QUESTION PAPERS FOR END TERM THEORY EXAMINATIONS

November/ December-2024

M.Tech., MTPT, M.Sc., MBA, EMBA, M.Des., MBA (USME), B.Sc. /M.Sc. Integrated

1st, 3rd & 5th SEMESTER

M.Sc.

B.Sc./M.Sc. Integrated

Total no. of pages: 296 Roll No.....

End Term Exam November- 2024

MSHU 113: Communicative English

Time: 2 Hour Max. Marks: 50

Note: Attempt all questions. Read instructions carefully and answer accordingly.

Q1. Transcribe the following:

Cite, plan, safe, third, meet

Or

Explain the importance of correct pronunciation in personal and professional life. **(100-150 words)** [CO3,4][BTL 4, 5]10M

Q2. Create an essay on one of the following:

Road Rage

How to curb pollution in Delhi

[CO1,3][BTL 1] 10M

Q3. Give your arguments for the following topic of Group Discussion

India as an Economic power [CO2][BTL3] 10M

Q4. Write short notes on the following:

Effective presentation

Body language [CO4][BTL5] 10M

Q5. Evaluate the significance of professional writing skills for better communication at workplace. CO1][BTL2] 10M

(b) Show that $W = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & 1 & 0 \\ i & -i & 0 \\ 0 & 0 & \sqrt{2} \end{pmatrix}$ is unitary. Perform the unitary transformation $W^{\dagger}HW$ where $H = \begin{pmatrix} 1 & 0 & -2i \\ 0 & 1 & 0 \\ 2i & 0 & 4 \end{pmatrix}$ and find the eigenvalues and eigenvectors of $W^{\dagger}HW$. [6] [CO2]

Q.3 Obtain the Clebsch-Gordan (CG) coefficients for system of two non-interacting particles with angular momentum $j_1 = \frac{1}{2}$ and $j_2 = \frac{1}{2}$, and write the corresponding matrix. [10] [CO3]

Q.4 The Hamiltonian for a three-state quantum system is given by the matrix

$$H = V_0\begin{pmatrix} 1-\varepsilon & 0 & 0 \\ 0 & 1 & \varepsilon \\ 0 & \varepsilon & 2 \end{pmatrix},$$

where V_0 is a constant, and ε is some small number $(\varepsilon = 1)$.

(a) Use first- and second-order nondegenerate perturbation theory to find the approximate eigenvalue for that state that grows out of the nondegenerate eigenvector of H^0. [4] [CO4]

(b) Use degenerate perturbation theory to find the first-order correction to the two initially degenerate eigenvalues. [6] [CO4]

Q.5 Consider a *trial* function, $\varphi(x) = Axe^{-bx^2}$, and use this to calculate the first excited state energy for the one-dimensional harmonic oscillator

$$H = -\frac{\hbar^2}{2M}\frac{d^2}{dx^2} + \frac{1}{2}m\omega^2 x^2,$$

by invoking the Variational method. [10] [CO5]

OR

Q.6 For the one-dimensional harmonic oscillator $\left[V(x) = \frac{1}{2}kx^2\right]$, suppose the spring constant increases slightly $k \to (1+\varepsilon)k$. Use perturbation theory to calculate the first- and second-order correction to the ground state energy. [10] [CO5]

--END--

[Table of Fresnel Integrals is provided below for reference, if required.]

Table for Fresnel integrals

FRESNEL INTEGRALS

s	$C(s)$	$S(s)$
0.0	0.000	0.000
0.2	0.200	0.004
0.4	0.398	0.033
0.6	0.581	0.111
0.8	0.723	0.249
1.0	0.780	0.438
1.2	0.715	0.623
1.4	0.543	0.714
1.6	0.366	0.638
1.8	0.334	0.451
2.0	0.488	0.343
2.5	0.457	0.619
3.0	0.606	0.496
3.5	0.533	0.415
4.0	0.498	0.420
∞	0.500	0.500

Total No. of Pages :4 *Roll No. .....*

FIRST SEMESTER M.Sc.(Physics)

END SEM EXAMINATION *(November 2024)*

MSPH 107 APPLIED OPTICS

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

Note: **Question 1 is compulsory.**
Attempt any five questions from Q.2-Q.7.
All symbols have their usual meanings
Assume suitable missing data, if any.

1. (a) What should be the response time of the detector required to detect the beating of D_1 and D_2 lines of Sodium (λ_1=5890Å, λ_2=5896Å).

[2][CO# 4]

(b) Calculate the resolving power of a Fabry-Perot interferometer made of reflecting surfaces of reflectivity 0.85 and separated by a distance 1 mm at wavelength 4880 Å.

[2][CO#5]

(c) What do you understand by the Laser speckles?

[2][CO#4]

(d) Discuss the condition of temporal coherence to achieve an interference pattern of good contrast in a Young's double hole experiment?

[2][CO#4]

(e) Calculate the velocity of an extraordinary wave propagating in an anisotropic medium with its k at 60° to the optic axis. (n_o = 2.6, n_e = 2.9)

[2] [CO# 1]

(f) What are the spatial frequencies present in an object described by: $f(x) = A + B \cos(20\pi x)$; x is in mm.

[2] [CO# 3]

(g) Draw the variation of ordinary and extra-ordinary refractive indices for a negative uniaxial crystal in x-z plane, with optic axis along x-axis.

[2] [CO# 1]

(h) Discuss the state of polarization for the following:

$E_x = E_0 \sin(kz-\omega t+\pi/6)$, $E_y = E_0 \sin(kz-\omega t-\pi/3)$

[2] [CO# 1]

(i) Calculate the thickness of a Quarter Wave Plate made of Calcite, required for an operating wavelength 0.589 μm. ($n_o = 1.66584$ and $n_e = 1.4864$)

[2] [CO#1]

(j) Plane waves of monochromatic light (600 nm) light are incident on an aperture. A detector is situated on axis at a distance of 20 cm from the aperture plane. What is the value of R1, the radius of the first Fresnel half period zone, relative to the detector? If the aperture is a circle of radius 1cm, centered on axis, how many half period zones does it contain?

[2] [CO# 3]

2. Derive the expression for the Coefficient of Finesse in case of a Fabry-Perot etalon. Calculate the reflectivity of each mirror with $n_2 = 1$, $h = 1$cm and $F = 400$.

[6] [CO# 5]

3. What is a Hologram? Write down the conditions required for constructing or reconstructing a hologram. Give one application.

