.	8	CO4	BT3	1.2.1, 3.1.2
	Q4(A)	Let f: X → Y be a continuous map from a space X to a Hausdorff space Y. Then show that the graph $G(f) = \{(x, f(x)) \| x \in X\}$ is a closed set of X × Y.	8	CO4	BT4	1.2.1, 3.1.2
	4(B)	Show that a product of Tychonoff spaces is Tychonoff. Or Show that a regular normal space is completely regular.	7	CO3	BT3	1.1.1, 1.1.2
	Q5(A)	Show that a closed set F of a compact space X is compact.	6	CO2	BT3	1.2.1, 3.1.2
	5(B)	If K is a compact set in a Hausdorff space X and $x \in X$, $x \notin K$, then show that there exist open sets G_x and G_K of X such that $x \in G_x$, $K \subset G_K$ and $G_x \cap G_K = \emptyset$.	6	CO2	BT3	1.1.1, 1.1.2
	5(C)	Prove that a space X is compact if and only if each family of closed sets of X having the finite intersection property (f.i.p.) has non empty intersection.	8	CO3	BT4	1.1.1, 1.1.2
	Q6(A)	Show that a space X is disconnected if and only if there exists a continuous mapping from X to the discrete 2-space which is a surjection.	8	CO4	BT3	1.2.1, 3.1.2
	6(B)	Show that a set Y in a space X is connected iff there are no nonempty separated sets A and B in X such that Y = A ∪ B. Or Show that any two distinct components of a space are separated.	7	CO1, CO3	BT4	1.2.1, 3.1.2

PART-C covers rows Q3(A) through 4(B).
PART-D covers rows Q5(A) through 6(B).

****************** END ******************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End-term Examination, Dec-2023"

SEMESTER	I		DATE OF EXAM	20.12.2023 (I)
COURSE NAME	Mathematical Statistics		COURSE CODE	MAH512B
PROGRAM	M.Sc.(Mathematics)		CREDITS	4
TIME DURATION	3 Hrs		MAX. MARKS	100
NAME OF FACULTY	Dr. Deepa Arora		NAME OF COURSE COORDINATOR	Dr. Bhawna Singla

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1(A)	Given that $f(x) = k\left(\frac{1}{2}\right)^x$ is a probability distribution of a random variable which can take on the values $x = 0,1,2,3,4,5,6$, find k and an expression for the corresponding cumulative probabilities $F(x)$.	6	CO1	BT1	PI 2.3.1
	Q1(B)	Let the joint probability density function of the random variables X and Y be $$f(x,y) = \begin{cases} 2(x + y - 3xy^2); 0 < x < 1; 0 < y < 1 \\ 0, otherwise \end{cases}$$ Find i) *Marginal distributions of X and Y.* ii)*Are X and Y independent?* iii)*Find* $E(X + Y)$ *and* $E(X - Y)$.	9	CO1	BT3	PI 3.1.2
PART-B	Q2(A)	Obtain the maximum likelihood estimator for normal population $N(\mu, \sigma^2)$, for σ^2 when μ is known.	7	CO2	BT2	PI 1.1.2
	Q2(B)	Prove that an M.V.U is unique in the sense that if T_1 and T_2 are M.V.U estimators for $\gamma(\Theta)$, then $T_1 = T_2$, almost surely.	8	CO2	BT4	PI 3.1.2
	Q3	In a sample of 400 parts manufactured by a factory, the number of defective parts was found to be 30. The company however claimed that atmost 5% of their product is defective. Is the claim tenable?	5	CO3	BT2	PI 1.1.2

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PART - C	**Q4**	In an experiment on 164 people with flu, half of them were given the drug and half of them were given home remedies. The table given below shows the reactions to the treatment. Test the hypothesis that the drug in no better than the home remedies |	Helped	Harmed	No effect
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Drug	104	20	40
Home Remedies	88	24	52	 (Given Chi-square at 5% level of significance for 2 d.f. =5.99)	10	CO3	BT3	PI 2.3
	Q5	A nationwide retailer wants to test whether new product shelf facings are effective in increasing sales volume. New shelf facings for the soft drink Country Time are tested at a random sample of 15 stores throughout the country. Data on total sales of Country Time for each store, for the week before and the week after the new facings installed, are given below: 	Store	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Before	57	61	12	38	12	69	5	39	88	9	92	26	14	70	22
After	60	54	20	35	21	70	1	65	79	10	90	32	19	77	29 | Using the 0.05 level of significance, do you believe that the new shelf facings would increase sales of Country Time?	12	CO3	BT3	PI 2.3..
	Q6	Explain the merits and demerits of census and sample methods of collecting data.	8	CO3	BT2	PI 3.1.1
PART-D	**Q7**	Two different foods are tested for difference in weight gains. A random sample of 6 mice was given food A and another sample of 8 mice were given food B. Test the hypothesis that median weight is same for two different foods, given the following data: 	Food A	17	14	15	18	12	13		
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Food B	15	16	13	16	18	19	17	17	 (Critical Value ≤ 8)	12	CO4	BT4	PI 3.1.2
	Q8	Explain Analysis of Variance. Also explain the assumptions of ANOVA.	5	CO4	BT2	PI 3.1.2
	Q9	A trucking company wishes to test the average life of each of four brands of tyres. The company uses all brands on randomly selected trucks. The records showing the lives (thousands of miles) of tyres are as given in table below: 	Brand 1	20	23	18	17	
Brand 2	19	15	17	20	16
Brand 3	21	19	20	17	16
Brand 4	15	17	16	18		 Test the hypothesis that the average life for each brand of types is the same at 1% level of significance.	12	CO4	BT4	PI 3.1.2
	Q10	Describe the Mann-Whitney test for large samples. Explain the applications of the test and how is it different from t-test.	6	CO4	BT2	PI 1.1.2

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Table 2 : SIGNIFICANT VALUES $t_v (\alpha)$ OF t-DISTRIBUTION
(TWO TAIL AREAS) $[| t | > t_v(\alpha)] = \alpha$

d.f. (v)	Probability (Level of Significance)					
	0.50	0.10	0.05	0.02	0.01	0.001
1	1.00	6.31	12.71	31.82	63.66	636.62
2	0.82	0.92	4.30	6.97	6.93	31.60
3	0.77	2.32	3.18	4.54	5.84	12.94
4	0.74	2.13	2.78	3.75	4.60	8.61
5	0.73	2.02	2.57	3.37	4.03	6.86
6	0.72	1.94	2.45	3.14	3.71	5.96
7	0.71	1.90	2.37	3.00	3.50	5.41
8	0.71	1.80	2.31	2.90	3.36	5.04
9	0.70	1.83	2.26	2.82	3.25	4.78
10	0.70	1.81	2.23	2.76	3.17	4.59
11	0.70	1.80	2.20	2.72	3.11	4.44
12	0.70	1.78	2.18	2.68	3.06	4.32
13	0.69	1.77	2.16	2.05	3.01	4.22
14	0.69	1.76	2.15	2.62	2.98	4.14
15	0.69	1.75	2.13	2.60	2.95	4.07
16	0.69	1.75	2.12	2.58	2.92	4.02
17	0.69	1.74	2.11	2.57	2.90	3.97
18	0.69	1.73	2.10	2.55	2.88	3.92
19	0.69	1.73	2.09	2.54	2.86	3.88
20	0.69	1.73	2.09	2.53	2.85	3.85
21	0.69	1.72	2.08	2.52	2.83	3.83
22	0.69	1.72	2.07	2.51	2.42	3.79
23	0.69	1.71	2.07	2.50	2.81	3.77
24	0.69	1.71	2.06	2.49	2.80	3.75
25	0.68	1.71	2.06	2.49	2.79	3.73
26	0.68	1.71	2.06	2.48	2.78	3.71
27	0.68	1.70	2.05	2.47	2.77	3.69
28	0.68	1.70	2.05	2.47	2.76	3.67
29	0.68	1.70	2.05	2.46	2.76	3.66
30	0.68	1.70	2.04	2.46	2.75	3.65
∞	0.67	1.65	1.96	2.33	2.58	3.29

