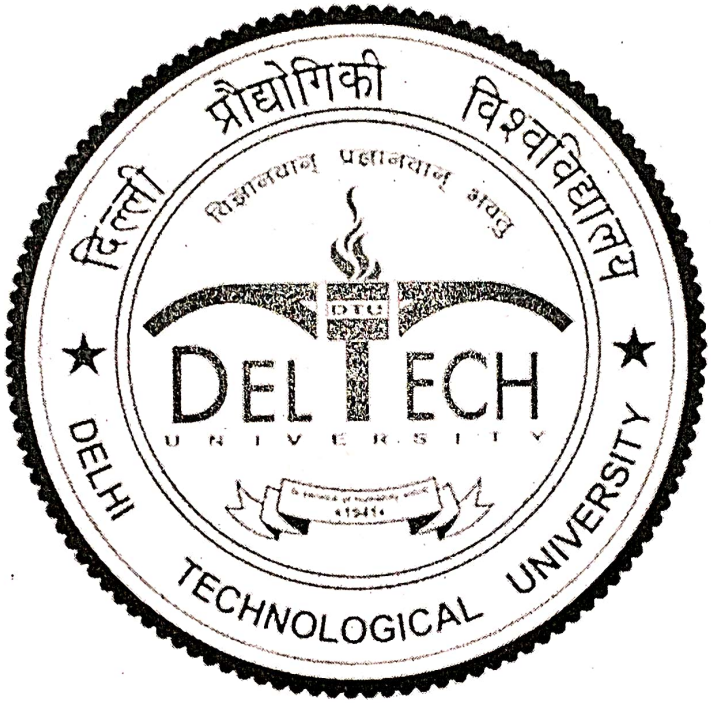
QUESTION PAPERS FOR END TERM THEORY EXAMINATIONS

May-2023



M.Tech., MTPT, M.Sc., MBA, EMBA, M.Des.,

2nd , 4th & 6th SEMESTER

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M.Sc.

Total no of pages: 1 140 Roll No:

2nd_ SEMESTER MSc. (Biotechnology)

END SEMESTER EXAMINATION May2023

MSBT 102 : Immunology

Time: 3:00 Hours *Max. Marks : 40*

Note : Answer all questions. Assume suitable missing data, if any.

1. Write short notes on the following: : [2x4] [CO#3, 4,5]

(a) Subunit vaccines

(b) Graft vs host rejection

(c) Grave's disease

(d) Type IV hypersensitivity

2. Attempt any 2 questions of the following: [4x2] [CO#2,3]

(a) Mechanism of killing of tumor cells by immune cells

(b) Complement activation cascade initiated by immune complexes and its regulation

(c) Mechanism of exogenous antigen presentation on MHC II and cross-presentation on MHC I

3. Attempt any 2 questions of the following: [4x2] [CO#1,2]

(a) How does the immune system ensure that there will be at least a B cell clone that will recognize all antigenic epitopes that the individual will come across in his lifetime (explain all the levels of antibody diversity in detail)? Justify the statement that IgM is the only antibody that can exist in both membrane bound and secreted forms(give suitable schematic diagrams).

(b) Distinguish between T cell and B cell signalling. Explain how T cell activation is regulated by inducible expression of CTLA4.

(c) What are cytokines? What are the properties of cytokines that make them crucial as the telecommunication network of our immune system? How do cytokines determine disease outcome by determining Th1 or Th2 response?

4. Attempt any 2 questions of the following: [4x2] [CO#3,4, 5]

(a) What is autoimmunity and explain its probable causes. Describe any one localized and one systemic autoimmune disease in detail.

(b) What is the difference between monoclonal and polyclonal antibodies? What do you understand by hybridoma technology? Explain the principle of HAT selection in monoclonal antibody production.

(c) Explain using suitable diagrams the difference between Indirect and Sandwich ELISA. How is a flowcytometer capable of detecting different types of immune cells in a PBMC preparation?

5. Attempt any 2 questions of the following: [4x2] [CO#1, 2,5]

(a) What is the crucial difference in Central and Peripheral tolerance? What is chronic graft rejection and why does it occur?

(b) What are the different types of tumor antigens? Explain how immune system fights tumorigenesis. What do you understand by Adoptive Transfer?

(c) Describe how the innate immune system plays an important role in immunity to bacterial infections? Explain how co-stimulation is essential for adaptive immune system and is also important in adding to the specificity of the adaptive immune system.

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SECOND SEMESTER

M.Sc [BT]

END TERM EXAMINATION

MAY-2023

MSBT 104: Microbiology and Industrial Applications

Time: 03:00 Hours

Max. Marks: 40

Note: ALL questions carry equal marks.
Assume suitable missing data, if any.

Q.1 (a) What are biogeological cycles and the role of microorganism in environment. Discus nitrogen cycle with diagram.

[2+2] [CO4]

(b) Write note on *any two* of the following: **[2+2] [CO4, CO1]**

(i) Biofilm and Quorum sensing

(ii) Microbial fuel cells

(iii) T-RFLP

Q.2 (a) What do you mean substrate level phosphorylation. Explain the steps involved in ED pathway along with ATP generation.

[1+3=4] [CO2]

(b) Differentiate between: **[2+2] [CO2, CO5]**

(i) Viriod and Prion

(ii) Primary and secondary metabolites

Q.3 (a) What is an infection? Analyze the terms ID and LD50 for infections. Explain the Port of entry of pathogens into a host cell?

[1+1+2] [CO3]

(b) Differentiate following: **[2+2] [CO3]**

(i) Endotoxin and Exotoxin

(ii) Mutualism and Ammensalism

Q 4. Explain the stages involved in infection and disease, with the help of curve. What are the symptoms and syndrome. **[3+1=4] [CO3]**

[b] Define the term taxonomy? Explain any six approaches are applied for bacterial classification.

[1+3=4] [CO1]

Q.5 (a) Write the approaches used for strain improvement of microorganisms. Calculate the sterilization time period for the bacteria whose specific death rate at 121°C was found to be 1.62 min^{-1}, if del factor for heating, cooling and overall are respectively 10, 9, 29.2.

[1+3=4] [CO5]

(b) Discuss how the pH and temperature are measured and controlled during fermentation process.

[4] [CO5]

OR

Elaborate the different steps involved during production and recovery of microbial enzyme.

[4] [CO5]

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2nd SEMESTER

M.Sc.

END TERM EXAMINATION *May-2023*

COURSE CODE MSBT1105

COURSE TITLE ENVIRONMENTAL BIOTECHNOLOGY

Time: 03:00 Hours *Max. Marks: 50*

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1(a) Municipal solid waste is a big issue in Delhi city. Discuss important parameters that can be taken for management of solid waste.

(b) Explain why landfills are harmful to environment. **[5X2=10][CO1]**

Q.2 Yamuna is lifeline of Delhi city. Explain the steps taken by the Hon'ble LG to mitigate water pollution in Yamuna. **[10][CO3]**

Q.3 Explain the types and processes involved in bioremediation of pollutants in environment. **[10][CO4]**

Q.4 (a) Define vermiculture? Explain the process of vermicomposting with example.

OR

(b) What is E-waste? Explain the process of e-waste recycling. **[10][CO4]**

Q.5 Define the following (Any five) **[5X2=10][CO2]**

(a) Nitrification

(b) Ground level ozone

(c) Eutrophication

(d) Ecological Succession

(e) Xenobiotics

(f) Biofertilizer

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IInd SEMESTER

M.Sc. Biotechnology

END TERM EXAMINATION *May-2023*

MSBT 106 GENETIC ENGINEERING

Time: 3:00 Hours *Max. Marks: 40*

Note: Answer any 5 questions.
All questions carry equal marks.
Assume suitable missing data, if any.

Q.1. A multi loci region of 500kb in human genome has various regulatory sequences that have lot of importance for gene expression. Describe strategy (ies) to identify these regions in one go with 100-200 picogram of DNA. Explain various limitations to execute the experiment. **[08][CO3]**

Q.2. Explain the mechanism and protocol of agarose gel electrophoresis. Explain the composition of reagents and buffers used in agarose gel electrophoresis. Discuss the difference between horizontal and vertical gel electrophoresis. Explain the mechanism and phenomenon of site-specific mutagenesis. **[08][CO1]**

Q.3 An arbitrary internal DNA sequence is present in the qARM of human chromosome number 15 which is; 5' CTCAGTCACTAGCATGGACCGAGCTAGATACAACAATTCACGAT AACTTAGCCGATTGCTAATACTAGCTTACGTTACGACATGAACT AATACGCCGGATCGATCGACTAACATTC-3'. In order to identify and validate the sequence in human genomic DNA what methodology would you opt? Write detail steps with pictorial representation. **[08][CO2]**

Q.4 What are the limiting factors in PCR? Describe the saturation curve? What would be the advantage of multiplex, semi- quantitative, non-specific and nested PCR? Define your answer with pictorial representation. What is the role of high-fidelity Taq polymerase? With the help of given arbitrary sequence prepare at least two sets of primers and load EcoRI (GAATTC), EcoRV (GATATC), SalI (GTCGAC), NheI (GCTAGC)REs in the primers together with their Tm (While preparing primers with the restriction site minimum mismatch are allowed) 5'CTCAGTCACTAGCATGGACCGAGCTAGATACAACAATTCACGATTAACTTAGCCGATTGCTAA TACTAGCTTACGTTACGACATGAACTAATACGCCGGA TCGATCGACTAACATTC3'

[08][CO3]

Q.5 Explain gene silencing techniques, principle and applications of gene silencing.

[08][CO4]

Q.6 What is the purpose of transfection? Briefly discuss any two methods of transfection with appropriate protocol. Explain the reason behind the low transfection efficiency and low cell-viability after transfection

[08][CO4]

Q.7 What are the tools of recombinant DNA technology? Explain the process of blunting and ligation. Briefly discuss the role of recombinant DNA technology in human health and disease.