[6] [CO#3]

4. Describe the working of Michelson Stellar interferometer with the help of a neat labelled diagram.

[6] [CO# 4]

5. Explain spatial frequency filtering with the help of a schematic diagram. Give different kind of filters used in the spatial filtering with their applications. **[6] [CO#3]**

6. Consider a linearly polarized electromagnetic wave propagating in vacuum (n_1) incident on a dielectric (n_2) interface at $x = 0$ at an angle θ_1. Show that for the electric vector lying perpendicular to the plane of incidence, the amplitude reflection coefficient, r_s and the amplitude transmission coefficient, t_s is given by:

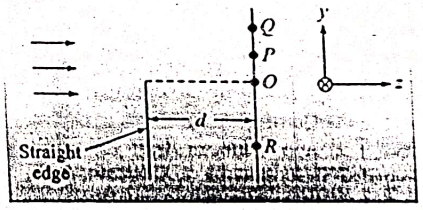
$$r_s = -\frac{\sin(\theta_1 - \theta_2)}{\sin(\theta_1 + \theta_2)}$$

$$t_s = \frac{2\sin\theta_2 \cos\theta_1}{\sin(\theta_1 + \theta_2)}$$

where θ_2 is the angle of refraction. **[6] [CO#1]**

7. (a) Explain Cornu's Spiral. Briefly discuss its salient features and applications

(b) In a straight edge diffraction pattern, assume $\lambda = 5000$ Å and d = 100 cm. Find approximately the values of (I/I_0) at the positions O, P (y= 0.5 mm), Q (y=1.0 mm) and R (y= -1mm) where O is at the edge of the geometrical shadow region as shown in the figure below.



[2,4] [CO# 3]

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Semester-I
M.Sc Physics

End Semester Examination **November-2024**

MSPH109: Electronics

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

Note: Question 1 is compulsory. Attempt any four questions out of the remaining five.

Q1. Answer the following questions: **(10 = 2x5)**

(a) Calculate the reverse saturation current of a diode if the current at 0.2V forward bias is 0.1mA at a temperature of 25°C and the ideality factor is 1.5. **[CO1]**

(b) How many J-K Flipflops are required to achieve a frequency division of 8. **[CO4]**

(c) An operational amplifier has differential gain of 100 and CMRR of 80 dB, Input voltages are 100 μV and 60 μV. Determine the output voltage. **[CO3]**

(d) Design and draw an inverting OP-AMP where gain is -5 and Ri= 10 KΩ. **[CO3]**

(e) A 4-bit modulo 16 ripple counter uses J-K Flip flops. If the propagation delay of each FF is 50 ns. Calculate the maximum clock frequency which can be used. **[CO4]**

Q2 (a) Derive the expression for the position of Fermi Energy Level in a n-type semiconductor in terms of intrinsic fermi energy level position. Also show the variation of the fermi level with doping concentration and temperature. **[6] [CO1]**

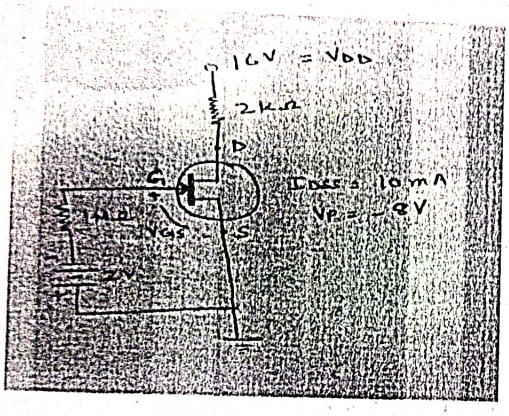
Q2 (b) Consider germanium at T= 300 K with donor concentration of $N_d = 10^{14}$, 10^{16}, and 10^{18} cm^{-3}. Let Na=0. Calculate the position of Fermi energy level with respect to the intrinsic Fermi level for these doping concentration.Assume $n_i = 1.5 \times 10^{10}$ cm^{-3}. **[4] [CO1]**

V_{GSQ}, I_{DQ}, V_{DS}, V_D, V_G and V_S for the network shown below, mathematically as well as graphically and compare the results.

[6][CO2]

Q3 (b) Describe in your own words why I_G is effectively 0 A for a JFET Transistor. Why is the input impedance to a JFET is so high. Sketch the transfer curve defined by I_{DSS} = 12 mA and V_p = - 4V.

[4][CO2]



Q4(a) What are the different types of shift registers? Explain the working of Parallel in Serial Out (PISO) shift register with suitable circuit diagram.

[6] [CO4]

Q4(b) How is excitation table different from flip-flop truth table? Write the excitation table for S-R, J-K and D flip-flop. Covert the SR FF to D FF.

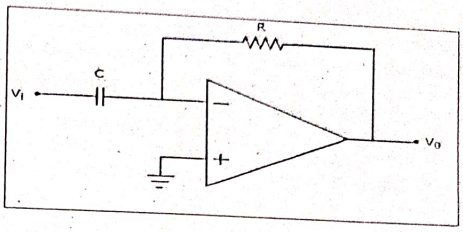
[4] [CO5]

Q5(a) Explain the working of OP-AMP as integrator and derive the expression for the output voltage (V_0) for a given input voltage (V_i). Draw the output voltage for sinusoidal and square wave as input signal. Also explain the limitation of simple integrator circuits and to design the integrator circuit for circumventing the limitations.

[6][CO3]

Q5(b) For the circuit given below, If a sine wave of peak value 1V at 1000 Hz frequency is applied, find the output voltage and the frequency at which the gain will be 0 dB. Also draw the output waveform.

[4][CO3]

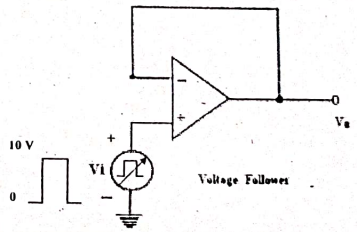


Q6(a) Design a circuit to obtain $V_o = -V_1 + 5V_2 - 25V_3$ using an operational amplifier.

[6][CO3]

Q6(b) Define slew rate (SR) of an OP-Amp. Find the frequency of the square wave input pulse (Vi), where the output (Vo) will be a triangular wave with peak voltage of 4 V. The SR of an OP-Amp is 2V/μS.