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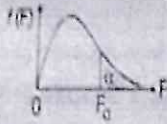
X. 5% POINTS OF FISHER'S F-DISTRIBUTION

n \ m	1	2	3	4	5	6	7	8	9	10	12	15	20	30	60	α
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	243.91	245.95	248.01	250.09	252.20	254.32
2	18.513	19.000	19.164	19.247	19.296	19.330	19.353	19.371	19.385	19.396	19.413	19.429	19.446	19.462	19.479	19.496
3	10.128	9.5521	9.2766	9.1172	9.0135	8.9406	8.8868	8.8452	8.8123	8.7855	8.7446	8.7029	8.6602	8.6166	8.5720	8.5265
4	7.7086	6.9443	6.5914	6.3883	6.2560	6.1631	6.0942	6.0410	5.9988	5.9644	5.9117	5.8578	5.8025	5.7459	5.6878	5.0281
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8753	4.8183	4.7725	4.7351	4.6777	4.6188	4.5581	4.4957	4.4314	4.3650
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2066	4.1468	4.0990	4.0600	3.9999	3.9381	3.8742	3.8082	3.7398	3.6688
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767	3.6365	3.5747	3.5108	3.4445	3.3758	3.3043	3.2298
8	5.3177	4.4590	4.0662	3.8378	3.6875	3.5806	3.5005	3.4381	3.3881	3.3472	3.2840	3.2184	3.1503	3.0794	3.0053	2.9276
9	5.1174	4.2565	3.8626	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789	3.1373	3.0729	3.0061	2.9365	2.8637	2.7872	2.7067
10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204	2.9782	2.9130	2.8450	2.7740	2.6996	2.6211	2.5379
11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480	2.8962	2.8536	2.7876	2.7186	2.6464	2.5705	2.4901	2.4045
12	4.7272	3.8853	3.4903	3.2502	3.1059	2.9961	2.9134	2.8486	2.7964	2.7534	2.6866	2.6169	2.5436	2.4663	2.3842	2.2962
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669	2.7144	2.6710	2.6037	2.5331	2.4589	2.3803	2.2966	2.2064
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458	2.6021	2.5342	2.4630	2.3879	2.3082	2.2230	2.1307
15	4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876	2.5437	2.4753	2.4035	2.3275	2.2468	2.1601	2.0658
16	4.4940	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572	2.5911	2.5377	2.4935	2.4247	2.3522	2.2756	2.1938	2.1058	2.0096
17	4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6143	2.5480	2.4943	2.4499	2.3807	2.3077	2.2304	2.1477	2.0584	1.9604
18	4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563	2.4117	2.3421	2.2686	2.1906	2.1071	2.0166	1.9168
19	4.3808	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227	2.3779	2.3080	2.2341	2.1555	2.0712	1.9796	1.8780
20	4.3513	3.4928	3.0984	2.8661	2.7100	2.5990	2.5140	2.4471	2.3928	2.3479	2.2776	2.2033	2.1242	2.0391	1.9464	1.8432
21	4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876	2.4205	2.3661	2.3210	2.2504	2.1757	2.0960	2.0102	1.9165	1.8117
22	4.3009	3.4434	3.0491	2.8167	2.6613	2.5491	2.4638	2.3965	2.3419	2.2967	2.2258	2.1508	2.0707	1.9842	1.8895	1.7831
23	4.2793	3.4221	3.0280	2.7955	2.6400	2.5277	2.4422	2.3748	2.3201	2.2747	2.2036	2.1282	2.0476	1.9605	1.8649	1.7570
24	4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226	2.3551	2.3002	2.2547	2.1834	2.1077	2.0267	1.9390	1.8424	1.7331
25	4.2417	3.3852	2.9912	2.7587	2.6030	2.4904	2.4047	2.3371	2.2821	2.2365	2.1649	2.0889	2.0075	1.9192	1.8217	1.7110
26	4.2252	3.3690	2.9751	2.7426	2.5868	2.4741	2.3883	2.3205	2.2655	2.2197	2.1479	2.0716	1.9898	1.9010	1.8027	1.6906
27	4.2100	3.3541	2.9604	2.7278	2.5719	2.4591	2.3732	2.3053	2.2501	2.2043	2.1323	2.0558	1.9736	1.8842	1.7851	1.6717
28	4.1960	3.3404	2.9467	2.7141	2.5581	2.4453	2.3593	2.2913	2.2360	2.1900	2.1179	2.0411	1.9586	1.8687	1.7689	1.6541
29	4.1830	3.3277	2.9340	2.7014	2.5454	2.4324	2.3463	2.2782	2.2229	2.1768	2.1045	2.0275	1.9446	1.8543	1.7537	1.6377
30	4.1709	3.3158	2.9223	2.6896	2.5336	2.4205	2.3343	2.2662	2.2107	2.1646	2.0921	2.0148	1.9317	1.8409	1.7396	1.6223
40	4.0848	3.2317	2.8387	2.6060	2.4495	2.3359	2.2490	2.1802	2.1240	2.0772	2.0035	1.9245	1.8389	1.7444	1.6373	1.5089
60	4.0012	3.1504	2.7581	2.5252	2.3688	2.2540	2.1665	2.0970	2.0401	1.9926	1.9174	1.8364	1.7480	1.6491	1.5343	1.3893
120	3.9201	3.0718	2.6802	2.4472	2.2900	2.1750	2.0867	2.0164	1.9588	1.9105	1.8337	1.7505	1.6587	1.5543	1.4290	1.2539
∞	3.8415	2.9957	2.6049	2.3719	2.2141	2.0986	2.0096	1.9384	1.8799	1.8307	1.7522	1.6664	1.5705	1.4591	1.3180	1.0000

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	1st		DATE OF EXAM	22.12.2023 (I)
COURSE NAME	Abstract Algebra		COURSE CODE	MAH514B
PROGRAM	M.Sc-Mathematics		CREDITS	4
TIME DURATION	3 hrs		MAX. MARKS	100
NAME OF FACULTY	Dr. Kamlesh Kumar		NAME OF COURSE COORDINATOR	Dr. Dinesh Tripathi

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1(A)	Let A is left ideal and B be a right ideal of a ring R, then show that AB is a two sided ideal of R, whereas BA is not an ideal of R.	5	CO1	BT3	1.1.
	1(B)	Examine that the map $f:\mathbb{Z}[\sqrt{2}] \to \mathbb{Z}[\sqrt{2}]$ defined as $f(x+\sqrt{2}y) = x - \sqrt{2}y; \ x,y \in \mathbb{Z}$ is homomorphism. Is this an isomorphic function?	5	CO1	BT4	1.1.
	1(C)	Show that $1-i$ is an irreducible element in $\mathbb{Z}[i]$. Is this prime element in $\mathbb{Z}[i]$?	5	CO1	BT3	1.1. 3.1.
PART-B	Q2(A)	If possible, find the g.c.d and l.c.m of $10+11i$ and $8+i$ in $\mathbb{Z}[i]$.	5	CO2	BT4	1.1. 3.1. 3.1.
	2(B)	Show that the ideal $A := \{xf(x) + 2g(x): f(x), g(x) \in \mathbb{Z}[x]\}$ is a maximal ideal of $\mathbb{Z}[x]$.	5	CO2	BT4	1.1. 3.1. 3.1.
	2(C)	Let R be an UFD and $0 \neq f(x) \in R[x]$. Then show that $f(x) = a\, g(x)$, where $a = c(f)$ and $g(x)$ is a primitive in $R[x]$.	5	CO2	BT3	3.1. 3.1.
PART-C	Q3(A)	For an abelian group M, let $End_{\mathbb{Z}}(M)$ be the ring of all (additive) endomorphism's of M. Let R be any ring. Show that M is a left $R-$module $\Leftrightarrow \exists$ a ring homomorphism $\phi: R \to End_{\mathbb{Z}}(M)$.	10	CO3	BT2	3.1. 3.1.
	3(B)	Suppose M and N are submodules of an $R-$module P. Show that $M \cap N = (0)$ if and only if $\forall z \in M + N$ can be uniquely written as $z = x + y$ with $x \in M$ and $y \in N$.	10	CO3	BT3	3.1. 3.1.
	3(C)	Let M be an $R-$module and N be its submodule. Then prove the following; i. M/N is module containing N. ii. The submodules of M/N are of the form N_0/N, where N_0 is a submodule of M	15	CO3	BT2	3.1. 3.1.