[08][CO2]

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EVEN SEMESTER

M.Sc. BIOTECHNOLOGY

END TERM EXAMINATION ***MAY 2023***

MSBT108 GENETICS

Time: 03:00 Hours ***Max. Marks: 50***

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 a) Explain the difference in the mechanism of generalized and specialized transduction.
b) How is the Ames test used in determining the mutagenicity of a compound? [5][CO1]

Q.2 Describe the steps of attachment, entry and release of M13 phage during infection of a bacterial cell. [5][CO 2]

Q.3 Discuss the patterns of inheritance, defects in genes, and symptoms associated with any 2 of the following diseases: [5][CO 3]
a) Cystic Fibrosis
b) Huntington disease
c) Hemophilia

Q.4 a) What is Heritability and its application? Explain briefly two types of Heritability.
b) What do you understand by Genomic imprinting. Give 2 examples of diseases caused by it. [5][CO 3]

Q.5 Explain cytoplasmic inheritance in 4 o'clock plant (*Mirabilis jalapa*) variant having some branches with white leaves, few with green leaves and others with variegated leaves. [5][CO 3]

Q.6 What is the role of Homeotic Selector genes in the development of *Drosophila*? Write two properties of *Drosophila* Hox genes. [5][CO 4]

OR

Q.6' Describe the events in embryonic development of *Drosophila* initiated by gradients of maternal effect gene products. [5][CO 4]

Q.7 Explain the use of Fluorescence In Situ Hybridization (FISH) and Comparative Genomic Hybridization (CGH) in molecular cytogenetics. [5][CO 4]

Q.8 Explain briefly: [5][CO 4]
(i) Somatic hypermutation in Ig genes
(ii) Class switching in B lymphocytes
(iii) Allelic exclusion during B cell differentiation
(iv) Clonal selection theory
(v) Minigene hypothesis to explain antibody diversity

Q.9 Explain the link between mutations and DNA polymorphism. List different types of polymorphisms occurring in genome. [5][CO 5]

Q.10 What are the various factors that can alter allele frequencies in a population? [5][CO 5]

OR

Q.10' What are the assumptions made while stating Hardy-Weinberg Law? Discuss the predictions and important consequences of this law. [5][CO 5]

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FOURTH SEMESTER(M.Sc)

END TERM EXAMINATION May-2023

MSBT 204 Genomics and Proteomics

Time:3 hours **Max. Marks: 50**

Note: Answer all questions.
All question carry equal Marks
Assume suitable missing data, if any.
Use diagrams, flowchart and table wherever possible

1.Differentiate between coding and non-coding DNA sequence. Explain the structural organization of genome. Mention different types of DNA sequencing methods. (10)(CO1)

2.Discuss the application of several genome projects for improving human health. Can animal genome project impact the precision breeding of animals? (10)(CO2)

3.What is 2-D gel electrophoresis and 2-D DIGE? Briefly, mention five other protein-protein interaction methods (10)(CO3)

4.Design a high throughput screening method for drug discovery by in-silico analysis and in-vitro analysis. (10)(CO4)

5. Explain five type of microarray based technology. What are the applications of microarray technology. (10)(CO5)

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2nd SEMESTER

M.Sc. (Chemistry)

END TERM EXAMINATION ***May-2023***

MSCH102 Molecule Symmetry and Group Theory

Time: 03:00 Hours ***Max. Marks: 50***

Note : All questions carry equal marks. Do any ten.
Assume suitable missing data, if any.

Q.1 What is the ground term symbol for octahedral Cr^{3+} ion. Derive. [5, CO1]

Q.2 Distinguish between the features of Orgel diagrams and Tanabe-Sugano diagrams. [5, CO1]

Q.3 (a) Explain Curie's Law and describe its significance.

(b) Explain Temperature Independent Paramagnetism giving suitable examples. [5, CO2]

Q.4 What do you understand by the terms hydrolysis, acid hydrolysis and base hydrolysis of coordination compounds? Explain the mechanism of base hydrolysis of an octahedral complex using suitable example. [5, CO3]

Q.5 (a) What is Chelate effect? Why it is considered as an entropy effect? Predict and give reasons which of the following pairs would have higher order of stability. [5, CO3]

(i) $[Cu(acac)_2]^{2+}$ $[Cu(en)_2]^{2+}$
(ii) $[Cu(en)_2]^{2+}$ and $[Cu(NH_3)_4]^{2+}$

Q.6 Explain the mechanisms of outer and inner sphere electron transfer in metal complexes. [5, CO3]

Q.7 Write the point group and symmetry elements of following molecules- [5, CO4]

i) $POCl_3$ ii) PCl_5 iii) CS_2

Q.8 What is GOT. Explain its significance. [5, CO5]

Q.9 Write a short note on group, subgroup, class and order. [5, CO4]

Q.10 Discuss all elements of symmetry in staggered ethane molecules. [5, CO5]

Q.11 Write a short note on the following: [5, CO4]

i) Symmetry elements
ii) Symmetry operation
iii) Point group

Q.12 Write the number of symmetry operations involved using suitable examples of molecules having point groups: [5, CO4]

i) $D_{\infty h}$
ii) C_{2v}

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SECOND SEMESTER

M.Sc. (Chem)

END TERM EXAMINATION

May-2023

Course Code MSCH 104

Course Title: Photochemistry & Pericyclic reactions and Spectroscopy

Time: 3 Hours

Max. Marks : 50

Note: Answer questions of courses A & B separately in single answer sheet. Assume suitable missing data, if any

Course A

[1] Write Scheme and mechanism for the following reactions:

(i) [1,5] Sigma-tropic reaction

(ii) Group Ene transfer reaction

(iii) Norrish type - II

(iv) Claisen condensation [3×4; CO1,2]

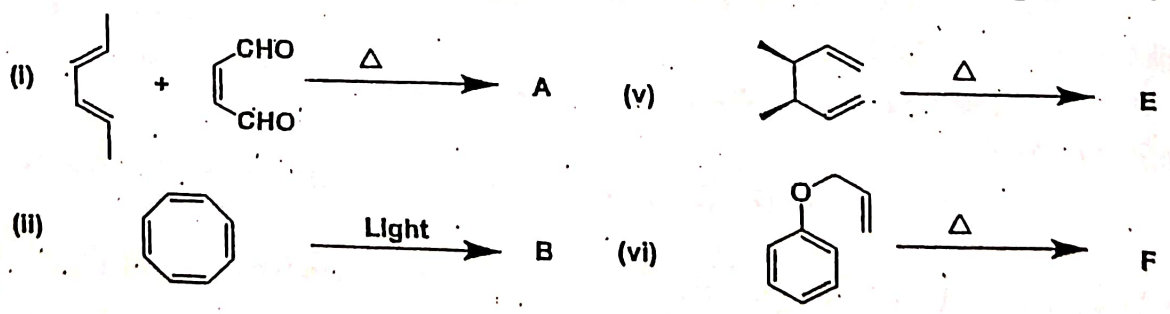
[2] Explain <u>any two</u> of the following: [3+3; CO1,2]

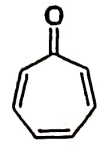
(i) Give reason why [4+2] and [2+2] cycloaddition reactions occur in the presence of heat and light respectively.

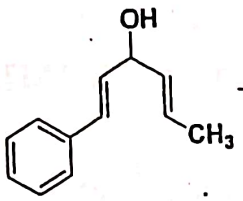
(ii) Why group ene transfer reaction occurs at higher temperature and how we can increase the rate of the reaction.

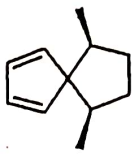
(iii) Explain the Frontier molecular orbital (FMO) approach for 1, 3-butadiene molecule for thermal allowed and photochemical reactions.

[3] Write product(s) of <u>all</u> reactions with the stereochemistry (if required). [7; CO1,2]



(iii)  $\xrightarrow{\Delta}$ C

(iv)  $\xrightarrow[\Delta]{H^+}$ D

(vii)  $\xrightarrow{\Delta}$ G

Course B

[4] A compound with molecular formula $C_8H_{14}O$ shows the following spectroscopic data:
FTIR: 3500, 3290, 2952, 2850, 2100 cm^{-1}.
^1H NMR: 1.00 (d, 6H); 1.50 (s, 3H); 1.70 (d, 2h); 1.91 (m, 1H); 2.32 (s, 1H); 3.40 (s, 1H).
Determine the structure of this compound. Discuss the above data with respect to the structure and provide ^{13}C NMR values for the predicted structure. [1+2+3+2 = 8; CO3,4]

[5] How will you distinguish between 1-hexene and 2-hexene on the basis of mass spectral data? Explain. [4, CO4]

[6] Discuss the 1H NMR of ethylbenzyl ether. [3, CO4]

[7] Define auxochrome. Explain with an example. [2, CO3]
OR Define figure print region. Write its significance.