[4][CO5]



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3rd SEMESTER
END SEMESTER EXAMINATION

Roll. No.....
M.Sc. Physics
Nov-Dec 2024

MSPH201: Atomic and Molecular Physics

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

Note: Answer Any Five questions from Part A and Part B
Assume suitable missing data, if any

Part A (Atomic Physics)

Q1. (a) Illustrate with the help of diagrams the splitting of ^2D levels of sodium when (i) a weak magnetic field, (ii) a strong magnetic field is applied. Also find the number of Zeeman components in the transition $^2D_{3/2} \rightarrow {}^2P_{1/2}$. [5][CO#2,3]]

(b) Write a short note on ESR spectroscopy. Also explain zero-field splitting and Kramer's degeneracy with the help of example in ESR spectroscopy. [5][CO#1,2]

Q2. (a) Describe the general features of spectra of alkali-like atoms. Derive an expression for the interaction energy and wave number shift for the fine-structure in alkali spectra. Also display the splitting of alkali levels which are involved in the emission of four series. [5][CO#1,2]

(b) Explain the characteristic X-ray spectra in emission and absorption. Give importance of absorption edges. State and deduce Moseley's law from Bohr's theory. [5][CO#2,3]

Q3. (a) Write down the normal electronic configuration of carbon (Z=6) and obtain the spectral terms arising from it. Also, write down its first excited configuration and obtain the spectral terms. Indicate the allowed transitions. [5][CO#1]

(b) If the wavelength of the first line of the Lyman series of hydrogen is 1215 Å, calculate the wavelength of the second line of the series and wavelength of the series limit. [5][CO#1]

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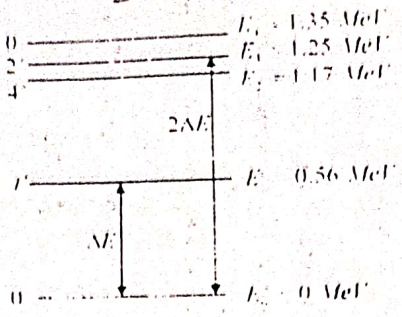

4. [5x2=10][CO#2,3]

a) Draw a meson octet and the baryon decuplet.

b) Check if the following decay reactions are possible/not possible. Give reasons indicating conserved/not conserved quantity for each reaction.

i. $K^+ \rightarrow \mu^+ + \nu_\mu$

ii. $\Omega \rightarrow \Xi^+ + \pi^-$

iii. $\Delta^+ \rightarrow \pi^+ + \pi^0$

iv. $\Xi^+ \rightarrow p^+ + k^0$

v. $\Sigma^+ \rightarrow p^+ + k^0$

5. [5x2=10][CO#3,4]

a) Explain Isospin using suitable example. Differentiate between spin and isospin.

b) List three properties of a Lepton. Why tauons are classified as mesons even though they are heavier than baryons.(two reasons)

6. [5x2=10][CO#4,5]

a) The annihilation of an electron and a positron at rest produces a pair of identical gamma ray photons travelling in opposite directions. Find the energy (in MeV) each photon is expected to have.

b) Write a short note on Scintillation detector explaining its working, types and applications

Total No. of Pages: 3 *Roll No. .....*

THIRD SEMESTER M.Sc.(Physics)

END SEMESTER EXAMINATION ***(Nov.-2024)***

MSPH207 – FIBER AND INTEGRATED OPTICS

Time: 3 Hours *Max. Marks: 50*

Note: Question No.1 is compulsory
Answer any seven questions from Q2-Q9
Assume suitable missing data, if any.
Symbols have their usual meanings

1. (a) Briefly indicate with the aid of suitable diagrams, the light guidance by meridional and skew ray paths in step index fibers.
   (b) Consider a 5mW laser beam passing through a 40 km fiber link of loss 0.5 dB/km. Calculate the output power in dBm & in mW.
   (c) Consider an LED operating at 1.3μm with a spectral width of 20 nm. At this wavelength $\frac{d^2n}{d\lambda_0^2} \approx -0.00055\ \mu m^{-2}$. Calculate the material dispersion.
   (d) Calculate intermodal dispersion for a step index fiber with n_1= 1.5, core radius = 40 μm and Δ= 0.015 operating at 0.85 μm.

[2*4 =8][CO# 1,2,3]

2. (a) Consider a planar symmetric waveguide with $n_1 = 1.5$ and $n_2 = 1.0$ and $d = 0.555$ μm. At $\lambda_0 = 1.3$ μm, calculate V and the propagation constant β for TE as well as TM mode.
   [Use b(TE) = 0.6280 and b(TM) = 0.4491]
   (b) The values of the propagation constant β of TM_m modes are smaller than those of the corresponding TE_m modes. Explain.

[3,3] [CO#2]

3. (a) Explain the Plasma – Activated Chemical Vapor deposition method for the fabrication of optical fibers.
   (b) Sketch the schematic diagram of a fiber drawing apparatus.

[3,3] [CO#4]

4. (a) An approximation for the normalised propagation constant in single mode step index fiber is given by

$$b(V) \approx \left(1.1428 - \frac{0.9960}{V}\right)^2$$

Obtain the corresponding approximation for the waveguide parameter $V\frac{d^2(bV)}{dV^2}$ and hence write down the expression for waveguide dispersion in the fiber.

(b) The refractive index for fused silica in the wavelength region $0.5\ \mu m < \lambda_0 < 1.6\ \mu m$ is approximately given by the following empirical formula

$$n(\lambda_0) = C_0 - a\lambda_0^{\,2} + \frac{b}{\lambda_0^{\,2}}$$

Where $C_0 = 1.451$; $a = b = 0.003$ and λ_0 is measured in micrometers.

Using the above mentioned empirical formula, calculate the zero material dispersion wavelength and also the pulse dispersion at 0.8 μm and 1.55 μm.

[3,3] [CO#1,3]

5. (a) Briefly describe the three types of fiber misalignment which may contribute to loss at a joint between two single mode fibers.
(b) Plot normalized radial intensity distribution of LP_{01}, LP_{22} and LP_{31} modes for a step index fiber.

[3,3] [CO#1,3]

6. (a) A double heterojunction InGaAsP LED emiting at peak wavelength of 1310 nm has radiative and non radiative recombination times of 25ns and 90ns respectively. The drive current is 35 mA.Find the internal quantum efficiency and the internal power. If the refractive index of the light source material is n = 3.5. Find the power emitted from the device.

(b) With the help of suitable diagram, explain the frequency response for an LED, exhibiting electrical bandwidth and optical bandwidth. Mention the relationship between optical bandwidth and output power.

[3,3] [CO#2]

7. Starting from the Maxwell's Equations for dielectric medium, establish an eigen value equation for step index optical fiber. Point out the method to solve the above mentioned Eigen value equation.

[6] [CO#1]

8. (a) Describe the design and working mechanism of semiconductor laser diode. Discuss both quantitatively and qualitatively, how the condition of population inversion and light amplification is achieved in semiconductor laser diodes.

(b) Consider a semiconductor laser operating at 900 nm. If the spectral width over which gain is available is 15 nm, what is the maximum cavity length for single longitudinal mode operation? Assume the refractive n = 3.6.

[4,2] [CO# 2,4]

9. (a) Establish the relation between responsivity and quantum efficiency of a PIN photodiode.

(b) Consider an InGaAs PIN photodiode with a quantum efficiency of 0.6. Calculate the responsivity at 1300 and 1550 nm. Why is the responsivity larger at 1550nm?