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		containing.				
PART-D	Q4(A)	Define Noetherian Modules. Show that M is Noetherian Module if and only if Maximum condition holds for M.	12	CO4	BT2	1.1. 3.1.
	4(B)	With suitable example show that *Artinian* $\not\Rightarrow$ *Noertherian*.	10	CO4	BT3	1.1. 3.1. 3.1.
	4(C)	State and prove Hilbert Basis Theorem.	13	CO4	BT3	1.1. 3.1.

******************* END *******************

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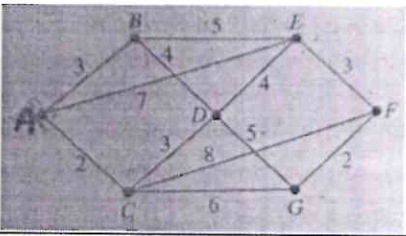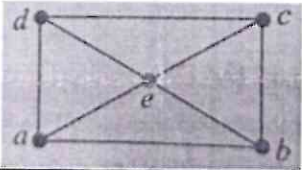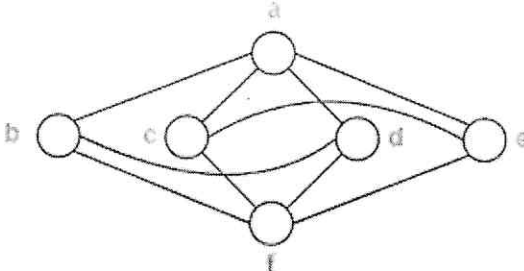
MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	IIIrd	DATE OF EXAM/SESSION	08/12/2023
COURSE NAME	Graph Theory	COURSE CODE	MAH605B (II)
PROGRAM	M.Sc. (Mathematics)	CREDITS	4
TIME DURATION	3 Hrs.	MAX. MARKS	100
NAME OF FACULTY	Dr. Ankita Gaur	NAME OF COURSE COORDINATOR	Dr. Ankita Gaur

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q.1 (a)	Show that the maximum number of edges in a complete bipartite graph of n vertices is $\frac{n^2}{4}$.	8	CO1	BT2	PI 1.1.1
	Q.1(b)	Consider the three distinct vertices x, y, z in a graph G. Prove that there exists a path between z and x if there is a path between x and y and also a path between y and z.	7	CO1	BT4	PI 4.1.1
PART-B	Q.2 (a)	Prove that in a non-trivial tree T there are at least two pendant vertices.	7	CO2	BT4	PI 1.1.2
	Q.2(b)	Find out the minimal spanning tree using Prim's algorithm for the following graph.	8	CO2	BT3	PI 4.1.2
PART-C	Q.3	Prove that a connected graph G contains an unicursal line if it has two vertices of odd degree. Answer and justify: (i) Which complete bipartite graphs are Eluerian ?	12	CO3	BT4	PI 4.2.1 PI 4.2.2

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	(ii) For what values of n is the graph k_n Eulerian ?					
Q.4	Prove that in a complete graph with n vertices there are $\frac{(n-1)}{2}$ edge – disjoint Hamiltonian circuits, if n is odd. Also solve the following problem: Eleven students plan to have dinner together for several days. They will be seated at a round table and the calls for each student to have different neighbors at every dinner. For how many ways can this be done?	12	CO3	BT4	PI 4.1.2
Q.5	Find the shortest path from A to all other vertices using Dijkstra's algorithm in the given weighted graph: 	11	CO3	BT3	PI 1.1.1
Q.6	State and prove decomposition theorem. Find out the chromatic polynomial of the given graph using decomposition theorem: 	12	CO4	BT2 BT4	PI 4.1.1
Q.7	Stat and prove Euler's theorem for planar graphs. Also, show that a simple graph with 7 vertices each of degree 4 is non – planar.	11	CO4	BT4 BT3	PI 4.1.2
Q.8	State and prove five color problem. Also find chromatic number of the following graph: 	12	CO4	BT4 BT3	PI 4.1.1

PART-D (vertical label along left side)

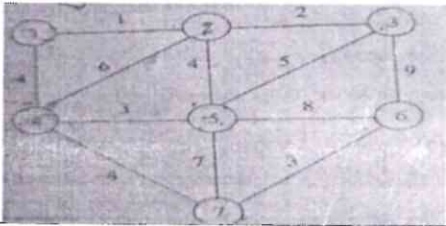****************** END ******************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM/SESSION	12/12/2023
COURSE NAME	Integral Equations and Calculus of Variations	COURSE CODE	MAH601B (II)
PROGRAM	M.Sc. Mathematics	CREDITS	4
TIME DURATION	3 hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Kamlesh Kumar	NAME OF COURSE COORDINATOR	Dr. Deepa Arora

Note: *All questions are compulsory.*

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Convert the differential equation into an integral equation: $$y'' - (\sin x)\, y' + e^x y = x;$$ $y(0) = 1,\ y'(0) = -1.$ Analyze the equation obtained and tell its type and kind.	7	CO1	BT4	1.1.1
	1(B)	Is $y(x) = \cos 2x$ is a solution of the integral equation $y(x) = \cos x + 3\int_0^\pi K(x,t)y(t)dt$ where $K(x,t) = \begin{cases} \sin x \cos t, 0 \le x \le t \\ \cos x \sin t, t \le x \le \pi \end{cases}$? Verify.	8	CO1	BT2	1.1.1
PART-B	2(A)	Compute the iterated kernels for $K(x,t) = x + \sin t ; a = -\pi, b = \pi.$	8	CO2	BT4	1.1.1
	2(B)	Find the characteristic values and the corresponding Eigen functions of the homogeneous Fredholm integral equation of the second kind: $$y(x) = \lambda \int_0^\pi \cos(x + t)\, y(t)dt.$$	7	CO2	BT4	1.1.1 1.1.2
PART-C	3(A)	Show that necessary and sufficient condition that the second order homogeneous linear differential equation $$a_0(x)\frac{d^2y}{dx^2} + a_1(x)\frac{dy}{dx} + a_2(x)y = 0$$ where $a_0(x)$ is continuously differential positive function and	11	CO3	BT2	1.1.1 2.2.1

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		$a_1(x)$ has the a continuous first order derivative on interval $[a, b]$ to be self adjoint is that $a_0'(x) = a_1(x)$ on $\leq x \leq b$, where prime denotes differentiation w.r. t. x. What will be the result if the homogeneous linear differential equation is self adjoint?				
	3(C)	Construct the Green's function for the boundary value problem $\frac{d^2y}{dx^2} + 4y = 0, y(0) = y(1) = 0.$	12	CO3	BT4	1.1.1 2.2.1
	3(D)	Reduce the boundary value problem to integral equation by using the Green's function : $y'' = \lambda y + x^2$; $y(0) = y\left(\frac{\pi}{2}\right) = 0.$	12	CO3	BT3	1.1.1 1.1.2
PART-D	4(A)	Find the stationary value or extremal of the functional $\int_1^2 \frac{\sqrt{1+y'^2}}{x}\, dx$ with $y(1) = 0, y(2) = 1.$	8	CO4	BT3	1.1.1 1.1.2
	4(B)	Prove that the area of the surface of revolution of a curve $y = y(x)$ is $2\pi \int_{x_1}^{x_2} y\sqrt{1 + y'^2}\, dx$, Hence show that for the area to be minimum, the curve must be catenary.	10	CO4	BT4	1.1.1 1.1.2 2.2.1
	4(C)	Compute the Euler –Ostrogradsky equation for $$I[u(x,y)] = \int \left[\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial y}\right)^2\right] dx\, dy$$ where the values of u are prescribed on the boundary C of the domain D.	7	CO5	BT3	1.1.1 1.1.2
	4(D)	Extremise the functional $I[y(x)] = \int_{x_0}^{x_1}[(y''^2 - 2y'^2 + y^2 - 2y\sin x]dx$	10	CO5	BT2	1.1.1