[8] Write short note on **any two** of the following: [4+4, CO4]
(i) McLafferty rearrangement
(ii) Coupling constant in NMR
(iii) ESR

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SECOND SEMESTER M.Sc. [Che]

END-SEMESTER May-2022

MSCH 106 Physical Chemistry II

Time: 3:00 Hours Max. Marks : 50

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 [a] Derive the relation between internal energy and partition function. [CO1] [2.5 Marks]

[b] Find the value of β from the above relation. [CO2] [2.5 Marks]

Q.2 [a] Differentiate Fermions and Bosons by the corresponding weight of the configuration. [CO3] [2.5 Marks]

[b] Show that $Q = q^N$ [CO3] [2.5 Marks]

Q.3 Derive the weight expression for Fermi-Dirac statistics and reduce the statistics to Boltzmann distribution. [CO2] [CO4] [5 Marks]

Q.4 Find the expression of rotational contribution of the partition function. [CO2] [5 Marks]

Q 5 Sketch the molecular orbital energy level diagram for XeF and deduce its ground-state electron configurations. Is XeF likely to have a shorter bond length than XeF^+? Prove the same. [CO3] [CO5] [5 Marks]

Q6 Discuss the approximations built into the Hückel method. [CO2] [5 Marks]

Q7 Discuss the steps involved in the construction of sp^3 hybrid orbitals. (physical Chemistry aspects only). [CO2] [CO5] [5 Marks]

Q8 Explain Langmuir-Rideal mechanism for a bimolecular process. [CO1] [5 Marks]

Q9 What is mean by volcano curve? and explain its significance. [CO2] [CO4] [5 Marks]

Q10 Illustrate Born-oppenheimer approximation in detail. [CO3] [5 Marks]

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Second SEMESTER

M.Sc. (Chemistry)

END TERM EXAMINATION

May-2023

COURSE CODE: MSCH112

COURSE TITLE: Basics of IPR and Computers

Time: 3 Hrs

Max. Marks: 50

Note: Solve all questions of one section at one place in single answer sheet

IPR Section

[1] What do you understand by copyright? Write all types of copyright. [2+3][CO1]

[2] Write the five main categories of trademark. [2½][CO2]

[3] Write short note on 'Geographical Indication'. [3½][CO1,2]

[4] Write any six types of non-patentable inventions. [3][CO2]

[5] What do you understand by 'Novelty' and 'Prior Art'? [5][CO2]

[6] Discuss any case study with respect to patent. [3][CO1]

[7] Write short note on 'Design'. [3][CO1,2]

Computer section

(Answer **any five**)

[8] What is an operator? Define Different operators in c. [5, CO3]

[9] What is a flow chart? Explain different symbols used for flow chart. Explain with example. [5, CO4]

[10] Explain the advantages and disadvantages of using high level languages over machine level languages. [5, CO3]

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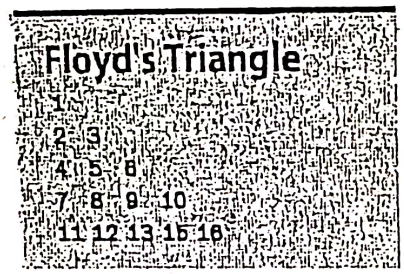
[11] (a) Write a program to check whether the number is even or odd.

(b) Write a program to make Floyd's triangle.



[5, CO3]

[12] (a) Differentiate between Latex and MS Word

(b) Write the advantages and disadvantages of Latex

[5, CO4]

[13] Make a flow chart and write the algorithm to check number is a prime number?

[5, CO3]

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END SEMESTER EXAMINATION **MSc**

FOURTH SEMESTER **May 2023**

INORGANIC CHEMISTRY (MSCH 202)

[Time: 3 Hours] [Max. Marks: 50]

Instructions: *All Questions are compulsory*
Neat diagrams must be drawn wherever necessary.
Assume missing data if any.

Q1a) Explain in detail the role of Raman and Infrared selection rule in determining the structure of NSF_3.

b) Using the given data and approach of group theory, identify the structure of A_2B_2

A_2B_2	Raman	IR
3374	strong	-------
3284	----------	Very strong, PR
1973	Very strong	----------
729	----------	Very strong
612	Weak	----------

c) A compound having molecular formula $C_{10}H_{14}$ gives the following NMR data 0.88 (9H, Singlet), 7.28 (5H, singlet). Identify the structure

d) Find out the possibility of Quadrupole splitting in $Fe(H_2O)_6Cl_3$

CO1, CO5, CO2 (2.5 X 4 = 10 marks)

Q2a) Explain in brief the basic principle of Mossbauer spectroscopy.

b) Discuss in detail the role of Mossbauer spectroscopy in predicting the bonding and structure of Sn^{2+} and Sn^{4+} compounds.

c) How one can distinguish between ethylamine, diethylamine and triethylamine on the basis of mass spectroscopy.

d) write a short note on NQR.

CO2, CO5 (2.5 X 4 = 10 marks)

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Q3 a) Write a short note on Van Vleck equation of magnetic susceptibility

b) Arrange the following complexes in increasing order of their magnetic moment (spin only value)

$[TiF_6]^{3-}$
$[CrF_6]^{3-}$
$[MnF_6]^{3-}$
$[CoF_6]^{3-}$

c) A copper (II) complex having distorted octahedral geometry shows an absorption band at 625 nm. Calculate the value of μ_{eff} in B.M. (Given spin orbit coupling of complex as 625 cm^{-1})

d) Among the following complexes which one will show orbital contribution to the magnetic moment?

$[Cu(H_2O)_6]^{2+}$

$[Ni(H_2O)_6]^{2+}$

$[Co(H_2O)_6]^{2+}$

CO3 (2.5 X 4 = 10 marks)

Q4 a) Distinguish between ESR and ^{13}C NMR spectroscopy

b) Which among the following molecules will show same number of hyperfine lines with same intensity ratio

1. CD_3 and $C_6H_6^+$
2. NH_2 and CH_3CH_2
3. H_2^+ and HD^+
4. CH_4 and 

c) For a tetragonally distorted Cr^{3+} complex zero field splitting will result in how many Kramer's doublet

d) Predict the no of ESR lines for the copper(II) ethylenediamine $[Cu(en)_2]^{2+}$complex

CO5, CO6 (2.5 X 4 = 10 marks)

Q5 a) The complex $[Ni(H_2O)_6]^{2+}$ shows three absorption bands at 8500, 14500, 25300 cm^{-1}. Assign the three bands and calculate the value of B', Δo and β for the complex, where B' is Racah parameter for complex and B is for free ion. B= 1080 cm^{-1}

b) What do you mean by nephelauxetic effect.

c) Arrange the following in increasing order of their nephelauxetic effect

i) F^-, urea, NH_3, NCS^-, H_2O, en, Cl^-

ii) Ni(II), Re(IV), Mn(II), Mo(II), Mn(IV), Co(III), Ir(III),

CO4 (5+2.5+2.5 = 10 marks)

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FOURTH SEMESTER M.Sc. (Chemistry)

END TERM EXAMINATION May-2023

COURSE CODE: MSCH202b

COURSE TITLE: Medicinal and Natural product chemistry

Time: 3 h *Max. Marks: 50*

Note: Answer questions of courses A & B separately in single answer sheet. Assume suitable missing data, if any

Course A

[1] What is the importance of stereochemistry in drug action. Explain it by taking any suitable example. Write down list of things to consider when isomeric drugs are compared. [5][CO2]

[2] Explain the synthesis of any antibiotic starting from the natural template. [5][CO3]

[3] Discuss the importance of metals in therapeutics? Give any two examples of metal-based drugs and draw their structures. [5][CO2]

[4] What are neurotransmitters? Write down the characteristics required to be a neurotransmitter. Explain neurotransmitter by taking any suitable example. [5][CO2]

[5] Write short notes on Antihistamines? Give two examples and draw their structures as well. [5][CO3]

Course B

[6] Classify terpenes. Write number of carbon atoms and isoprene units in each. [7][CO4]

[7] Discuss the chemistry and structure elucidation of citral. [5][CO4]

[8] How will you ascertain the chemical structure of Quercetin? Give one synthesis. [5][CO6]

[9] Define steroids. Write the basic structure and number the carbon. What do you understand by Diels hydrocarbon? [3][CO]

[10] Write short note on **any two** of the following: [5][CO5]

[a] Diadzein

[b] Nicotine

[c] Progesterone

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FOURTH SEMESTER M.Sc. (Chemistry)

END TERM EXAMINATION *May-2023*

COURSE CODE: MSCH202c

COURSE TITLE: Advance Electrochemistry

Time: 3 h *Max. Marks: 50*

Note: Answer all questions. Assume suitable missing data, if any

[1] (i) Derive an expression for cell-potential-current relation.

(ii) Draw the plot for cell-potential versus current density relations for

a) an idealized electrochemical energy converter with planar, smooth electrode

b) limiting current [5+4][CO1]

[2] (i) What do you understand by the term overpotential? How is it related to current? (Explain graphically)

(ii) Elucidate an expression for exponential law for n-p junction. [5+4][CO2]

[3] (i) Write a short note on principle and working of scanning electrochemical microscopy.

(ii) Write a short note on cold combustion. [5+4][CO1-2]

[4] What are semiconductors? Briefly explain p-n and n-p type semiconductors? [5][CO3]

[5] Schematically represent the efficiency of a heat engine. [4][CO3]

[6] (i) How fuel cells are advantageous over batteries?

(ii) What are the different types of fuel cells? Briefly describe each of them. [4+4][CO4]

[7] (i) What is lipid-proteic bilayer? What happens when electric potential difference is created between intra- and extracellular layers of the membrane? [3][CO3]

(ii) Derive an expression for transmembrane potential? Schematically represent trans-membrane profile.

[3][CO2]

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FOURTH SEMESTER M.Sc. Chemistry

END TERM EXAMINATION May-2023

MSCH 206f Macromolecules

Time: 03:00 Hours Max. Marks: 50

Note : Attempt any five questions. All questions carry equal marks. Assume suitable missing data, if any.

[1] (i) What do you mean by polymer molecular weight? Discuss in detail. [4][CO1]

(ii) Write the IUPAC name of PTFE and graft copolymer of butadiene and styrene? [2][CO1]

(iii) Discuss the practical significance of polymer molecular weight. [4][CO1]

[2] (i) Elaborate the kinetics of free radical chain polymerization. [5][CO2]

(ii) What is doping? Discuss the role of doping in polymers? [3][CO2]

(iii) How will you get the band gap by using UV-visible spectroscopy? [2][CO1]

[3] (i) What do you know about the electrically conducting polymers? Discuss the technological applications in detail. [5][CO3]

(ii) Discuss the microstructures of a macromolecule based on the chemical structure. [5][CO2]

[4] (i) Elaborate the Flory-Huggins theory of polymer solutions in detail. [5][CO2]

(ii) What is the importance of T_g? Discuss the relationship between T_g and molecular weight. [5][CO1]

[5] (i) What do you mean by polymeric crystallization? Explain the factors determining the crystal structure. [5][CO2]

(ii) Elaborate the degree of crystallinity in detail. [5][CO2]

[6] (i) Discuss about the thermodynamics of polymer dissolution. [5][CO2]

(ii) Viscosity of dilute polymer solutions is helpful to measure the molecular weight of the polymer. Justify it. [5][CO3]

[7] Write short notes on any two of the following. [2x5][CO1-3]

(i) Applications of degradable polymers

(ii) Kinetics of polycondensation

(iii) Smart polymers

(iv) Conduction mechanism in polymers

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SECOND SEMESTER M.Sc.