[3,3] [CO#2,4]

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Third Semester
M.Sc. (Physics)

END TERM EXAMINATION November 2024
COURSE CODE: MSPH 215 COURSE TITLE: Plasma Physics
Time: 3.00 Hours Max. Marks: 50

Note : Attempt any Five Questions
All Questions carry equal Marks
Assume Suitable missing data, if any

Q.1. Explain the construction and working of any plasma production device. How can you measure the plasma parameters e.g., electron density n_e and electron temperature T_e using Langmuir probe techniques? [10][CO#1]

Q.2. (a) Differentiate between bulk plasma and plasma sheath. [5][CO#1]
(b) Differentiate between Carbon Nanotube (CNT) and 2D graphene on the basis of electronic properties. [5][CO#4]

Q.3. What are the electrostatic ion –cyclotron waves? An ion beam of density n_{ob}, velocity $\overline{v_{ob}} \| z$, charge (+e) and mass m_b is propagating through a plasma of electron density n_{oe}, electron temperature T_e, ion density n_{i0}, ion mass m_i, ion temperature $T_i \approx 0$ immersed in a static magnetic field $\overline{B_s} \| z$. Show that the growth rate of the unstable mode is given by

$$\gamma = \left(\frac{\omega_{pb}^2 \alpha_1}{2} \right)^{1/3}, \alpha_1 = \frac{kc_s}{\left(1 + \frac{k^2 c^2}{\omega_{pi}^2}\right)^{1/2}}$$ [10] [CO#2]

Q. 4. What is Weibel Instability? Show that the growth rate of the Weibel instability of counter streaming electron beams is given by [10] [CO#3]

$$\gamma = \omega_{pe} \frac{v_0}{c} \sqrt{2}.$$

Q.5. What is the distribution function f? Solve the Vlasov equation for an isotropic plasma ($B_s = 0$) and obtain $\varepsilon = 1 + \chi_e + \chi_i$, where [10] [CO#4]

$$\chi_e = \frac{2\omega_{pe}^2}{k^2 v_{th}^2}\left[1 + \frac{\omega}{kv_{th}} Z\left(\omega / kv_{th}\right)\right] \quad \text{and} \quad \chi_i = \frac{2\omega_{pi}^2}{k^2 v_{thi}^2}\left[1 + \frac{\omega}{kv_{thi}} Z\left(\omega / kv_{thi}\right)\right]$$

Q.6. What is Cerenkov free electron laser (CFEL)? Explain the physical mechanism using suitable schematic diagram. [10] [CO#4]

Q.7. What is Free Electron Laser (FEL)? Explain the physical mechanism using schematic diagram. Show that the growth rate of the FEL instability is given by

$$\Gamma = \left(\frac{v_{o\perp}^2}{c^2} \frac{\omega_{pb}^2 k_w c}{\gamma_0^3} \right)^{1/3} \frac{\sqrt{3}}{2}$$ [10] [CO#4]

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THIRD SEMESTER M.SC. [PHYSICS]

END SEMESTER EXAMINATION (November, 2024)

MSPH-217 CHARACTERIZATION TECHNIQUES

Time: 3:00 Hours Max. Marks: 50

Note: Answer Any FIVE questions. Question No. 1 is Compulsory. Assume suitable missing data, if any

1. Answer all the questions. [2 x 5]

[a]. Write difference between point, line and areal type detectors. (CO2)

[b]. Determine the frequency and energy of CuK_α ($\lambda = 0.15418\ nm$) and FeK_α ($\lambda = 0.19373\ nm$). (CO1)

[c]. Distinguish between atomic force microscopy (AFM) and scanning tunneling microscopy (STM). (CO3)

[d]. Show the Schematic diagram of a typical X-ray emission spectrum showing $K_{\alpha 1}$, $K_{\alpha 2}$ and K_β line for Mo spectrum. (CO1)

[e]. Explain about magnetic force microscopy (MFM) technique. What type of tip is used for magnetic force measurement? (CO3)

2[a]. What are the characteristics of materials investigated by scanning electron microscope (SEM) and transmission electron microscope (TEM)? Drawing a schematic diagram, discuss the working and principle of TEM to study the internal structure of materials. (CO4)[7]

[b]. How many electrons per second can directed at the given area of specimen, for a beam of e-s generated by thermionic emission at high temperature of 2700 K and applied potential 40 kV, if the work function of filament material is 4.5 eV. (CO2) [3]

3[a]. What is X-ray photo electron spectroscopy (XPS)? Discuss basic principle and instrumentation of XPS. Write the different characteristics using spin – orbit coupling analyzed by XPS. What type of ion is used for depth profiling and why? (CO3) [7]

[b]. A microscope consists of a 5X objective and a 20X ocular. The distance between the lenses is 15 cm. (a) Determine the overall magnification if the eye is relaxed (b) determine the focal length of the ocular lens (c) the focal length of the objective lens. (CO4) [3]

4[a]. What is Atomic Force Microscopy (AFM)? Describe the principle and working of AFM in contact mode. Why contact mode is not useful for characterization of biological sample? Write the example where contact mode would give best result. (CO3) [7]

[b]. What is atomic sensitivity in AFM? How is it related to distance (deflection) and voltage (force)? (CO2) [3]

5[a]. Explain Differential Thermal Analysis (DTA). Describe the working principle and instrumentation of DTA with proper diagram. Write the physical and chemical properties analysed by DTA. (CO5) [7]

[b]. A 250 mg hydrated sample of Na_2HPO_4 decreases to a mass of 145.7 mg after heating to 15 °C. What is the number of water hydration in Na_2HPO_4? (CO5) [3]

6. Discuss briefly any ***FOUR***. [5X4]

[a]. Energy dispersive X-ray spectroscopy (EDS) (CO2)
[b]. Deep level transient spectroscopy (DLTS) (CO3)
[c]. Dark field optical microscopy (DFOM) (CO4)
[d]. Differential Scattering Calorimetry (DSC) (CO5)
[e]. Fourier Transform Infrared Spectroscopy (FTIR) (CO3)
[f]. Thermogravimetric analysis (TGA) (CO5)

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MSc Chemistry-I

I SEMESTER EXAMINATION **Nov 2024**

Course Code: MSCH101

Course Title: Chemical Bonding, Stability Constant and Supramolecular Chemistry

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

Instructions: *Attempt any 5 questions from each section.*

Section A

Ques1. Describe Job's method of continuous variation to estimate the composition of a metal complex? (5) [CO2]

Ques2. A) Discuss the structure of following on the basis of VSEPR theory:

(i) ClF_3 ii) XeF_4

B) Describe Bent's rule and compare the stability of PCl_3F_2 and PF_3Cl_2 using this rule. (3+2) [CO1]

Ques3. Explain the structure of triatomic molecule (AB_2) on the basis of Walsh Diagram. (5) [CO1]

Ques4. Define the average ligand number ($\bar{n}$) and derive the following expression for the equilibria of mononuclear complex (MLn). (5) [CO2]

$$\bar{n} = \frac{\sum_{i=1}^{N} i\beta_i[L]^i}{\sum_{i=0}^{N} \beta_i[L]^i\}}$$

Ques5. A) Calculate the solubility of CaF_2 in water ($Ks = 3 \times 10^{10}$).