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM	16.12.2023 (II)
COURSE NAME	FLUID MECHANICS	COURSE CODE	MAH602B
PROGRAM	M.Sc. (Mathematics)	CREDITS	4
TIME DURATION	3:00 hr.	MAX. MARKS	100
NAME OF FACULTY	Dr. Ruchi Gupta	NAME OF COURSE COORDINATOR	Dr. Ruchi Gupta

Note: *All questions are compulsory.*

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1.	Define stream line, path line and vertex line. Obtain the necessary and sufficient conditions that vortex lines may be right angle to the stream lines.	6+9	CO1	BT2	2.3.1
PART-B	Q2.	What do you mean by equation of continuity? Drive it in any one form.	5+10	CO2	BT4	3.1.3
PART-C	Q3(A)	Prove that a two dimensional flow towards a normal boundary is found to be characterized by normal component of velocity that directly with distance from the boundary determine stream function and stream line.	7	CO3	BT3	2.2.1
	Q3(B)	State and prove circle theorem.	8	CO3	BT3	2.2.1
	Q4(A)	What arrangement of source and sink will give rise to the function $w = log\left(z - a^2/z\right)$. Prove that two of the stream lines sub-divide into the circle r=a and axis of y.	5+5	CO3	BT3	2.3.1
	Q4(B)	Prove that for the complex potential $tan^{-1}z$ the stream lines and equi-potentials are circles.	5+5	CO3	BT3	2.2.1

PART-D	Q5	Establish Navier-Stokes equations of motion for a viscous compressible fluid.	15	CO4	BT4	2.3.1
	Q6(A)	Examine the motion of viscous fluid of uniform density between parallel planes, the motion being steady where one plate is at rest and other in the motion.	10	CO4	BT4	3.1.3
	Q6 (B)	Water at 20^0C flows between two large parallel plats at a distance 1.5 mm apart. If the average velocity is 0.15m/sec. Compute (a) The maximum velocity (b) The wall shearing stress	5+5	CO4	BT3	1.1.2

******************** END ********************

MANAV RACHNA UNIVERSITY
SCHOOL OF EDUCATION AND HUMANITIES
DEPARTMENT OF EDUCATION
End Semester Examination, Dec-2023"

SEMESTER	3 (Set-B)	DATE OF EXAM	December 19,2023
COURSE NAME	Pedagogical skills	COURSE CODE	EDS234 (II)
PROGRAM	M.Sc Mathematics and M.Tech (ME)	CREDITS	2
TIME DURATION	1.5 hours	MAX. MARKS	50
NAME OF FACULTY	Dr Kiran Gupta	NAME OF COURSE COORDINATOR	Dr Kiran Gupta

Note: *Part A - All questions in Part A are compulsory. Each question carries 2 marks Write your answer in at least 30 words.*
All questions in part-B are compulsory. Each question carries 10 Marks.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	1(a)	Why is there a need to write objectives in Behavioral terms? Discuss.	2	CO1	BT6
	1(b)	Interpret the concept of 'Rubrics" and prepare rubrics for a group discussion.	2	CO4	BT3
	1(c)	Explain the term "Taxonomy" list different levels of Cognitive Domains Bloom's Taxonomy.	2	CO2	BT2
	1(d)	Elucidate different types of concept maps used while explaining different kinds of concepts.	2	CO3	BT4
	1(e)	Write two learning objectives using 'Application' level of Bloom's Taxonomy.	2	CO3	BT3
PART-B	2	Infer the concept of 'Flipped Classroom". Highlight the role of students as well as teachers in a flipped class.	4+6	CO3	BT2
		OR			
		Represent the concept of STEM and STEAM. Illustrate its significance in today's time.	5+5	CO3	BT2
	3	Explain the concept of 'Blended Learning'. As a team Leader or a teacher what learning objectives will you	4+6	CO3	BT3

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		formulate while using 'Blended Learning' approach to teach? **OR** List the Six Thinking Hats. "'The six thinking hats are a method used to amplify creative conversations", Evaluate the statement.	2+8	CO3	BT3
4		Name 4C's the 21st century. Determine their significance for the teachers and professionals to do justice to their professions.	4+6	CO3	BT5
		OR What is "Cooperative Approach" to Learning? It facilitates development of social skills and enhanced learning in students". Justify.	4+6	CO3	BT5
		Define Action Research. Explain various steps of the process of Action Research. **OR**	2+8	CO4	BT2
5		Illustrate the concept of TPACK. Explain how does it show that there is a relationship among technology, Content and Pedagogy for effective teaching learning process?	4+6	CO4	BT2

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM	21.12.2023 (I)
COURSE NAME	Operations Research	COURSE CODE	MAH604B
PROGRAM	M.Sc. Mathematics	CREDITS	4
TIME DURATION	3 Hrs.	MAX. MARKS	100
NAME OF FACULTY	Dr. Aparna Vyas	NAME OF COURSE COORDINATOR	Dr. Aparna Vyas

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1(A)	Give the mathematical and economic structure of linear programming problems. What requirements should be met in order to apply linear programming?	5	CO1	BT1	1.1.1 2.1.1
	1(B)	Solve the following LP problem by using the simplex method: $Minmize\ Z = 3x_1 + 5x_2 + 4x_3$ Subject to the constraints $2x_1 + 3x_2 \leq 8$ $2x_1 + 5x_2 \leq 10$ $3x_1 + 2x_2 + 4x_3 \leq 15$ $x_1 \geq 0, x_2 \geq 0, x_3 \geq 0.$	10	CO3	BT3	1.1.1 2.1.1 3.1.1
PART-B	Q2(A)	A company sells two different products A and B, making a profit of Rs 40 and Rs 30 per unit, respectively. They are both produced with the help of a common production process and are sold in two different markets. The production process has a total capacity of 30,000 man-hours. It takes three hours to produce a unit of A and one hour to produce a unit of B. The market has been surveyed and company officials feel that the maximum number of units of A that can be sold is 8,000 units and that of B is 12,000 units. Subject to these limitations, products can be sold in any combination. Formulate this problem as an LP model to maximize profit.	5	CO2	BT2	1.1.1 2.1.1

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM	21.12.2023 (II)
COURSE NAME	Operations Research	COURSE CODE	MAH604B
PROGRAM	M.Sc. Mathematics	CREDITS	4
TIME DURATION	3 Hrs.	MAX. MARKS	100
NAME OF FACULTY	Dr. Aparna Vyas	NAME OF COURSE COORDINATOR	Dr. Aparna Vyas

Note: *All questions are compulsory.*

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1(A)	Give the mathematical and economic structure of linear programming problems. What requirements should be met in order to apply linear programming?	5	CO1	BT1	1.1.1 2.1.1
	1(B)	Solve the following LP problem by using the simplex method: $$Minmize\ Z = 3x_1 + 5x_2 + 4x_3$$ Subject to the constraints $$2x_1 + 3x_2 \leq 8$$ $$2x_1 + 5x_2 \leq 10$$ $$3x_1 + 2x_2 + 4x_3 \leq 15$$ $$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0.$$	10	CO3	BT3	1.1.1 2.1.1 3.1.1
PART-B	Q2(A)	A company sells two different products A and B, making a profit of Rs 40 and Rs 30 per unit, respectively. They are both produced with the help of a common production process and are sold in two different markets. The production process has a total capacity of 30,000 man-hours. It takes three hours to produce a unit of A and one hour to produce a unit of B. The market has been surveyed and company officials feel that the maximum number of units of A that can be sold is 8,000 units and that of B is 12,000 units. Subject to these limitations, products can be sold in any combination. Formulate this problem as an LP model to maximize profit.	5	CO2	BT2	1.1.1 2.1.1