END SEMESTER EXAMINATION (May 2023)

MSMA-102, Complex Analysis

Time: 3 Hr. Max. Marks: 50

Note: Attempt **Any Five** questions.
All questions carry equal marks.

(1) (a) Interpret $\frac{z_1 - z_2}{z_1 - z_3}$. Show that for real values of a and b

$$e^{2ai\cot^{-1}b}\left[\frac{bi-1}{bi+1}\right]^{-a} = 1$$

(b) Explain stereographic projection. Find the point on the sphere corresponding to $z = 3 + i$.

(2) (a) State and prove Cauchy Integral Formula.
(b) Evaluate

$$\int_C \frac{z^2 - 2z}{(z+1)^2(z^2+4)}dz$$

where C is the circle $|z| = 10$.

(3) (a) State and prove Laurant's theorem.
(b) State and prove Casorati-Weierstrass theorem.

(4) (a) Discuss the transformation $w = \frac{1}{z}$.
(b) The function $f(z)$ has a simple pole at $z = 1$ with residue 2, a double pole at $z = 0$ with residue 2, is analytic at all the other points of the plane and is bounded as $|z| \to \infty$. If $f(2) = 5$ and $f(-1) = 2$, find $f(z)$.

(5) (a) State and prove Rouche's theorem.
(b) Evaluate the following integral:

$$I = \int_0^{2\pi} \frac{\sin^2\theta}{5 - 4\cos\theta}d\theta.$$

(6) (a) State and prove open mapping theorem.
(b) State and prove Schwarz Lemma.

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SECOND SEMESTER M.Sc. (Mathematics)

END SEMESTER EXAMINATION May -2023

MSMA – 104 PARTIAL DIFFERENTIAL EQUATIONS

Time : 3 hrs **Max. Marks: 50**

Note: Attempt **Any five** questions. All questions carry equal marks. Assume missing data if any.

Q.1 **(a)** Form the partial differential equation from the following.

$$z = f(x^3 + 2y) + g(x^3 - 2y)$$

(b) Solve $x^2 \frac{\partial^2 z}{\partial x^2} - 4y^2 \frac{\partial^2 z}{\partial y^2} - 4y \frac{\partial z}{\partial y} - z = x^2 y^2 \log y.$ [5, 5]

Q. 2 **(a)** Find the solution of the linear partial differential equation

$$x(y^2 + u) \frac{\partial u}{\partial x} - y(x^2 + u) \frac{\partial u}{\partial y} = (x^2 - y^2)u,$$

subject to the condition $u(x, 3x) = x^2$.

(b) Classify and find the characteristic curves for the following equations.

$$u_{xx} + 2u_{xy} + \sin^2 x\, u_{yy} + u_y = 0.$$ [5, 5]

Q.3 **(a)** A bar *10cm* long with insulated sides, has its ends A and B maintained at temperature 50^0C and 100^0C respectively, until steady-state condition prevails. The Temperature at A is suddenly raised to 90^0C and at the same time that at B is lowered to 60^0C. Find the temperature distribution in the bar at time t.

(b) Using Charpit method to find the complete solution of equation

$$(p^2 + q^2)y = qz.$$ [5, 5]

Q.4 **(a)** Solve the wave equation $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$ under the conditions

$$y(0, t) = 0 = y(\pi, t), \quad \frac{\partial y}{\partial t} = 0 \text{ at } t = 0 \text{ and } y(x, 0) = x.$$

(b) Change the following equation into canonical form
$y^2u_{xx} + x^2u_{yy} = 0$. [5, 5]

Q.5 (a) Show that the general solution of the wave equation can be expressed in the form $y(x,t) = \phi(x+ct) + \psi(x-ct)$. If $y(x,0) = f(x)$ and $\frac{\partial y}{\partial t}(x,o) = 0$, find the solution.

(b) Solve $(D^3 + D^2D' - DD'^2 - D'^3)z = e^x cos2y$, where $D \equiv \partial/\partial x$, and $D' \equiv \partial/\partial y$ [5, 5]

Q. 6 (a) Using the method of separation of variables, find the solution of partial differential equation

$u_{xx} - 2u_x + u_y = 0$, given $u(0,y) = 0$ and $\frac{\partial u}{\partial x} = e^{-3y}$ at $x=0$.

(b) A rectangular plate with insulated surfaces is $8cm$ wide and so long compared to its width that it may be considered infinite in length without introducing an appreciable error. If the temperature along one short edge $y = 0$ is given by $u(x,0) = 100 \sin\left(\frac{\pi x}{8}\right), 0 < x < 8$, while the two edges $x=0$ and $x=8$ as well as the other short edge are kept at 0^0C. Find the steady-state temperature at any point of the plate.

[5, 5]

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II SEMESTER

M.Sc.

END TERM EXAMINATION **MAY-2023**

MSMA106 Topology

Time: 3 Hours ***Max. Marks: 50***

Note: Attempt any Five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

Q1(a) Let Y be a subspace of a topological space $(X, \Im)$ and $A \subseteq Y$. Show that A is compact in X iff A is compact in Y. (CO1,2)

(b) Prove that every open continuous image of a second countable space is second countable. (CO2)

Q2(a) Prove that the homomorphic image of a regular space is regular. (CO2,3)

(b) Show that a topological space is Normal iff for any closed set F and open set G containing F, there exists an open set V s.t. $F \subseteq V \ \& \ \bar{V} \subseteq G$. (CO3,4)

Q3(a) $(X, \Im)$ is a T_1 –space iff every singleton of X is $\Im$- closed. (CO1,3)

(b) Is the following statement true? If yes then prove it; otherwise state and prove the correct statement.
"$(X, \Im)$ is a T_0-space iff for any distinct points $x, y \in X$, closure of $\{x\}$ and $\{y\}$ are distinct." (CO2,3)

Q4(a) Let $X = \{a, b, c, d, e\}$ and

$\Im = \{\emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}, X\}$. Find Derived set of A, isolated points of A and adherent set of A, where

$A = \{b, c, d\}$. (CO2)

(b) Let $(X, \Im)$ be a topological space and $A, B \subseteq X$ Then show that

i. $x^0 = X, \quad \phi^0 = \phi$
ii. $A^0 \subseteq A$
iii. $A \subseteq B \Rightarrow A^0 \subseteq B^0$
iv. $(A \cap B)^0 = A^0 \cap B^0$
v. $(A^0 \cup B^0) \subseteq (A \cup B)^0$
vi. $A^{0^0} = A^0$

(CO3)

Q5(a) Define product space of two topological spaces. Let $(X, \mathcal{I})$ and $(Y, \mathcal{I}')$ be two topological spaces and $\mathcal{B}$ is a base for $\mathcal{I}$ and $\mathbb{C}$ is a base for $\mathcal{I}'$. Then prove that

$\mathcal{H} = \{B \times C : B \in \mathcal{B}, C \in \mathbb{C}\}$ is a base for the product topology for $X \times Y$. (CO2,3)

(b) Let f be a mapping of a space Y into a product space

$X = \times \{X_\lambda : \lambda \in \Lambda\}$, where each X_λ is a topological space and π_λ has its usual meaning. Then show that f is continuous iff

$\pi_\lambda o f : Y \longrightarrow X_\lambda$ is continuous. (CO2)

Q6(a) Show that the projection mappings of the product space of two topological spaces are continuous and open. (CO3)

(b) Define homeomorphism in a topological space. Show that if g is a homeomorphism from a topological space to another topological space, then it is an open mapping. (CO1,2)

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2nd SEMESTER

M.Sc. (Math)

END SEMESTER EXAMINATION (MAY-2023)

MSMA108 Linear Algebra

Time: 3:00 Hours **Max. Marks: 50**

Note: All questions are compulsory and carry equal marks.
Assume suitable missing data, if any.

Q1. a) Let $P_n = \{a_0 + a_1 x + \ldots\ldots + a_n x^n \mid a_i \in \square\}$. Exhibit a basis of P_4 / P_2, hence verify that

$$\dim(P_4 / P_2) = \dim P_4 - \dim P_2$$ **[CO4]**

b) Let T be a linear operator on R^2. If matrix of T w.r.t to basis $\beta = \{(1,1),(1,0)\}$ and $\beta' = \{(1,2),(0,1)\}$ be $[T]_{\beta\beta'} = \begin{pmatrix} 2 & 1 \\ -3 & -1 \end{pmatrix}$. Find T^{-1} Explicitly. **[CO1]**

Q2. a) Find the all possible Jordan canonical forms for the matrix whose characteristic polynomial $\Delta(t)$ and minimal polynomial *m(t)* are as follows:
$\Delta(t) = (t-2)^5(t-1)^2$ and $m(t) = (t-2)^2(t-1)^2$. **[CO1]**

OR

Find a 3×3 matrix for which the minimal polynomial is x^2. **[CO1]**

b) Let $\mathbf{C}^2(\mathbf{C})$ be the vector space with the standard inner product. Let T be the linear operator defined by $T(1,0) = (1,-2), T(0,1) = (i,-1)$. If $\alpha = (a,b)$, find $T^*\alpha$. **[CO5]**

Q3. a) Find the minimal polynomial of a linear operator T on R^3, given by $T(x,y,z) = (2x+y, y-z, 2y+4z)$. **[CO5]**

b) Let T be the linear operator on R^2, the matrix of which in standard basis is $A = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$. Prove that only subspaces of R^2 invariant under T are R^2 and the zero subspace. **[CO2]**

Q4. a) Prove that two vectors x, y in a real inner product space V are Orthogonal if and only if $\|x+y\|^2 = \|x\|^2 + \|y\|^2$. **[CO2]**

OR

Verify Cauchy Schwarz inequality for $u = (1, 2, -2)$ and $v = (2, 3, 6) \in R^3$. Where inner product is taken to be standard inner product on R^3 over R. **[CO3]**

b) Let V be the vector space of the real functions satisfying the equation $\frac{d^2y}{dx^2} + 4y = 0$. Find an orthonormal basis of V, if the inner product on V is defined by $< f, g >= \int_0^{\pi} fg\,dx$. **[CO2]**

Q5. a) Find the symmetric matrix of a quadratic form which corresponds to the following quadratic polynomial

$$q(x, y, z) = 4x^2 - 2yz + xz.$$

Check whether this matrix is positive definite or not? **[CO4]**

b) Let A be an $n \times n$ matrix over a field K. Show that the mapping f defined by $f(X, Y) = X^T AY$ is a bilinear form on K^n. **[CO3]**

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2nd SEMESTER

M.Sc.