B) Discuss of the method of determination of the concentration of free metal ion in case of electrodeposition gravimetry. (2+3) [CO3]

Ques6. A) Explain the method of estimation of metal ion using substitution titration in complexometry. Give one example.

B) Is it possible to determine 10^{-2}M magnesium with EDTA in the presence of 10^{-2}M zinc when potassium cyanide is present as a masking agent and Eriochrome Black T as indicator? The stability constants are log K_{MgEDTA} = 8.6 and log K_{ZnEDTA} = 16.5. The overall stability constant of the tetracyanozinc complex is log β = 16.7 and log $\alpha_{(MgNH4)}$ = 0.1 and log $\alpha_{EDTA(H)}$ = 0.5 (at pH 10). The titration is carried out at pH 10, in the presence ammonium chloride buffer. (2+3) [CO3]

Section B

Ques7. Define Self-assembly with example? Discuss the differences between molecular and supramolecular self-assembly. (5) [CO4]

Ques8. What are the various characteristics of anions that need to be considered while designing a host for anion-binding? Discuss the challenges of anion receptor chemistry. (5) [CO4]

Ques9. What are "Anticrowns"? Give examples. Write a short note on the "Soccer Ball" compound and explain its versatile binding ability for various types of guest ions. (5) [CO5]

Ques10. Explain the following terms (5) [CO5]

a) Molecular Machines
b) Calixarenes
c) Proton and Hydride sponge
d) Cryptands
e) Template Effect

Ques11. Write a short note on Hydrogen bonding interaction. Discuss the significance of Hydrogen bonding in water and DNA. (5) [CO6]

Ques12. Justify that Preorganisation is a thermodynamic effect in view of Li^+ binding free energies of spherands, cryptands, corands and podands. (5) [CO6]

No of Pages: 02 322 Roll No.

FIRST SEMESTER **M.Sc. (Chemistry)**

END TERM EXAMINATION *Nov/Dec-2024*

COURSE CODE: MSCH103

COURSE TITLE: Stereochemistry and Reaction Intermediates & Mechanism

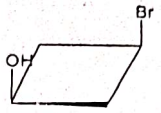
Time: 3 hours *Max. Marks: 50*

Note: Assume suitable missing data, if any. Answer Courses A and B separately in same answer sheet.

Course A

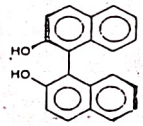
[1] Answer **any three** of the following questions [3×3, CO1&2]

(a) Explain the stereochemistry of the following compound (i) and label its prochiral centers.

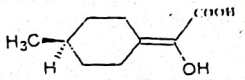


(i)

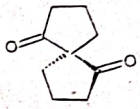
(b) Assign absolute configuration to the following compounds (ii – iv)



(ii)



(iii)



(iv)

(c) The (+) enantiomer of compound A has an optical rotation of 120°. If a scalemic mixture of the compound has an optical rotation of 95°, what is the composition of the sample?

(d) For a levorotatory molecule what is the relationship between refractive indices of RCP and LCP? Draw plain and anomalous ORD curves. Write an application of CD and ORD curves.

[2] (a) With a suitable example explain the chirality and nomenclature of ansa compounds. [5, CO1]

(b) Draw the structures of cis and trans decalins and compare their stability giving justification. [3, CO2]

[3] How will you account for the following observations (attempt **any two**) [2×4, CO1&2]

a) Reduction of 2-butanone with hydride gives racemic mixture of 2-butanol.

b) A Less stable conformer leads to the major product.

c) Circular Birefringence and Circular Dichroism.

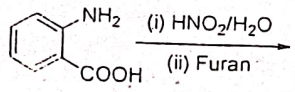
Course B

[4] Explain **any four** of the following:

Wittig Reaction; Carbanion stability; States of carbenes; Reimer Tiemann Reaction; Dienone-phenol rearrangement [3×4 = 12, CO4&6]

[5] Write the product(s) for the following reactions. Wherever two reagents (i) & (ii) used, write step-wise product(s) formation.

[13, CO4&6]

(a) 

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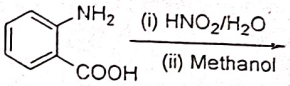
(b) 

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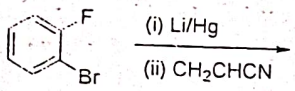
(c) 

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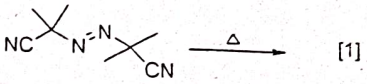
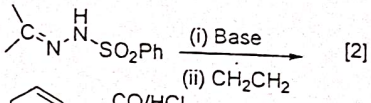
(d) 

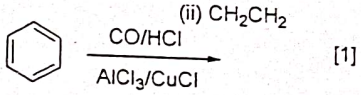
[1]

(e) CH_3COCH_3 $\xrightarrow{\text{Aq. NaOH}}$ [1]

(f) 

[2]

(g) $CH_3CH_2N_3$ $\xrightarrow[\text{(ii) cyclohexene}]{\text{(i) heat}}$ [2]

(h) 

[1]

Total No. of Pages:02 324 *Roll No. ... .*

First Semester

M.Sc.

END TERM EXAMINATION *Nov -2024*

MSCH 105 Physical Chemistry-I

Time: 3 Hours *Max. Marks: 50*

Note:	Attempt all Questions in Part A and Part B Assume suitable missing data, if any

Part-A

Q1 a) Show that $\Psi_1 = \frac{\sqrt{2}}{\sqrt{l}} . Sin \frac{n\pi x}{l}$ and $\Psi_1 = \frac{\sqrt{1}}{\sqrt{l}} . Sin \frac{n\pi x}{l}$ are normalised and orthogonal to each other.

[2.5 Marks] [CO1]

b) Calculate the probability of finding the particle (between 0 to l/2) that is confined to move in 1D box $0 \leq x \leq l$.

$\Psi = \frac{\sqrt{2}}{\sqrt{l}} . Sin \frac{n\pi x}{l}$

[2.5 Marks] [CO1]

Q2 a) Show that eigen value corresponding to Hermitian operators are real.

[2.5 Marks] [CO1]

b) Show that eigen function of Hermitian operators are orthogonal.

[2.5 Marks] [CO1]

Q3 A certain system is described by $\hat{H} = -\frac{d2}{dx} + x^2$. Show that $\Psi = Axe^{-x^2/2}$ is eigen function of $\hat{H}$. Determine the eigen value. If function is normalised determine A. What is the expectation value of x of the system.

[5 Marks] [CO1]

Q4 a) Discuss the five postulates of quantum mechanics.