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2(B)	Let S be a subset in $\mathbb{R}^n$. Then show that the set containing all convex linear combination of points in S is the convex hull of the set S.	10	CO4	BT4	1.1.1 2.1.1

Q3

	A company has factories at F_1, F_2 and F_3 that supply products to warehouses at W_1, W_2 and W_3. The weekly capacities of the factories are 200, 160 and 90 units, respectively. The weekly warehouse requirements are 180, 120 and 150 units, respectively. The unit shipping costs (in rupees) are as follows:	15	CO3 CO4	BT3	1.1.1 3.1.1

		Warehouse			
		W_1	W_2	W_3	Supply
Factory	F_1	16	20	12	200
	F_2	14	8	18	160
	F_3	26	24	16	90
	Demand	180	120	150	

Determine the optimal distribution for this company in order to minimize its total shipping cost.

Q4(A)

	A department of a company has five employees with five jobs to be performed. The time (in hours) that each man takes to perform each job is given in the effectiveness matrix.	10	CO3 CO4	BT4	1.1.1 2.1.1 3.1.1

		Employees				
		I	II	III	IV	V
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the jobs be allocated, one per employee, so as to minimize the total man-hours?

4(B)

	ABC Ice Cream Company has a distribution depot in Greater Kailash Part I for distributing ice-cream in South Delhi. There are four vendors located in different parts of South Delhi (call them A, B, C and D) who have to be supplied ice-cream every day. The following matrix displays the distances (in kilometres) between the depot and the four vendors:	10	CO2 CO4	BT4	1.1.1 2.1.1

		To				
		Depot	A	B	C	D
For	Depot	--------	3.5	3	4	2
	A	3.5	-------	4	2.5	3
	B	3	4	-----	4.5	3.5
	C	4	2.5	4.5	-----	4
	D	2	3	3.5	4	-------

What route should the company van follow so that the total distance travelled is minimized?

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Q5(A) Find the range of values of p and q that will render the entry (2, 2) a saddle point for the game:

		Player B		
		B_1	B_2	B_3
Player A	A_1	2	4	5
	A_2	10	7	q
	A_3	4	p	6

5   CO3   BT3   1.1.1 2.1.1

5(B) Solve the zero-sum game for two persons whose pay off matrix is

		Player B		
		B_1	B_2	B_3
Player A	A_1	1	-1	3
	A_2	2	-1	2
	A_3	-1	0	0
	A_4	-2	0	4

Obtain the best strategies for both players and the value of the game.

10   CO3   BT4   1.1.1 2.1.1 3.1.1

Q6(A) We have five jobs, each of which must go through the machines A, B and C in the order ABC. Processing times (in hours) is as follows:

Job	1	2	3	4	5
Machine(A)	5	7	6	9	5
Machine(B)	2	1	4	5	3
Machine(C)	3	7	5	6	7

Determine the sequence for the jobs that will minimize the total elapsed time.

15   CO1 CO3   BT3   1.1.1 2.1.1 3.1.1

6(B) What do you understand by the problem of sequencing? Discuss the various aspects of data required to formulate the problem of sequencing two jobs on m machines.

5   CO2   BT3   1.1.1 2.1.1

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIECNES (Program-Physics)
"End Semester Examination, Dec-2023"

SEMESTER	I		DATE OF EXAM/SESSION	11.12.2023 (I)
COURSE NAME	Classical Mechanics		COURSE CODE	PHH502B-
PROGRAM	M. Sc. Physics		CREDITS	4
TIME DURATION	3 hrs		MAX. MARKS	100
NAME OF FACULTY	Dr. Ananna Bardhan		NAME OF COURSE COORDINATOR	Dr. Ananna Bardhan

[SET A]

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1(a)	What are inertial and non-inertial frames? Show that if a frame is an inertial frame, then a frame, moving with constant velocity relative to it, is also inertial.	04	CO1	BT2	
	Q1(b)	What is center of mass? Show that in the absence of external forces, the velocity of center of mass remains constant.	05		BT4	
	Q1(c)	A particle moves under a force $F = -\left(\frac{K}{r^2}\right)\hat{r}$. Prove that the angular momentum of the particle is conserved. If $F = (2xy + z^2)\hat{\imath} + x^2\hat{\jmath} + 2xz\hat{k}$ newton, then show that it is conservative. Calculate the amount of work done by this force in moving the particle from (0,1,2) to (5, 2, 7).	06		BT5	
PART-B	Q2(a)	Determine the degrees of freedom for the following cases: (a) Five particles moving freely in a plane (b)Two particles connected by rigid rod moving freely in a plane.	02	CO2	BT4	
	Q2(b)	Discuss and derive Gauge invariance of the Lagrangian.	07		BT4	
	Q2(c)	A cylinder of radius and mass m rolls down an inclined plane making an angle θ with the horizontal. Set up the Lagrangian and find equation of motion.	06		BT5	
PART-C	Q3(a)	Show that if the central force is defined by $F = -\left(\frac{K}{r^2}\right)$, where K is force constant, then the path of the particle is a conic. Also show that the conic is an ellipse, parabola, hyperbola and circle.	18	CO3	BT3	
	Q3(b)	A particle of mass 50 gm moves under an attractive central potential of magnitude $4r^3$ dynes. The angular momentum is equal to 1000gmcm²/s. (i) Find the effective potential energy. (ii) Find the total energy for circular motion.	07		BT5	
	Q4	Deduce the expression for reduced mass and equation of motion of a two-particle system to one particle system. Calculate the reduced mass of CO molecule. If Sun collapsed to form a black hole, what effect would this event have on the orbit of the earth?	10		BT5	

PART-D	Q5(a)	Discuss in detail the canonical transformations. Deduce the expressions for transformation equations for all the possible generating functions.	15		BT3	
	Q5(b)	Show that the following transformations are canonical (i) $Q = q\,tanp$ $P = \log(sinp)$ (ii) $Q = p\,tanq$ $P = \log(sinp)$	05	CO4	BT5	
	Q6	What do you understand by stable and unstable equilibrium? Establish the Lagrangian and deduce the Lagrange's equations of motion for small oscillations of a system with stable equilibrium.	15		BT3	

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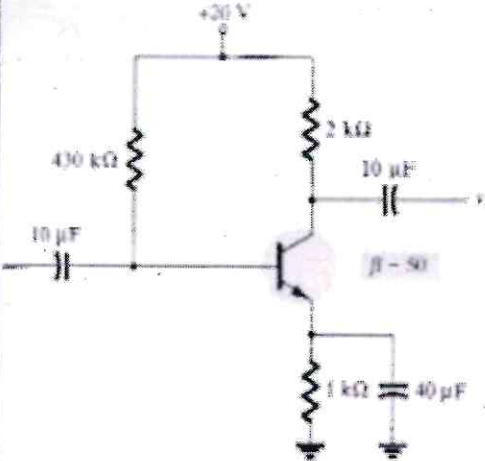
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DEPARTMENT OF SCIENCES
Physics Program
"End Term Examination, Dec 2023"

SEMESTER	I	DATE OF EXAM	18.12.2023
SUBJECT NAME	Physics of Electronic Devices	SUBJECT CODE	PHH504B
BRANCH	Physics	SESSION	I
TIME	3 hrs	MAX. MARKS	100
PROGRAM	M.Sc	CREDITS	4
NAME OF FACULTY	Dr. Shiv Kumar Dixit	NAME OF COURSE COORDINATOR	Dr. Shiv Kumar Dixit