END TERM EXAMINATION *May-2023*

MSMA 110 **NUMERICAL ANALYSIS**

Time: 03:00 Hours *Max. Marks: 40*

Note : Attempt any five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 Perform 3 iterations of Newton Raphson method to solve the system of equations

$$x^2 + xy + y^2 = 7$$
$$x^3 + y^3 = 9$$ [8][CO1]

Q.2 Use Given's method to find eigenvalue of the following matrix

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$ [8][CO2]

Q.3 The following values of the function $f(x) = \sin x + cox\ x$ are given

x	10^0	20^0	30^0
$f(x)$	1.1585	1.2817	1.3660

Construct the quadratic interpolating that fits the data. Hence, find $f\left(\frac{\pi}{12}\right)$. Compare with exact value. [8][CO2, CO3]

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Q.4 Obtain the cubic spline approximation for the function defined by the data

x	0	1	2	3
$f(x)$	1	2	33	244

with $M(0) = 0,\ M(3) = 0$. Hence find an estimate of $f(2.5)$.

[8][CO4, CO5]

Q.5 Evaluate the integral $\int_0^1 \frac{1}{1+x} dx$ using:

i. Trapezoidal rule
ii. Simpson's rule with 4 and 8 equal subintervals.

[8][CO4]

Q.6 Solve the IVP $u' = -2tu^2,\ u(0) = 1$ with $h = 0.2$ on interval [0,0.4] using Runge Kutta fourth order method. Compare with the exact solution.

[8][CO5]

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MSc BIOTECH II SEMESTER

END TERM EXAMINATION 2023 (May)

Paper Code: MSMA 114 (FUNDAMENTALS OF Comp

Time: 180 MINUTE **max marks: 40**

NOTE: All Questions are compulsory.

Q1. What is the difference between an Open source Software and a Freeware. Write 2 examples of each. (5marks) [CO1]

Q2. Differentiate between: (10marks) [CO2]

1. Primary memory and Secondary memory.
2. RAM and ROM.
3. CISC and RISC processors.
4. Time Sharing and Real Time Operating System.

Q3. Convert the following. (10marks) [CO2]

1. Convert the Decimal number 125 to its Binary equivalent.
2. Convert Binary number 101101.001 to its decimal equivalent.
3. Convert the Decimal number 300 to its Hexadecimal equivalent.
4. Convert the Octal number 321 into decimal number.
5. Convert the Octal number 576 to Decimal.

Q4. Write an algorithm to find the sum of two numbers.(5marks) [CO3]

Q5. Draw a flowchart to find bigger number among two numbers.(5marks) [CO4]

Q6. What is the purpose of Cache memory? (5marks) [CO4].

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M.Sc. (II SEMESTER)

END TERM EXAMINATION

May-2023

MSMA-114

Fundamentals of Computer

Time: 3:00 Hours

Max. Marks: 40

Note : All questions are compulsory.
All questions carry equal marks.
Assume suitable missing data, if any.

Q.1 (a) Discuss the need for an operating system. Also explain some commonly used operating systems. [4][CO1]

(b) Explain the difference between Priority Scheduling and Round Robin Scheduling. [2][CO1]

Q.2 (a) What is recursion? Write a program in C to find the factorial of a number using recursion. [4][CO2]

(b) Write a C program to calculate the volume of the following shapes: Cube, Cuboid, Sphere, Cylinder and Cone. Ask the user which one s/he wants to calculate, and take the appropriate required inputs. Then print the result. The calculations for every solid should be done in a separate function by passing appropriate arguments. [6][CO2]

Q.3 (a) Write a command in MATLAB that produces a diagonal matrix D with the eigenvalues on the main diagonal, and a full matrix X whose columns are the corresponding eigenvectors. [2][CO4]

(b)Write the commands in MATLAB to plot two functions $\cos^{-1} x + \sin x$ and $\sinh x + \cos x$. Use different commands to distinguish the two graphs. [4][CO3]

Q.4 (a) Explain the difference between Set (=) and SetDelayed (:=) in Mathematica by giving suitable example. [3][CO3]

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(b)Write the commands for the following in **Mathematica.**

(i)To make a list of odd numbers from 1 to 100.

(ii) To find the numerical solution of the polynomial equation $x^5 - 10x^2 5x + 1 = 0$. .

(iii)To check whether a given number is prime or not. [3][CO

Q.5 (a)Write the commands in LaTeX to draw the following table. [3][CO5]

Table 1: This is the list

8	here's
86	stuff
2008	now

(b) Write the commands for the following equations in LaTeX.

(i) $R(t) = A\left(\frac{E_0}{\rho_0}\right)^{1/5} t^{2/5}$

(ii) $\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}$

(iii)$\sum_{n=1}^{\infty} 2^{-n} = 1$

[3][C

Q.6 (a) Discuss the applications of Microsoft Office along with their functions. [3][CO5]

(b) Write the syntax for a presentation in **Beamer.** [3][CO

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M.Sc. Physics (II SEMESTER)

END TERM EXAMINATION May-2023

MSMA-114 FUNDAMENTALS OF COMPUTER

Time: 3:00 Hours Max. Marks: 40

Note : All questions are compulsory.
Assume suitable missing data, if any.

Q.1 (a) Write shortcuts to align the text to the left side and right side of the document in Word. [1/2]

(b) Write file extension for an Excel document. [1/2]

(c) Write shortcut to execute a command in Mathematica. [1/2]

(d) What is landscape and portrait in Excel. [1/2]

(e)Write a code in Latex to produce the following sentence in your document. [1]

Item #1A\642 costs \$8 & is sold at 10% profit.

(f) Write any four reserved characters in Latex. [1]

(g) Write a command to draw the following table in Latex: [1]

1	2	3
4	5	6

(h) How will you write the given fraction in Latex: [1]

$$\frac{2x^2}{3}$$

(i) Write the command in Mathematica to plot two functions $f(x) = 3x+5$ and $g(x) = Sin(x)$ simultaneously in the range $0 < x < 3$. [1]

(j) Write a command for any piecewise function in Mathematica. [1]

(k) Write a source code in Latex that will create the following output: [2]

- One
  - Two
    - Three
- Four

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Q.2 (a) Distinguish between library function and user defined function in C and explain with examples. [5]

(b) Write a program in C to multiply two square matrices of order 3. [5]

Q.3 (a)Write a MATLAB program to find the roots of the equation using bisection method. [5]

(b) What is the difference between main memory and secondary memory. [5]

Q.4 Describe all variants of if-else statement and loop statement in MATLAB with clear syntax and examples. [10]

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FOURTH SEMESTER

M.Sc. Mathematics

END TERM EXAMINATION

May 2023

Course Code: MSMA-202 **Course Title: Measure and Integration**

Time: 3 : 00 Hours Max. Marks: 50

Note: Attempt **ANY FIVE** questions. All questions carry equal marks.
Assume suitable missing data, if any.

(1) State TRUE or FALSE. Justify your answer.

(a) A function f is measurable if and only if $|f|$ is measurable. [2][CO2]

(b) There exist uncountable sets of zero measure. [2][CO1]

(c) If f is a measurable function and $f = g$ a.e., then g is measurable. [2][CO2]

(d) The set on which a sequence of measurable functions converges is measurable. [2][CO2]

(e) If f is a measurable function and B a Borel set, then $f^{-1}(B)$ is a measurable set. [2][CO2]

(2) (a) Prove that the Lebesgue outer measure of an interval equals its length. [5][CO1]

(b) For an infinite increasing sequence $\{E_i\}$ of sets (not necessarily measurable), show that

$$m^*\left(\bigcup_{i=1}^{\infty} E_i\right) = \lim_{n\to\infty} m^*(E_n).$$

[5][CO1]

(3) (a) State and prove Lusin theorem. [5][CO3]

(b) If a sequence $\{f_n\}$ converges in measure to f on E, then show that there exists a subsequence $\{f_{n_k}\}$ of $\{f_n\}$ which converges to f a.e. on E. [5][CO3]

(4) (a) Let $\{f_n\}$ be a sequence of non-negative measurable functions and let f be a measurable function such that $f_n \to f$ in measure. Prove that $\int f\,d\mu \le \liminf \int f_n\,d\mu$. [5][CO4]

(b) State and prove Lebesgue dominated convergence theorem. [5][CO4]

(5) (a) If $1 \le p \le \infty$, prove that $\|f+g\|_p \le \|f\|_p + \|g\|_p$ for every pair $f, g \in L^p$. [5][CO6]

(b) Prove that the normed spaces L^p, $1 \le p \le \infty$, are complete. [5][CO6]

(6) (a) Let $\{f_n\}$ be a sequence of measurable functions defined on a set E of finite measure. Suppose there is a real number M such that $|f_n(x)| \le M$, for all x and all n. If $f(x) = \lim_{n\to\infty} f_n(x)$ for each $x \in E$, then

$$\int_E f = \lim_{n\to\infty} \int_E f_n.$$

[5][CO3]

(b) Let E be a measurable set with $m(E) < \infty$. Show that $L^\infty(E) \subset L^p(E)$ for each p, where $1 \le p < \infty$. Furthermore, prove that $\|f\|_\infty = \lim_{p\to\infty} \|f\|_p$ if $f \in L^\infty(E)$. [5][CO5]

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Fourth Semester
M.Sc. Applied Mathematics