[2.5 Marks] [CO1]

b) Find the average value of <r> for 1s orbital of hydrogen atom.

[2.5 Marks] [CO1]

$\Psi_s = \frac{1}{\sqrt{\pi}} \cdot \frac{1}{a^{3/2}} e^{-r/a}$

Given: $\int_0^\infty r^n e^{-\alpha r} . dr = \frac{n!}{\alpha^{n+1}}$

Q5 An electron is confined to a box 2Å × 3Å × 5Å.

a) Determine the wavefunction for the four lowest energy states.

[4 Marks] [CO2]

b) What is the ground state energy of this electron?

[1 Mark] [CO2]

Part-B

Q6. Derive and discuss in detail Hydrogen-Oxygen reaction kinetics.

[5 Marks][CO3]

Q7. Illustrate Garrett-Brattain space charge. [5 marks][CO4]

Q8. Find the concentration of product [Z] in the following consecutive reaction,

$A \rightarrow X \rightarrow Z$

[5 Marks][CO6]

Q9. Draw the relaxation curve for simple first order opposition reaction, derive the rate equation and define relaxation time [5 Marks][CO5]

Q10. Give an example for organic decomposition reaction and prove the order of the overall reaction is unity. [5 Marks][CO4]

------End----

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Total no of Pages: 02 Roll No .....

First SEMESTER **M.Sc. (Chemistry)**

END TERM EXAMINATION *Nov/Dec-2024*

MSCH107: Elementary Topics for Chemists

Time: 3 hrs *Max. Marks: 50*

Course A: Biology for Chemists

Answer any FIVE questions

Q1. Define and classify carbohydrates. Give one example of each class and draw their structures. What is the difference between epimers and isomers? [5] [CO3]

Q2. What are biomolecules? Explain different types of biomolecules. [5] [CO3]

Q3. Define and classify lipids. Write their importance. [5] [CO4]

Q4. Write a short note on (any two): [5] [CO4]

1. Cell Organelles
2. Krebs Cycle
3. Double Helix DNA model

Q5: What is a protein? Classify them giving example of each. Explain different types of protein structures. [5] [CO4]

Q6: What are nucleic acids? Explain different types of nucleic acids. What are different forces that hold nucleic acid double helices together? [5] [CO3]

Course B: Standard Laboratory Practices and Chemical Safety

Attempt any **FIVE** questions from the following.

Q.1 Write SIX principles of green chemistry. Explain any one in detail. [5][CO5]

Q.2 List possible sources of fire in lab? Discuss any one in detail. [5][CO6]

Q.3 Define and classify Fire. Explain the difference between Fire and explosion. Explain different types of fire extinguishers. Suggest the conditions when you can use them and explain the PASS method. [5][CO6]

Q.4. Suggest and explain any three green experiments/ procedures that can be followed in the chemistry laboratory. [5][CO5]

Q.5. What do you mean by MSDS of a chemical? Explain. [5][CO5]

Q.6. Suggest the possible measures that can be taken in case of accidental contact of chemicals with skin and chemicals in the eyes. Write some of the adverse health impacts due to exposure of chemicals. [5][CO6]

Q.7. Draw and explain any five safety symbols that can commonly be found on the label of a chemical container. [5][CO6]

Total no. of Pages: 02 328 Roll No.....

THIRD SEMESTER M.Sc. (CHEM.)

END TERM EXAMINATION Nov/Dec-2024

MSCH201 (Organic Chemistry – 3)

Time: 3 Hours *Max. Marks: 50*

Note: Assume suitable missing data, if any. Answer Course A and B separately in same answer sheet.

Course A

[1] Answer any **four** of the following [3×4 = 12][CO1&2]

(a) Explain the catalytic cycle for the Heck Reaction and its application in organic synthesis.

(b) Explain Corey Winter reaction with suitable example.

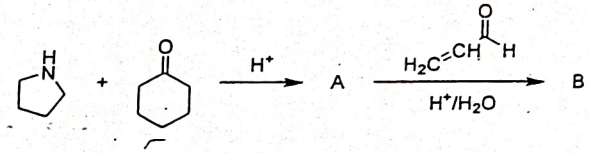
(c) Show the synthesis of alkenes from α-β unsaturated hydrazones.

(d) Explain the preparation and uses Umpolung reaction.

(e) Write a short note on the Wacker process.

[2] Answer the following [2×2 = 4][CO2]

(i)



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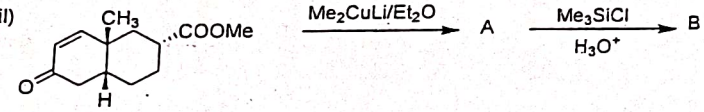
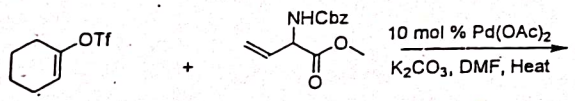


[3] List the products of the following transformations: [3×1 =3][CO1&2]

i)



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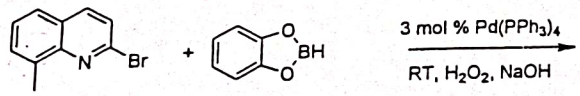

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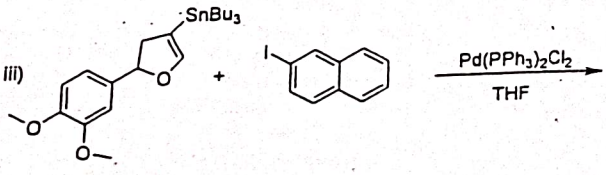

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Third Semester *Roll No. .....*

END TERM EXAMINATION **M.Sc.**

MSCH203 Physical Chemistry-III **Nov/Dec-2024**

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

Note: Attempt all Questions
All Questions carry equal marks.
Assume suitable missing data, if any

Part A

Q1. (a) Deduce the bond-stretching vibration frequency ν_{osc} of a diatomic molecule AB by classical method. [3Marks] [CO1]

(b)How many lines will be observed for $4f \rightarrow 3d$ (2F to 2D) transitions? [2Marks] [CO5]

Q2. Given that the stretching frequency of a C-C bond is approximately 1000 cm^{-1}, Calculate the stretching frequencies of C=C and C≡C bonds on the assumption that double and triple bonds have force constants which are, respectively, two or three times those of a single bond.

[5 Marks] [CO5]

Q3. Calculate the moment of inertia of the HF molecule ($r_e = 92$ pm), its rotational constant and hence the energy required to excite it from the $J = 0$ to the $J = 1$ level. At what temperature does this energy equal the thermal energy, k_BT? What wavelength of radiation is required for this excitation? Where in the electromagnetic spectrum does it fall?