Note: All questions are compulsory.   SET -A

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(a)	The intrinsic resistivity of germanium at room temperature is 0.47 Ω-cm. The electron and hole mobilities at room temperature are 0.39 and 0.19 m^2/V.s. respectively. Calculate the density of electrons in the intrinsic semiconductors. Also calculate the drift velocities of these charge carriers for a field of 10 KV/m.	3	CO1	BT3	2.1 1
	1(b)	Define conductivity (σ) and leakage current in a semiconductor.	2	CO1	BT1	1.1 1
	1(c)	What are majority and minority carrier current? How these depend on temperature? Explain. A pure semiconductor (Si) is doped with donor impurity of $1:10^6$. Find conductivity due to majority and minority carriers. Given total number of atoms in Si = 5×10^{22} atoms/cm^3, Intrinsic concentration $n_i = 1.5\times 10^{10}$ atoms/cm^3, $\mu_n = 1300 cm^2$/V.s, $\mu_p = 500 cm^2$/V.s.	5	CO1	BT3	1.2 1
	1(d)	An amplifier has a bandwidth of 100 KHz and a voltage gain of 50. What will be the bandwidth and gain with a 4% negative feedback?	5	CO1	BT2	2.1 1

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2(a)	Elaborate Avalanche and Zener breakdown mechanism.	5	CO2	BT2	1.2. 1
2(b)	Define current gain in CE, CB and CC configuration and explain CB configuration with diagram.	5	CO2	BT2	1.1. 1,
2(c)	Explain base width modulation and punch through phenomenon in transistor.	5	CO2	BT2	3.1. 1
Q.3	For the emitter bias network find I_B, I_C, V_{CE}, V_C, V_E, V_B, and V_{BC}. Given V_{cc} = +20V, R_B = 430kΩ, R_C = 2kΩ, C_1= 10µF, R_E = 1 kΩ, Ce= 40 µF, β= 50, C_2=10 µF .	5+5+ 5	CO3	BT3	2.1. 1
Q.4	An audio frequency amplifier is to be designed for operating over a range of 20 Hz to 20 KHz. Calculate the value of input coupling capacitor C_1 if the total series resistance (Rs) is 10KΩ.	5	CO3	BT1	2.1. 1
Q.5	Explain RC coupled amplifier, its features, frequency response with diagram. Discuss the effect of negative feedback on gain and bandwidth of the amplifier.	10+5	CO3	BT3	2.1. 1
Q6.	(i) Compare and explain class A and Class B power amplifiers with diagram. (ii) Why class C amplifier is called tuned amplifier? Explain with diagram.	10+5	CO4	BT4	2.2. 1
Q7.	Draw the figure and explain Class D power amplifier.	10	CO4	BT2	2.2. 1
Q8.	For harmonic distortion reading of D_2=0.1, D_3=0.02, and D_4= 0.01, with I_1 = 4 A and R_C= 8Ω, calculate the total harmonic distortion, fundamental power component, and total power.	10	CO4	BT3	2.1. 1
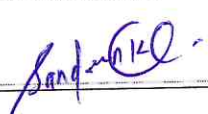
PART-B

***************** END *****************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	I	**DATE OF EXAM/SESSION**	20.12.2023(I)
COURSE NAME	Mathematical Physics	**COURSE CODE**	PHH501B -
PROGRAM	M.Sc. Physics	**CREDITS**	4
TIME DURATION	3 hours	**MAX. MARKS**	100
NAME OF FACULTY	Dr. Moditma	**NAME OF COURSE COORDINATOR**	Dr. Moditma

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q.1	Determine the eigen values of the matrix $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.	5	CO1	BT2	1.4.2
	Q.2	Determine whether the matrix $A = \begin{bmatrix} 0 & 2 \\ 3 & -1 \end{bmatrix}$ can be diagonalized. If yes, determine the diagonalizing matrix P.	10	CO1	BT2	1.4.2
PART-B	Q.3	Solve the differential equation $(x^3 + 3x^2y)dx + (3x^2y + y^3)dy = 0$	8	CO2	BT4	1.4.2
	Q.4	Consider the linear differential equation $\frac{dy}{dx} + 2y\,tanx = sinx$ Determine the integrating factor and hence solve the differential equation.	7	CO2	BT2	1.4.2
PART-C	Q.5	Write the expression for Legendre's differential equation. Obtain the form of recurrence relation and hence deduce the functional form of Legendre's polynomial.	2+8+10 =20	CO3	BT4	1.4.2, 10.1.1
	Q.6	Consider the differential equation $y'' + 2y = 0$ What is the order of this differential equation? Determine the recurrence relation by assuming a power series solution and hence solve the differential equation.	1+7+7= 15	CO3	BT4	1.4.2, 10.1.1

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Q.7	Find the Laplace transform of $f(x) = 1 + \sin(2x)$.	5	CO4	BT2	1.4.2
PART-D **Q.8**	Show that the Fourier transform of Gaussian function is also Gaussian.	10	CO4	BT2	1.4.2
Q.9	Write the Fourier series expansion of a periodic function with period 2L. In the limit L→ ∞ show that the series expansion can be written as a complex Fourier Integral. Also obtain expressions of Fourier Integral for even and odd functions.	4+10+6 =20	CO4	BT4	1.4.2, 10.1.

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DEPARTMENT OF SCIENCES

A

"End-Term Examination, December-2023"

SEMESTER	I	DATE OF EXAM	22-12-2023
SUBJECT NAME	COMPUTATIONAL METHODS AND PROGRAMMING	SUBJECT CODE	PHS505B
BRANCH	Physics	SESSION	Morning
TIME	8:30 AM to 10:00 AM	MAX. MARKS	50
PROGRAM	MSc	CREDITS	2
NAME OF FACULTY	Dr. Sandeep Kumar	NAME OF COURSE COORDINATOR	Dr. Sandeep Kumar

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Create a matrix of zeros with 5 rows and 3 columns.	2	CO1	BT1	2.1
	1(B)	Create the row vector of odd numbers through 29.	2	CO1	BT2	5.2
	1(C)	Create two different vectors of the same length and add them.	2	CO1	BT1	3.3, 2.1, 7.1
	1(D)	Create a 4 x 4 matrix and display the second row of and the third column.	2	CO1	BT1	2.2, 4.3
	1(E)	Create a 4x1 vector A of zeros using the zero command.	2	CO1	BT1	8.1, 10.1
PART-B & PART-C	Q2	**a)** Using ezplot command, plot $y = 4\cos^2(\pi x)$ for values $x = 0: \pi/10: 2\pi$ **b)** Define the following function using **syms**: $$f(x) = x^2 e^x - 5x^3$$ Compute the integral with respect to x and second derivative with respect to x.	5+5	CO2	BT2, BT1	2.1, 10.2
	Q3	**a)** Find the general solution of the following ODE: $dy/dt + y\sin(t) = \tan(2t)$	5+5	CO2	BT3	8.1, 11.3

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PART-D		**b)** Find the general solution of the following first order ODE: $dy/dt - 2y = e^{5t}$				
	Q4	**a)** Solve the following ODE using forward Euler method and plot the solution along with exact solution on the same plot. $y'(t) = t^2 + y$, $0 \le t \le 2$. Use as initial conditions $y(0) = 1$, $h = 0.25$, $y_{exact} = 3e^t - t^2 - 2t - 2$. **b)** Using ode45 method, solve the following ODE with relative and absolute error of 10^{-10}, $y'(t) = 8sin(t) - 3y^3$, $y(0) = 1$. The initial time is t = 0, and the end time is t = 10. Plot the solution.	10+ 10	CO3	BT4	8.1, 11. 3

****************** END ******************

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SEMESTER	III		DATE OF EXAM/SESSION	12.12.2023 (II)
COURSE NAME	Nuclear and Particle Physics		COURSE CODE	PHH601B
PROGRAM	M. Sc. Physics		CREDITS	4
TIME	3Hrs		MAX. MARKS	100
NAME OF FACULTY	Dr. Ananna Bardhan		NAME OF COURSE COORDINATOR	Dr. Ananna Bardhan

Note: All questions are compulsory.