End Term Examination May, 2023

MSMA-212 Approximation Theory

Time: 3:00 Hours Max. Marks: 50

*Note: Attempt **any five**. Assume suitable missing data, if any.*

(1) (a) Let $V_n(x) = \frac{2n!!}{(2n-1)!!}\frac{1}{2\pi}\int_{-\pi}^{\pi} f(t)\cos^{2n}\left(\frac{t-x}{2}\right)dt$. Show that $V_n(x)$ is a trigonometric polynomial. (3)(CO1)

(b) Let f be a continuous and periodic function with period 2π. Show that f can approximately be represented as a trigonometric polynomial. (7)(CO1)

(2) (a) State the Weierstrass approximation theorem. Let $f : [0, 1] \to \mathbb{R}$ be a continuous function, and let $B_n(x)$ be the Bernstein function. Then prove that for each $\varepsilon > 0$, there exists $n_0 = n_0(\varepsilon) \in \mathbb{N}$ such that $|f(x) - B_n(x)| < \varepsilon$, $0 \leqslant x \leqslant 1$ and $n \geqslant n_0$. (5)(CO1)

(b) Evaluate the following:

(*i*) $\sum_{k=0}^{\infty}\binom{n+k-1}{k}\frac{x^k}{(1+x)^{n+k}}\left(\frac{k}{n}\right)$

(*ii*) $\sum_{k=0}^{\infty}\binom{n+k-1}{k}\frac{x^k}{(1+x)^{n+k}}\left(\frac{k}{n}\right)^2$ (5)(CO1)

(3) (a) What are the three conditions to be satisfied for the sequence of linear positive operators $\Phi_n(f; x)$ to converge uniformly to the function $f(x)$ in the interval $[a, b]$, where f is continuous and bounded in the given interval. (3)(CO2)

(b) Let $f : [0, \infty] \to \mathbb{R}$ and n be a natural number, the Szasz operators is defined as

$$S_n(f; x) = \sum_{k=0}^{\infty} e^{-nx}\frac{(nx)^k}{k!}f\left(\frac{k}{n}\right).$$

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Prove that $S_n(f;x)$ converges uniformly to the function $f(x)$ for $x \geq 0$. (7)(CO2)

(4) (a) Define the Bernstein operators. Find its moment generating function (MGF). Using MGF, find the first and second moment for the Bernstein operators. (5)(CO2)

(b) Prove that

$$B_n(e_{m+1};x) = \frac{x(1-x)}{n} B_n'(e_m;x) + xB_n(e_m;x)$$

(5)(CO2)

(5) (a) (i) When is the function f said to be absolutely continuous on the interval $[a,b]$?

(ii) When is the function f said to be of bounded variation on the interval $[a,b]$? (4)(CO3)

(b) Write the Jensen's, Holders and Bunyakovakis inequality for integration. (6)(CO3)

(6) Derive the Kantorovich variant of the Szasz operators and find its first, second and third moment. (10)(CO3)

(7) (a) State and prove the Stone-Weierstrass theorem. (6)(CO4)

(b) State the Dini-Lipschitz and Lipschitz test used to prove the uniform convergence of the Fourier series of function f. (4)(CO4)

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End Term Examination
IV Semester (M.Sc.), May 2023
Fuzzy Sets and Applications(MSMA-224)

Max Marks: 50 **Time: 3 Hours**

Note: Attempt any 5 questions.

Q 1. (a) Consider a fuzzy number characterized by a triangular fuzzy number $\widetilde{A}$ under $y = x^2$ that is $f(\widetilde{A}) = \widetilde{B}$. Calculate the image for each interval for which $\mu_A(x)$ is defined as :

$$\widetilde{A}(x) = \begin{cases} 0 & x < 1, x > 5 \\ \frac{x-1}{2} & 1 \leq x \leq 3 \\ \frac{5-x}{2} & 3 \leq x \leq 5 \end{cases}$$

(b) Consider the linguistic variable 'age'. Let the term old be defined as

$$\{(x, \mu_{\text{old}}(x)) \mid x \in [0, 100]\}$$

$$\mu_{\text{old}}(x) = \begin{cases} 0, & x \in [0, 40] \\ \left(1 + \left(\frac{x-40}{5}\right)^{-2}\right)^{-1}, & x \in [40, 100] \end{cases}$$

Determine the membership functions of the linguistic terms 'very old', 'not very old', and 'more or less old'. What will be the membership function value of a person whose age is: (i) 20 years, (ii) 50 years and (iii) 70 years in the set old, very old.

(CO-1,2)

Q 2. (a) R_1 and R_2 are two fuzzy equivalence relations on a set A of order m then ckeck if $R_1 \bigcup R_2$, $R_1 \bigcap R_2$, R_1^{-1} are also fuzzy equivalence relations.

(CO-1,2,3)

(b) Explain fuzzy inference system using Mamdami model.

(CO-3,5)

Q 3. (a) Define input on the universe X=[0, 50, 100, 150, 200] on the output universe Y=[0, 50, 100, 150, 200]. Two fuzzy sets $\tilde{A}$, $\tilde{B}$ on X as:
$\tilde{A} = \{\frac{1}{0} + \frac{0.9}{50} + \frac{0.3}{100} + \frac{0.6}{150} + \frac{1}{200}\}$
$\tilde{B} = \{\frac{0.1}{0} + \frac{0.9}{50} + \frac{0.7}{100} + \frac{0.8}{150} + \frac{0.1}{200}\}$
and a fuzzy set $\tilde{C}$ on Y as:
$\tilde{C} = \{\frac{0}{0} + \frac{0.1}{50} + \frac{0.4}{100} + \frac{0.6}{150} + \frac{0}{200}\}$
Define a fuzzy relation "*If* $\tilde{A}$ *Then* $\tilde{B}$ *Else* $\tilde{C}$".

(b) Again continuing with above example suppose $\tilde{A}$ ia replace by $\tilde{A}' = \{\frac{0}{0} + \frac{0.8}{50} + \frac{0.4}{100} + \frac{0.4}{150} + \frac{0.2}{200}\}$ then compute new $\tilde{B}$ say $\tilde{B}'$.

(CO-3,5,6)

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Q 4. (a) Let $f(x) = x^2 + 1, g(x) = 2 - x$ and $\tilde{a}$ and $\tilde{b}$ be triangular fuzzy numbers $\tilde{a} = (1, 2, 3)$, $\tilde{b} = (3, 4, 5)$. Evaluate

$$\int_{\tilde{a}}^{\tilde{b}} f(x)dx \text{ and } \int_{\tilde{a}}^{\tilde{b}} g(x)dx$$

Is $\int_{\tilde{a}}^{\tilde{b}} f(x)dx + \int_{\tilde{a}}^{\tilde{b}} g(x)dx = \int_{\tilde{a}}^{\tilde{b}} (f(x) + g(x))dx$?

(b) Let $f(x) = 2x^3 + (x-1)^2, g(x) = 2x^3 - (x+1)^2$ and $\tilde{x}_0 = \{(-1, .5), (0, .8), (1, 1), (2, .8), (3, .4)\}$. Compute $f'(\tilde{x}_0)$ and $g'(\tilde{x}_0)$ and verify whether $f'(\tilde{x}_0) \oplus g'(\tilde{x}_0) = (f' + g')\tilde{x}_0$

(CO-1,2,4)

Q 5. (a) Explain intuitionistic fuzzy number $\tilde{A}$ and $\alpha - cut$ of $\tilde{A}$.

(b) What do you mean by intuitionistic Fuzzy equivalence Relation R. Explain.

(CO-1,2,6)

Q 6. (a) Give detailed methodology to solve fuzzy LPP with fuzzy constraints.

(b) Give detailed algorithm of Fuzzy C-mean clustering. Apply the algorithm to get the optimal partition matrix for given data point in 2D space {(1, 3), (2, 3.1), (1.5, 2.9), (3,1)}.

(CO-4,5,6)

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SECOND SEMESTER

END SEMESTER EXAMINATION

Roll No... ... ...

M.Sc. Physics

May 2023

MSPH102: ADVANCED QUANTUM MECHANICS

Time: 1.5 Hours *Max. Marks: 50*

Note: Answers any five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

1. (a) Starting from Klein-Gordon equation, obtain the equation of continuity and discuss how Klein-Gordon equation leads to positive and negative probability density values. [5] [CO1]

(b) Plot the energy spectrum of free Dirac particle and explain the negative energy states. What is a hole? [5] [CO1]

2. (a) If radial momentum p_r and radial velocity α_r for an electron in a central potential are defined by

$$p_r = \frac{\bar{r}.\bar{p} - i\hbar}{r} \qquad \alpha_r = \frac{\bar{\alpha}.\bar{r}}{r}$$

show that

$$\bar{\alpha}.\bar{p} = \alpha_r p_r + \frac{i\hbar k \beta \alpha_r}{r}$$

where

$$k = \frac{\beta\left(\bar{\sigma}.\bar{L} + \hbar\right)}{\hbar}$$

[5] [CO2]

(b) Draw and discuss the Feynman diagrams corresponding to (a) two-quantum pair creation and (b) two-quantum pair annihilation. [5] [CO4]

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3. (a) Demonstrate, mathematically, that the quantized EM fields are equivalent to a system of decoupled harmonic oscillators and hence calculate the Hamiltonian for the EM field. [5] [CO3]

(b) What is second quantization? Deduce the second quantization of non-relativistic fields for a system of Boson or Fermion. [5] [CO2]

4. (a) Deduce the classical field equation in terms of Lagrangian density and derive the Hamiltonian density in terms of conjugate field. [5] [CO3]

(b) Consider the Lagrangian density L_s, given below, for a classical field. Find the conjugate field and hence deduce the Hamiltonian density (*symbols have their usual meaning*).

$$L_s = i\hbar\psi^*\dot{\psi} - \frac{\hbar^2}{2m}\left(\nabla\psi^*.\nabla\psi\right) - V\psi^*\psi$$ [5] [CO2]

5. Write short answers to the following question: [2x5] [CO2,3,5]

a) What is the dimension of Lagrangian density for classical fields?

b) Why quantization of EM fields is difficult?

c) Differentiate between function and functional with examples.

d) Discuss *Pauli-Weisskopf* interpretation.

e) Give the physical significance of Dirac's α matrix.