(The relative atomic masses of H and F are 1.00783 and 18.9984 *u*, respectively and $k_B = 1.38066 \times 10^{-23}$ J K^{-1}) [5 Marks] [CO1,CO4]

Q4. Deduce Einstein co-efficient for various emission processes.

[5Marks] [CO2]

Q5. Illustrate schematic representation of Zeeman Effect for $2p^2$ system in detail.

[5 Marks] [CO4]

Part B

Q.1a. Work out the term symbols for CO molecule in its excited states:

(i). When one electron from the filled $\sigma 2p_x$ orbital of CO is transferred to the empty $\pi 2p_y^*$ orbital and in the excited state and both of these electrons have ***parallel spin***.

(ii). When one electron from the filled $\sigma 2p_x$ orbital of CO is transferred to the empty $\pi 2p_y^*$ orbital and in the excited state and both of these electrons have ***opposite spin***.

Based on the term symbols, arrange them in decreasing order of energy along with that of the ground state of CO. [3 Marks][CO3, L2]

b.(i). How is Koopmans' theorem related to photoelectron spectroscopy? Differentiate between vertical and adiabatic energies using potential energy surface diagram.

(ii). For the ejection of photoelectron from N_2 molecule, He(I) radiation of 58.42 nm was used. If He(I) radiation had kinetic energies of 5.63 eV, find out the ionization energy needed in eV to remove an electron from the occupied molecular orbital with the highest energy of N_2 molecule.

(Given: $h = 6.626 \times 10^{-34}$ J s; $c = 3 \times 10^8$ m s^{-1}; 1 eV=1.602×10^{-19} J).

[3 Marks][CO3, L1, L5]

c. The length for octatetraene (CH_2=CHCH=CHCH=CHCH=CH_2) molecule is taken as **8R**, where R=140 pm. Using free electron MO theory, calculate the wavelength in nm required for excitation of this molecule involving HOMO and LUMO.

(Given: $h = 6.626 \times 10^{-34}$ J s; $c = 3 \times 10^8$ m s^{-1}; $m_e = 9.1 \times 10^{-31}$ kg.)

[2.5 Marks][CO3, L3]

Q.2a. Define the term oscillator strength for a spectroscopic transition.

The electronic spectrum of a molecule showed an optical absorption band of Gaussian shape having an absorption maximum at 400 nm. For this absorption band, if the full width at half-maximum and molar absorption coefficient (ϵ_{max}) are: 4000 cm^{-1} and 5×10^3 L mol^{-1} cm^{-1}, respectively. Calculate the oscillator strength of this transition.

[3 Marks][CO3, L2]

b. State the basic concepts of Mössbauer spectroscopy. Predict the increasing order of isomeric shift (δ) in the Mössbauer spectra (^{57}Fe source) of iron compound present in different oxidation states: Fe(II), Fe(III) and Fe(IV). Justify your answer.

[3 Marks][CO4, L1, L2]

c. The benzophenone triplet has a lifetime of 2.5×10^{-6} s. If its emission is quenched in a dynamic process by a compound Q with a quenching rate constant of 1.5×10^9 L mol^{-1} s^{-1}, find out the [Q] required to reduce its lifetime to $1/5^{th}$.

[2.5 Marks][CO4, L1, L5]

Q3a. Differentiate between the mechanisms of longitudinal and transverse relaxation in nuclear magnetic resonance (NMR) spectroscopy. Also predict the effect of inhomogeneity in magnetic field on the transverse relaxation time.

[3 Marks][CO4, L1]

b. Work out the structure factor F_{hkl} of body-centred cubic (BCC) lattice. The fractional coordinates (x_i,y_i,z_i) of the atoms in this lattice are (0,0,0) and (1/2,1/2,1/2). From its X-ray diffraction pattern, which of the reflections:(0,0,0), (0,1,0), (0,0,1),(0,1,1), (1,0,0), (1,1,0), (1,0,1), and (1,1,1) would be absent? Justify your answer.

[3 Marks][CO4, L1, L4]

(or)

b. Present a comparison of X-ray diffraction method with that of neutron diffraction method for structural analysis of materials giving salient points.

[3 Marks][CO4, L1, L2]

c. The Larmor frequency of radiation that is absorbed by a sample containing protons is 400 MHz. Find out the required magnetic field strength (in Tesla) for achieving the resonance? Given: for the ^1H nucleus, the magnetogyric ratio is 2.6752×10^8 T^{-1} s^{-1}.

[2 Marks][CO5, L3, L5]

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END SEMESTER EXAMINATION

THIRD SEMESTER

November 2021

Inorganic Chemistry-3 (MSCH 205)

Course Title: Organometallic Chemistry and its Application

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

Instructions: Attempt any 10 queestion. All carries equal marks. Assume missing data if any.

Question 1. Define organometallic compounds. Which of the followings are organometallic compounds? [CO1, L1]

1) CH_3MgBr
2) $(C_2H_5)_2Zn$
3) $Ti(OEt)_4$
4) Zeise's salt
5) $(\Pi^6\text{- } C_6H_6)_2Cr$

Question 2. Nickel carbonyl, $Ni(CO)_4$ reacts with cyclopentadiene to give a red diamagnetic compound of formula $NiC_{10}H_{12}$. The ^1H NMR spectrum of this compound at room temperature shows four different types of hydrogen; integration gives relative areas of 5:4:2:1 with the most intense peak in aromatic rings. Suggest the structure of $NiC_{10}H_{12}$ that is consistent with the NMR spectrum. [CO2, L2]

Question 3. The V-C bond lengths in $V(CO)_6$ and $[V(CO)_6]^-$ are 200 pm and 193 pm respectively. Explain. [CO2, L4]

Question 4. $[Re_2Cl_8]^{-2}$ adopts an eclipsed conformation whereas $Re_2(CO)_{10}$ adopts a staggered confirmation in the solid state. Explain [CO3, L3]

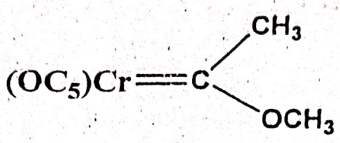
Question 5. Which of the following compounds undergoes oxidative addition reaction faster? Give explanation. [CO4, L4]

1. $Rh(CO)(PPh_3)_2$ Cl or $Ir(CO)(PPh_3)_2Cl$ 332
2. Ir(dmpe)(CO)Cl or Ir(dppe)(CO)Cl
3. $Rh(PPh_3)_3$ Cl or $Ir(PPh_3)_2$ (CO)Cl

Question 6. How is $Mn_2(CO)_{10}$ converted into $(CH_3)Mn(CO)_5$. [CO1, L1]

Question 7. What are the Fischer type and Shrock type carbenes? Give two examples of each. How Fischer type carbene differ from Shrock-type carbene? [CO4, L1]

Question 8. Treatment of $Cr(CO)_6$ with $LiCH_3$ followed by $[(CH_3)_3O]BF_4$, gives the carbene complex. [CO1. L2]



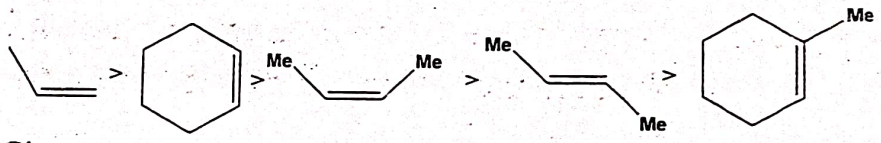
Propose a mechanism for the synthesis.