[SET B]

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1a	If the nuclear force is charge independent and a neutron and a proton form a bound state, then why is there no bound state for two neutrons? What information is obtained from it?	04		BT4	
	1b	Si_{14}^{27} and Al_{13}^{27} are mirror nuclei having ground states except for charge. If their mass difference is 6 MeV, estimate the radius, neglecting the proton-neutron difference.	05	CO1	BT4	
	1c	Calculate the binding energies for K^{39} and Ca^{39} from semi empirical binding energy equation. What do you infer from these energies about the relative stabilities.	06		BT4	
PART-B	2a	Determine the J^P for the ground state of B_5^{11}, Sc_{21}^{45} and Kr_{36}^{84} using the shell model diagram	05	CO2	BT4	
	2b	Explain and deduce an expression for liquid drop model. Explain all the terms explicitly and their contribution in semi – empirical mass formula.	10		BT3	
PART-C	3a	How are matrix elements used to calculate the transition rates for beta decay processes? Are there situations where parity is not conserved in beta decay, and if so, under what conditions? Explain the concept of forbidden beta transitions.	10+5	CO3	BT3	
	3b	Discuss selection rules, Decay constants and transition probability during a gamma decay.	15		BT5	
	4	How does the energy conservation is maintained during internal pair creation. Also explain the phenomena of nuclear isomerism.	05		BT4	
PART-D	5a	Determine the number of quarks of the atom Be_4^9.	02		BT3	
	5b	Complete the reactions: (i) $_3^6Li + ? \rightarrow _4^7Be + _0^1n$ (ii) $_{17}^{35}Li + ? \rightarrow _{16}^{32}S + _2^4He$ (iii) $_4^9Be + _2^4He \rightarrow 3_2^4He + _0^1n + ?$ (iv) $_{35}^{79}Br + _1^2H \rightarrow ? + 2_0^1n$	08		BT3	
	6a	Why must the quark in a hardon have different colors? Would they have to have different colors if their spins were 0 or 1 rather than ½?	04	CO4	BT3	
	6b	Allocate the isospin to the strange particles from the following reactions: (i) $\pi^- + p \rightarrow \lambda^0 + K^0$ (ii) $\pi^+ + n \rightarrow \lambda^0 + K^+$	04		BT4	
	6c	Out of the two following reactions, which reaction is allowed. Support your answer with justification. (i) $p \rightarrow \pi^0 + e^+ + \nu_e$ (ii) $e^+ + \nu_e \rightarrow \mu^+ + \nu_\mu$	04		BT5	
	6d	What are elementary particles. Discuss the Gell Mann Nishijima scheme used for the classification of elementary particles.	13		BT3	

****************** END ******************

DEPARTMENT OF SCIENCES

"End-Term Examination, December-2023"

A

SEMESTER	IIIrd	DATE OF EXAM	16-12-2023
SUBJECT NAME	Electrodynamics and Plasma Physics	SUBJECT CODE	PHH602B
BRANCH	Physics	SESSION	Afternoon
TIME	12.30 PM - 03.30PM	MAX. MARKS	100
PROGRAM	MSc	CREDITS	4
NAME OF FACULTY	Dr. Sandeep Kumar	NAME OF COURSE COORDINATOR	Dr. Sandeep Kumar

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BT	PI
PART-A&B	Q.1(a)	Given point P (-2, 6, 3), and vector $\vec{A} = y\hat{\imath} + (x + z)\hat{\jmath}$, express P and $\vec{A}$ in cylindrical and spherical coordinates. Evaluate $\vec{A}$ at P in the Cartesian, cylindrical, and spherical systems.	9	CO1	BT1, BT3	1.11., 2.1.1, 2.2.1,4.1.1
	1(b)	Given the field $\vec{H} = \rho z \cos\phi \, \hat{a}_\rho + e^{-2} \sin\frac{\phi}{2} \hat{a}_\phi + \rho^2 \hat{a}_z$ at point $(1, \pi/3, 0)$, find (i) $\vec{H} \cdot \hat{a}_\rho$ (ii) $\vec{H} \cdot \times \hat{a}_\phi$	6	CO1	BT3	1.11., 2.1.1, 2.2.1,4.1.1
	Q.2 (a)	Discuss the wave propagation in lossy dielectrics. Obtain an expression for $\vec{E}$.	9	CO2	BT1, BT4	1.11., 2.1.1, 2.2.1,4.1.1
	2(b)	A region $0 \leq z \leq 2\,m$ is occupied by an infinite slab of permeable material ($\mu_r = 2.5$). If $\vec{B} = 10y\hat{a}_x - 5x\hat{a}_y$ Wb/m^2 within the slab, determine (i) $\vec{J}$ (ii) $\vec{M}$	6	CO2	BT5	1.11., 2.1.1, 2.2.1,4.1.1
PART-C	Q.3(a)	What is gauge transformations? Explain in detail.	6	CO3	BT1, BT4	1.11., 2.1.1, 2.2.1,4.1.1
	Q3(b)	Find the charge and current distributions that would give rise to the potentials V = 0, $A = \begin{cases}(\mu_0 k/4c)(ct - \|x\|)^2\hat{z}, for\ \|x\| < ct, \\ 0, \quad for\ \|x\| > ct,\end{cases}$ where k is a constant and $c = 1/\sqrt{\varepsilon_0 \mu_0}$	6	CO3	BT5	1.11., 2.1.1, 2.2.1,4.1.1
	Q3©	Discuss the concept of retarded potentials for non-static case and prove that they verify the inhomogeneous equations	8	CO3	BT2	1.11., 2.1.1, 2.2.1,4.1.1
	Q.4(a)	Obtain the expressions for Liénard-Wiechert Potentials.	6	CO3	BT2, BT4	1.11., 2.1.1, 2.2.1,4.1.1
	Q.4(b)	Deduce an expression for Larmor's formula for a non-relativistic accelerated charge.	9	CO3	BT2, BT3, BT4	1.11., 2.1.1, 2.2.1,4.1.1
PART-D	Q.5(a)	Discuss in detail the concept of the temperature in plasma. What are the necessary conditions for an ionized gas to be plasma?	8	CO4	BT2, BT3, BT4	1.11., 2.1.1, 2.2.1,4.1.1
	Q.5(b)	What is Plasma Debye length? Discuss it in detail and obtain an expression for it.	6	CO4	BT2, BT3, BT4	1.11., 2.1.1, 2.2.1,4.1.1

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Q.5(c)	Deduce Debye length λ_D and the number of particles in Debye sphere N_D for the following cases: (a) glow discharge with $n = 10^{18}$ m^{-3}, $KT_e = 3\ eV$, (b) The earth's ionosphere, with $n = 10^{11}$ m^{-3}, $KT_e = 0.3\ eV$. (c) A θ-pinch, with $n = 10^{24}$ m^{-3}, $KT_e = 750\ eV$.	6	CO4	BT2, BT3, BT4	1.11., 2.1.1 2.2.1,4.1.1
Q.6(a)	What is the plasma Oscillation? Deduce an expression for plasma frequency with the help of mass conservation of continuity.	9	CO4	BT2, BT3, BT4	1.11., 2.1.1 2.2.1,4.1.1
Q.6(b)	Write a short note on magnetic confinement and inertial confinement in plasma.	6	CO4	BT2, BT3, BT4	1.11., 2.1.1, 2.2.1,4.1.1

************ END ************

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MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIENCES
"End Semester Examination, Dec-2023"