6 (a) Show that, for a Dirac particle moving in a central potential, the orbital angular momentum is not a constant of motion. [5] [CO5]

(b) Work out the Hamiltonian corresponding to EM field in terms of position and momentum operators. Also deduce the commutation relation between momentum (P) and position (Q) operator. [5] [CO5]

–END–

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Roll No.....

Second Semester **M.Sc. Physics**

END SEMSTER EXAMINATION **May- 2023**

MSPH 104 STATISTICAL MECHANICS

Time-3.00 hrs **Max. Marks-50**

- All questions are compulsory.

Q1. a) State the postulates of statistical mechanics? Explain how does the postulate of equal prior probabilities laid the basis of the entire theory of sytem in equilibrium? [5] [CO1]

b) Give the concept of ensemble and phase space. Explain the difference between classical and Quantum statistics mentioning the limitations of Classical statistics? [5] [CO1, 2]

Q2. a) Define entropy and probability? Show that the entropy of the system is propotional to the logarithm of probability of that system? Explain the difference between Fermi Dirac and Bose Einstein statistics along with its distribution functions? [5] [CO2]

b) What is the significance of partition function (Z) in statistical Physics? Six distinguishable particles are distributed over three non- degenerate level of energies 0, E, 2E.

(1) Calculate the total number of microstates of the system.

(2) Determine the thermodynamic probabilities for all possible distributions and obtain the total energy of the distribution for which the probability is maximum ?

(3) Using the result of the thermodynamic probabilities calculations and knowledge of permutation verify the result obtained in part (1) of this question. [5 [CO1]

Q3. a) Consider two identical particles. Each particle can be in one of the three possible quantum states of energies 0, E and 3E. Calculate the number of microstates of the system for Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. Also determine the ratio of probability that the two particles are found in the same state to the probability that two particles are found in different states in each of the three cases? [5] [CO2]

(b) Explain Gibbs canonical distribution function. Using the Gibbs canonical distribution function, calculate the partition function, mean energy and entropy for classical harmonic oscillator? [5] [CO2]

Q4. a) Explain the concept of quantum mechanics which have influenced the transition from classical to quantum mechanics? In quantum statistics 'h' is selected as a constant by nature. Explain by using the case of particle in one-dimensional box? [5] [CO1]

b) What is indistinguishability of particles? What role it play in quantum statistics? What are its consequences? What are Bosons? Which statistics is used to study them? [5] [CO1,2]

OR

Q4. a) What is Ising Model? Solve Ising Model in 1D for a magnetic sytem having no interaction ? Derive the expression for the magnetic susceptibility and verify Curie law when weak magnetic field and high temperature is applied to the system? [5] [CO3]

b) Solve Ising Model in 1D for a magnetic sytem having interaction ? Derive the expression for the magnetic susceptibility and discuss the behavior of the system at T=0K? [5] [CO3]

Q5. a) Consider the experiment of tossing a coin. If the coin shows head, toss it again but if it shows tail, then throw a die. Find the conditional probability of the event that 'the die shows a number greater than 4' given that 'there is at least one tail'? [5] [CO1]

b) Suppose that the reliability of a HIV test is specified as follows: Of people having HIV, 90% of the test detect the disease but 10% go undetected. Of people free of HIV, 99% of the test are judged HIV negative but 1% are diagnosed as showing HIV positive . From a large population of which only 0.1% have HIV, one person is selected at random, given the HIV test, and the pathologist reports him/her as HIV positive. What is the probability that the person actually has HIV? [5] [CO1]

OR

Q5. a) Discuss Langevin Theory for the Browanian motion? Calculate mean square displacement and mean square velocity of Brownian particle? [5] [CO4]

b)Define Fluctuation- dissipation theorem. Uing Langevin theory for the Brownian motion derive expression for diffusion coefficient and Einstein relation. [5] [CO4]

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SECOND SEMESTER M. Sc. (Physics)

END SEMESTER EXAMINATION (May-2023)

MSPH- 106 COMPUTATIONAL METHODS

Time: 3 Hours Max. Marks: 50

Note: Answer any five questions.
Assume suitable missing data, if any.

1. (a) Show that error in the Trapezoidal formula is of the order of h^2 where h is the width of equal subinterval. [5] [CO # 2]

(b) How Secant method is different from Method of False Position? Find out the expression of the n^{th} approximated root of a function $f(x) = 0$ using Secant Method with the help of properly labelled figure. [5] [CO # 3]

2. (a) Find a negative root of function $f(x) = x^3 - sinx + 1 = 0$ using four approximation of Newton-Raphson Method (Given: $x_0 = -1$). [5] [CO # 3]

(b) Show that [5] [CO # 3]

$$u_1x + u_2x^2 + u_3x^3 + \ldots\ldots\ldots\ldots = \left(\frac{x}{1-x}\right)u_1 + \left(\frac{x}{1-x}\right)^2 \Delta u_1 + \left(\frac{x}{1-x}\right)^3 \Delta^2 u_1 + \cdots\ldots$$

3. (a) The velocity V of a particle at a distance S from a point of its path is given by table below

S (meter)	0	10	20	30	40	50	60
V (meter/sec)	47	58	64	65	61	52	38

Estimate the time taken to travel 60 meters using Simpson's 3/8 rule. [5] [CO # 1, 4]

(b) Find out the expression of first and second order derivative using Striling's method. Also deduce the formula for special case $p = 0$.

[5] [CO # 4]

4. **(a)** State and derive Newton cote's formula and deduce Simpson's one-third method. Write down the condition to use Simpson's one-third method for single-integration. **[5] [CO # 4]**

(b) Evaluate the double integral: $I = \int_0^1 \int_0^1 e^{x+y} dxdy$ using Trapezoidal method by dividing the x- and y range in four equal subintervals. **[5] [CO # 4, 5]**

by Euler's method

5. **(a)** Derive the expression to find out the solution of first order differential equation at any point 'x' with the help of suitable diagram. Explain in detail how Modified Euler's method is different from Euler's method. **[5] [CO # 4]**

(b) Given $y'' = y^3, y(0) = 10, y'(0) = 5$. Find the value of $y\ (0.1)$ by using fourth order Runge-Kutta method. **[5] [CO # 1, 4]**

6. **(a)** Apply Bessel's formula to find the value of $f\ (1.22)$ from the following table: **[5] [CO # 4, 5]**

x	0.0	0.50	1.0	1.5	2.0	2.5	3.0
$f(x)$	0.0	0.19146	0.34134	0.43319	0.47725	0.49379	0.49865

(b). Find $f\ (1)$ from the following table using Newton's divided difference formula **[5] [CO # 4, 5]**

x	-1	0	2	5	10
$f(x)$	-2	-1	7	124	999

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SECOND SEMESTER M.Sc [Physics]

END -SEMESTER EXAMINATION

MAY -2023 **MSPH 108 ELECTRODYNAMICS**

Time: 3 Hours **Max. Marks:50**

Q1 is compulsory
Attempt **total five** questions
Symbols have usual meanings. Assume suitable missing data if any

1. Answer all the following questions. **2x5=10**
   a) A straight wire along z axis carries a charge density λ travelling in +z direction at speed v. Construct the field strength tensor at point (x,0,0).[CO4,5, L6]
   b) For $\vec{E} = E_x\hat{x} + E_y\hat{y}$ and $\vec{B} = B_y\hat{y}$, sketch the motion of a positively charged particle together with relevant equations. [CO4, L3]
   c) Two uniform infinite sheets of electric charge densities +σ and -σ intersect at right angles. Find the magnitude and directions of electric field everywhere. Sketch the electric field lines. [CO1, L4]
   d) Calculate the scalar product of momentum 4 -vector with itself for the case of photon. [CO3, L3]
   e) To account the effect of energy radiation by an accelerating point charge particle q, what modifications are required in the expression $\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\hat{r}$. [CO5, L6]

2. **5x2=10**
   a) Given a uniform beam of charged particle with (q/*l*) charge per unit length, moving with velocity v, uniformly distributed within a circular cylinder of radius R. Calculate i) E, ii) B, iii) Energy density, iv) Momentum density. [CO1, L3]
   b) Write Maxwell equations assuming that no dielectric or magnetic material are present. State your system of units. If the system is time inverted $t \to t' = -t$ and space inverted $x \to x' = -x$, what happens to $\rho, \vec{J}, \vec{E}, \vec{B}$ respectively. Justify your answer. [CO2, L5]

3. 5x2=10

a) Obtain the continuity equation (tensorial form) directly from Maxwell equation $\partial_\nu F^{\mu\nu} = \mu_0 J^\mu$.[CO3, L3]

b) A car is travelling with ordinary speed of $\frac{c}{\sqrt{3}}$ inclined at an angle 60^0 with the x axis. Find all the components of proper velocity. [CO3,4, L3]

4. Answer all the following questions. 5x2=10

a) Express the following Lorentz scalars in terms of E and B;
i) $G^{\mu\nu}G_{\mu\nu}$
ii) $F^{\mu\nu}G_{\mu\nu}$ [CO3, L2]

b) For a field configuration: $\vec{B} = B_y(z)\hat{y}$ with gradient $\nabla|B| \propto \frac{1}{z}\hat{z}$. Analyse drifts present with proper diagram. [CO4, L4]

5. 5x2=10

a) List and describe with expressions and diagram, the types of drifts present inside Tokamaks. [CO4, L1,2]

b) A proton beam enters a uniform magnetic field of 0.3T with velocity of $4x10^5$ m/s. the velocity forms an angle 60^0 with B. Find the radius of helical path undertaken by the beam. [CO4, L3]

6. 5x2=10

a) Write the expressions for Lienard Wiechart potentials (in Lorentz Gauge) for a moving point charge. For a point charge constrained to move along positive x axis with, find the potentials at distance R on x axis. Show that the potentials satisfy Lorentz Gauge condition. [CO5, L1,3]

b) Write and describe general expression for retarded potentials for a continuous charge distribution. [CO5,2, L1,2]

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SECOND SEMESTER **M.SC [Physics]**

MID SEMESTER EXAMINATION ***(May - 2023)***

MSPH-110 Solid State Physics

Time: 3 Hours ***Max. Marks: 50***

Note: Answer ***Any FIVE*** questions,

Assume suitable missing data, if any.