SEMESTER	III	DATE OF EXAM/SESSION	19/12/2023 (II)
COURSE NAME	Advance solid-state physics	COURSE CODE	PHH603B
PROGRAM	M.Sc. (Physics)	CREDITS	4
TIME DURATION	3 Hrs	MAX. MARKS	100
NAME OF FACULTY	Dr. Deepti Maikhuri	NAME OF COURSE COORDINATOR	Dr. Deepti Maikhuri

Note: *All questions are compulsory. Use of scientific calculator is allowed during the exam.*

[SET –B]

Q NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	
PART A	1	Obtain an expression for density of states of free electrons in a metallic specimen. For an electron in a metallic specimen, calculate the density of energy states below 2eV.	9+6	CO1	BT2, BT3, BT5	
PART B	2	What is effective plasma permittivity? Derive an expression for it and interpret its physical significance. Show that Debye's potential $\psi(r) = \frac{e}{4\pi\varepsilon_0}\frac{\exp(\frac{-r}{\lambda})}{r}$, is solution of the equation $\nabla^2\psi(r) = \frac{\psi(r)}{r_D^2} = \frac{n_0 e^2}{\varepsilon_0 kT_e}\psi_r$, where r_D is the Debye's radius.	5+5+5	CO2	BT1, BT2, BT4	
PART C	3	what is meant by local field on dielectric and how it is calculated for a cubic structure? Deduce Clausius - Mosotti relation and explain, its use in predicting the dielectric constants of solids. Find the total polarizability of CO_2, if its susceptibility is $0.985\times10^{-3}C^2/Nm^2$. Density of CO_2 is $1.977 Kg/m^3$	6+9+5	CO3	BT3, BT4.BT5	
	4	At what frequency do the real and imaginary parts of the polarizability become dominant? Illustrate their distribution around that frequency. Show that the imaginary part of the dielectric constant is the measure of dielectric loss. or Delve into the theory of dielectrics when subjected to an	5+5+5	CO3	BT2, BT3, BT4	

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		electric field. Derive an equation for the frequency independent dielectric constant. Given a refractive index of 1.6 for an elemental semiconductor in the visible spectrum, calculate the polarizability of the material with an atomic density of $3.1 \times 10^{21}/cm^3$.			
PART D	5	Describe Heisenberg's interaction of the origin of Weiss molecular field. Relate exchange integral to the Weiss constant and Ferromagnetic Curie temperature. The curie temperature of Fe is 1043K. Assume that iron atoms, when in the metallic form, have moments of two Bohr magneton/atom. Fe is BCC with lattice parameter, a=0.286 nm. Calculate (a) the saturation magnetization (b) the Curie constant (c) the Weiss field constant (d) magnitude of the internal field or Describe Langevin's theory of paramagnetism. Obtain paramagnetic susceptibility of a free electron gas employing quantum statistics. Approximately how large must be the magnetic induction for the orientation energy to be comparable to the thermal energy at room temperature? Assume $\mu_m=5\mu_B$.	4+8+8	C O4	BT3, BT4, BT5
	6	Differentiate among ferromagnetic, ferrimagnetic, and antiferromagnetic materials. Utilizing the two-sublattice model, derive the susceptibility expressions for an antiferromagnetic substance both above and below the Neel temperature. or Explain the magnetic theory at the atomic level. Provide an in-depth analysis of all the three origins of permanent magnetic moments. A paramagnetic material has 10^{28} atom/m^3. The magnetic moment of each atom is $1.8\times10^{-23}Am^2$. Calculate the paramagnetic susceptibility at 300K. What would be the dipole moment of a bar of this material 0.1m long and 1sq cm cross-section placed in a filed of 8×10^4 A/m	5+10	CO4	BT3, BT4, BT5

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MANAV RACHNA UNIVERSITY

MANAV RACHNA UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF SCIECNES (Program-Physics)
"End Semester Examination, Dec-2023"

SEMESTER	3rd		DATE OF EXAM/SESSION	21/12/2023
COURSE NAME	Synthesis & Characterization Technique		COURSE CODE	PHH605B
PROGRAM	M.Sc. Physics		CREDITS	4
TIME DURATION	3 hrs		MAX. MARKS	100
NAME OF FACULTY	Dr. Anshuman Sahai		NAME OF COURSE COORDINATOR	Dr. Anshuman Sahai

***Note**: All questions are compulsory*

[SET B]

Q.NO.		QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	Q1(A)	Explain the working of CVD.	7.5	CO1	BT2	
	1(B)	With the help of neatly labeled diagram, explain the working of RF sputtering technique.	7.5		BT3	
PART-B	Q2(A)	Explain the criteria on which you differentiate between bulk, thin films, and nano materials?	7.5	CO2	BT2	
	2(B)	Explain the method of Bottom up approach to synthesize the nanomaterials	7.5		BT2	
PART-C	3(A)	Give principle, construction and working of Ultra-violet visible (UV-vis) spectroscopy. What are the applications of UV-visible in modern material science research?	10	CO3	BT3, BT4	
	3(B)	Give principle, construction and working of Raman spectroscopy. What are the applications of Raman spectrometer in Nano-science and nano-technology?	10		BT3, BT4	
	4(A)	Explain the working of X-ray diffraction methods.	5		BT3	
	4(B)	Explain the working of FTIR spectroscopy. How will you characterize the power materials? How this technique is better than conventional Infrared spectrophotometer.	10		BT3	
PART D	5	(a) Give principle, construction and working of TEM machine. (b) How the low temperature help to generate the image. (c) Describe the all vacuum pumps attached to it for generate the Ultra high vacuum.	5+5+10	CO4	BT3, BT4	
	6	(a) Give principle, construction and working of SEM machine. (b) How the elemental analysis can be obtained from the SEM. Describe the applications of SEM.	10+5		BT2, BT3. BT4	

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MANAV RACHNA UNIVERSITY

SCHOOL OF LAW

DEPARTMENT OF LAW

"End Semester Examination, Dec-2023"

SEMESTER	I	**DATE OF EXAM**	8/12/2023 (I)
COURSE NAME	Legal English-I	**COURSE CODE**	LWH106/LWH127
PROGRAM	BA LL.B/BBA LL.B	**CREDITS**	4
TIME DURATION	3 HOURS	**MAX. MARKS**	100
NAME OF FACULTY	DR SK BOSE	**NAME OF COURSE COORDINATOR**	DR SK BOSE

Note: There are four sections in the paper. Attempt all questions from each part.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	Q1	Explain- *Ignorantia facti excusat; Ignorantia juris non-excusat.*	5	CO1	BT2
	Q2(A)	In the case of ADM Jabalpur v. Shivkant Shukla, the word 'law' in the expression 'procedure' established by law'(Art 21) means…?	5	CO3	BT4
	Q2(B)	Literature plays pivotal role in shaping law-How far do you agree?	5	CO2	BT2
PART-B	Q3	Discuss the scope of law and literature.	5	CO2	BT2
	Q4(A)	How has the play "The Merchant of Venice" been influential in shaping the attitudes towards the legal system?	5	CO2	BT3
	Q4(B)	What is your view about Franz Kafka's "The Trial"?	5	CO3	BT2
PART-C	Q5	You are hosting a talk show called **"Legally Speaking"** where you invite speakers/experts to talk on various issues/topics on relevant domain. As a host, prepare a script outlining points or questions which you wish to discuss with your guest speakers/experts in your upcoming episode. Follow a suitable format	7+3	CO4	BT4
	Q6	Write an email to the Managing Director of WAT Company Pvt. Ltd. New Jersey to recommend your friend for a suitable job. In your letter introduce yourself and say what you are doing, describe the role your friend is interested in, and explain why he/she is suitable for the job.	2+3+5	CO4	BT3
	Q7(A)	Prepare your CV as a law student which is to be submitted for an upcoming internship program.	5	CO3	BT3
	Q7(B)	Write down the Preamble of Indian Constitution as it is mentioned in the Constitution.	5	CO2	BT2
	Q7(C)	Discuss some DOs and DON'Ts of Advocacy.	5	CO3	BT2

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