1.(a). Explain the Primitive cell and Unit cell in crystal structure. (CO1) **[2]**

(b). Write Meissner effect and explain type of superconductors follow it. (CO5) **[2]**

(c). Plot variation of "susceptibility vs temperature" for paramagnetic, ferromagnetic and anti-ferromagnetic materials. (CO4) **[2]**

(d). Draw B-H curve for ferromagnetic materials and explains its different regions using domain theory (CO4) **[2]**

(e). Explain Brillouin zones and construct first two Brillouin with proper diagram. (CO3) **[2]**

2(a). Describe Kronig-Penney model of an electron moving in a periodic potential. How does it lead to the formation of forbidden energy gaps? (CO3) **[6]**

(b). What do you mean by the effective mass of an electron in an energy band? How does it lead to the negative mass of an electron in an energy band? (CO3) **[4]**

3(a). Discuss diamagnetism and para-magnetism in magnetic materials. Derive an expression for diamagnetic susceptibility using Langevin's theory. (CO4) **[6]**

(b). The rare earth element gadolinium (Gd) is ferromagnetic below 16oC with 7.1 Bohr magneton per atom. Calculate the magnetic moment per gram. What is the value of saturation magnetization? The atomic weight of gadolinium is 157.26 and its density is 7.8 x 103 kg/m^3. (CO4) **[4]**

4(a). Discuss the Bloch/Domain wall theory of magnetic energy storage in ferromagnetic materials. The Curie temperature of iron is 1043 K. Assume that iron atoms, when in metallic form have moments of two Bohr magnetron per atom. Iron is body centered cube with lattice parameter, 'a = 0.286 nm. Calculate (i). the saturation magnetization, (ii). The Curie constant, (iii) the Weiss field constant. (CO4) [6]

(b). Show that the potential energy of two particles in the stable configuration is given by; $U_{min} = -\frac{4}{5}(\frac{a}{r_0^2})$, for m=2 and n=10. (CO2) [4]

5(a). Explain the concept of reciprocal lattice. Write the relationships for the primitive translational vectors of the reciprocal lattice in terms of those of the direct lattice. (CO1) [4]

(b). What are line defects in solids? Discuss about edge and screw dislocation with suitable diagram. (CO2) [3]

(c). Obtain the number of Schottky defects in KCl at 773 K. The energy required to form each Schottky defect is 2.6 eV. The density of KCl at 773 K is 1.955 g/cm^3. The atomic weight of K is 39.10 g/mol and of Cl is 35.45 g/mol. (CO2) [3]

6(a). Obtain London's equations in superconductivity. What is the drawback of London's theory? (CO5) [4]

(b). The London penetration depths for Pb at 3.0 K and 7.1 K are 39.6 nm and 173 nm, respectively. Calculate its transition temperature as well as the penetration depth at 0 K. (CO5) [3]

(c). What is the frequency of the electromagnetic waves radiated by the Joshepson junction having a voltage of 650 μV across its terminals? (CO5) [3]

7. Explain briefly any **FOUR**;

(a). DC Josephson effect (CO5) [2.5]

(b). Superconductive quantum interface device (SQUID) (CO5) [2.5]

(c). Bloch theorem for periodic potential. (CO3) [2.5]

(d). Weiss theory for paramagnetic materials. (CO4) [2.5]

(e). Ferrimagnetic materials and their applications. (CO4) [2.5]

(f). Metal, Semiconductor, and Insulator using band theory. (CO3) [2.5]

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Fourth SEMESTER

M.Sc [Physics]

END SEMESTER EXAMINATION

(May-2023)

MSPH-202 Advanced Semiconductor Devices

Time: 3.0 Hours

Max. Marks: 50

Note : Attempt any Five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

1. **(a)** What are the limitations of conventional tubes at microwave frequencies? Explain with schematic diagram. **[5][CO-1,4,5]**

(b) What is the Reflex Klystron? Prove that the maximum electronic efficiency of reflex klystron is 22.7%. **[5][CO-1,4,5]**

2. **(a)** What is a Travelling Wave Tube (TWT)? With the aid of a schematic diagram, explain about the helical slow-wave structure. **[5][CO-1,4,5]**

(b) Explain 'Mode Jumping' in a cavity magnetron. What remedial steps can be taken to prevent the same? **[5][CO-1,4,5]**

3. **(a)** Explain the J-E characteristics of Gunn diode with the help of two valley model theory. **[5][CO-1,4,5]**

(b) Explain, working principle of MOCVD technique. **[5][CO-4,5]**

4.**(a)** Explain the with diagram working principle P-N junction. Discuss forward and reverse biasing of P-N junction diode. **[5][CO-1,2,4,5]**

(b) Explain with reference to Zener diode characteristic curve the following:

(i) I_{ZK} (ii) I_{ZT} (iii) Z_z **[5][CO-1,2,4,5]**

5. **(a)** With suitable diagram, explain working principle of photodiode. **[5][CO-1,2,4,5]**

(b) Differentiate between semiconductor and Quantum Well Laser (QWL). Explain why, light is propagate only in active layer in QWL. **[5][CO-1,2,4,5]**

6. **(a)** With suitable diagram, explain work function, electron affinity, acceptor, and donor and Fermi level in semiconductor. **[5][CO-1,2,4,5**

(b) Differentiate between ferroelectric, degenerate and non-degenerate semiconductors. **[5][CO-1,2,4,5]**

7. Write short notes on **any two.** **[10][CO-1,4,5]**

(a) Application and working principle of charge couple device (CCD)

(b) Density of states for 3D material

(c) SAW and integrated devices

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FOURTH SEMESTER
M.Sc.
END SEMESTER EXAMINATION (May 2023)
MSPH-204 Space & Atmospheric Sciences

Time: 3:00 Hours ***Max. Marks: 50***

Note:	Answer ALL five questions All questions carry equal marks Assume suitable missing data, if any.

1. What is an automatic weather station and explain the measurement of different meteorological parameters using automatic weather station. What are the advantages of automatic weather station? (10 M)(CO2)
2. Discuss the needs for upper air observations along with various techniques available to explore the structure of the upper air. (10 M)(CO2)
3. Explain the basic principles of radiosonde. What are the thermo dynamical parameters? Discuss their importance. (10 M)(CO3)
4. What are trace gases? Explain various natural mechanisms and anthropogenic causes responsible for trace gases production. Explain the adverse effects of trace gases on human beings, animals and agriculture. (10 M)(CO4)
5. Explain in detailed the mechanism of production of tropospheric Ozone. Write its effect on various things in troposphere. Explain the role of Ozone in stratosphere and its depletion and consequences of its depletion in stratosphere. (10 M)(CO5)

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IV SEMESTER **M.Sc. (Physics)**

END SEMESTER EXAMINATION May 2023

MSPH206: Laser and Spectroscopy

Time: 3:00 Hours *Max. Marks: 50*

Note: Answer All questions
Assume suitable missing data, if any

Q1. Describe the essential components of a laser. Derive an expression (rate equations) for a three-level laser and show the necessary condition for population inversion. Also, shows why a two-level laser is not feasible. [2+4+4=10][CO#1,3]

Q2. Describe radiative and nonradiative transitions and correlate them with quantum yield and lifetime.
Describe the mode-locking operation in a laser in detail along with methods. [5+5=10][CO#1,2]

Q3. Describe linear and nonlinear optics with a diagram. What is a harmonic generation? How to obtain the second harmonic generation (SHG)? Also, discuss the theory of SHG. [4+6=10][CO#2,5]

Q4. What do you mean by steady-state spectroscopy? Describe the types of spectrometers with a schematic diagram and their applications in scientific fields. [3+7=10][CO#1,4]

Q5. Write short notes on any **Two** of the following: [5×2=10][CO#1,3,4]

(a) Raman effect, Stokes and Anti-Stokes shifts, and Raman spectrograph
(b) Time-domain spectroscopy
(c) Semiconductor lasers
(d) Dye or Excimer lasers
(e) Total energy and peak power of pulse of Q-switched laser

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Total No. of Pages 2 *Roll No. .....*

Fourth SEMESTER **M.Sc (Physics)**

END SEMESTER EXAMINATION *(May.-2023)*

MSPH-216 Advanced Function Materials

Time: 3 Hours *Max. Marks: 50*

Note : Attempt any Five questions.
All questions carry equal marks.
Assume suitable missing data, if any.

1. (a) What do you understand by carbon materials and classified them in terms of their electronic and bonding structures.

(b) Differentiate between the following:

(i) Crystallite size and Grain Size

(ii) Bottom up and Top down approaches for synthesis nanomaterial.

[10][CO#1,4]

2. Explain, fundamentals of Vapor-Liquid-Solid growth mechanism, explain the sequential steps for nanowire growth. **[10][CO#2,5]**

3. (a) With suitable diagram working principle of scanning electron microscope.

(b) State of procedure for indexing X-ray diffraction data of FCC structure.

[10][CO#1,3,5]

4. (a) With suitable diagram explain the working principle of electrostatic force microscopy by using EFM mode in atomic force microscope.

(b) Briefly, explain the working principle of Thermal- CVD and its application in carbon nanotube growth. **[10][CO#2,3,5]**

5. With suitable example, explain the synthesis of nanomaterial by using either by solid state synthesis or sol-gel process for the synthesis nanoparticles. **[10][CO#2,3,5]**

6. **(a)** Explain the mechanism of charge transfer between analyte and nanotube. **[5][CO#3,4,5]**

(b) Explain, response (I_{SD}-V_G response curve) of CNTFET device with a single semiconducting SWCNT as the conduction channel to NH_3 and NO_2 gas. **[5][CO#3,4,5]**

7. Write shorts notes on: **[10][CO#3,5]**

(a) Working principle of atomic force microscope

(b) Working principle of Transmission electron microscope