Question 9. The cyclopentadienyl ring in the ferrocene has an aromatic character, but cyclopentadiene itself has no such character. Explain. [CO3, L3]

Question 10. When $FeCp_2$ is oxidized to $FeCp^+$, what will be the effect on the Fe-C bond length? [CO3, L2]

Question 11. The trend in the rate of hydrogenation of some alkenes by Wilkinson's catalyst is:

[CO4, L5]



Give reason

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Total No. of Printed Pages: 02 *Roll No.....*

MSc Chemistry-III

III SEMESTER EXAMINATION **Nov 2024**

MSCH–207b

Course B: Inorganic Reaction Mechanism and Bioinorganic Chemistry

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

Instructions: *Attempt any 5 questions from each section.*

Section A

Ques1. Discuss the effect of steric crowding and charge on the metal complex on the rate of substitution reaction in square planar complexes? (5) [CO1]

Ques2. Give the preparation of *cis* and *trans* isomers of the composition $[Pt(NH_3)_2Cl_2]$. (5) [CO2]

Ques3. Why is the electron transfer in $[Co(NH_3)_6]^{2+} \rightarrow [Co(NH_3)_6]^{3+}$ slow? What is the effect of replacing one ammonia by a chloride ion on the rate of the reaction? (5) [CO3]

Ques4. What are the characteristics of ligand substitution reaction in metal complexes following the S_N1 mechanism? (5) [CO1]

Ques5. What are labile and inert complexes? Explain on the basis of Taube's approach. (5) [CO2]

Ques6. Write a short note on the following: (5) [CO3]
(i) Cross reactions ii) Non complimentary electron transfer reactions

Section B

Ques7. Discuss the structure and functioning of vitamin B_{12} coenzyme? (5) [CO5]

Ques8. What are transferrins? How do they differ from siderophores? (5) [CO6]

Ques9. Describe cooperativity and Bohr effect in haemoglobin? (5) [CO5]

Ques10. "Metal deficiency and metal excess both are possible in most of the cases". Justify the statement with suitable examples. (5) [CO4]

Ques11. Discuss the biochemical roles of calcium ion? (5) [CO4]

Ques12. What are metalloenzymes? Discuss the mechanism of any one metalloenzyme in human body. (5) [CO5]

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No of Pages: 02 | Roll No.

THIRD SEMESTER | **M.Sc. (Chemistry)**

END TERM EXAMINATION | *Nov/Dec-2024*

COURSE CODE: MSCH207c

COURSE TITLE: Organic Synthesis and Heterocyclic Chemistry

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

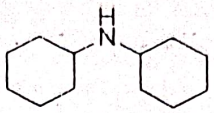
Note: Assume suitable missing data, if any. Answer Course A and B separately in same answer sheet.

Course A

Q1. Answer **any five** from the following:

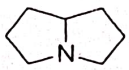
Write the Retrosynthetic analysis and Synthetic pathways with proper reagents and each step clarity for the target molecules.

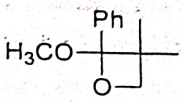
[5×5 = 25, CO1&2]

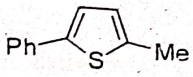
(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

Course B

Q2. Answer any **four** of the following [3×4 = 12][CO3&4]

(a) Explain the Dobner Miller synthesis of quinoline.

(b) Discuss the position of electrophilic substitution in furan and pyrrole.

(c) Discuss the aromaticity order of pyrrole, thiophen, furan, and benzene.

(d) Show the mechanism of synthesis of isoquinoline from benzaldehyde and 2,2-diethoxyethan-1-amine.

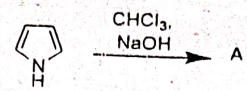
(e) Write the Knorr quinoline synthesis with the help of an example.

Q3. Write the short note on the following reactions: [3×2 = 6][CO3]

(a) Write any two syntheses of oxazole.

(b) Why electrophilic substitution occurs at fourth carbon in pyrazole?

Q4. List the products of the following transformations: [7×1 =7][CO]



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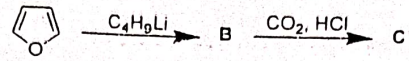

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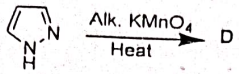

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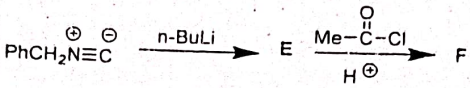

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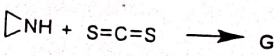

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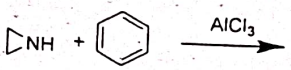

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END SEMESTER EXAMINATION
THIRD SEMESTER

MSc
November 2024

Solid State Synthesis (MSCH207d)

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

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

Q1a) Enlist the various methods that can be used for the growth of single crystals from solutions. Discuss in detail Bridgman method of single crystal formation.

b) Distinguish between paramagnetic, diamagnetic, ferromagnetic and anti-ferromagnetic materials using suitable examples.

CO1, CO4 (5 + 5 = 10 marks)

Q2a) Describe powder diffraction method in detail to determine crystal structure of lattice. Why is it more convenient to use than other reported diffraction method for determination of crystal structure. In Bragg's reflection of X-ray, a reflection was observed at 30° glancing angle with lattice planes of spacing 1.87Å. If this is a second order reflection. Calculate the wavelength of X-rays used.

b) Silver is known to be crystallized in cubic form. The Bragg's angle using CuKα X-rays with λ 154.1 pm for the first six diffraction lines are as follows

Θ 19.08° 22.17° 32.26° 38.74° 40.82° 49.00°

i) What is the type of cubic crystal formed by silver

ii) What is the length of a side of the unit cell

iii) What is the interplanar distance of the planes

CO2 (5 + 5 = 10 marks)

Q3a) Discuss in detail the kinetics of phase transitions in solids.

b) Describe various structural transformations in solids and explain classification

CO3 (5 + 5 = 10 ma

Q4a) State the differences between n- type & p- type doping of a condu material?

b) Explain in detail the BCS theory of superconductivity.

CO4 (5 + 5 = 10 ma

Q5a) Draw a typical B-H curve and describe the different magnetiz processes. Why Diamagnetic materials have negative susceptibility?

b) Write short note on

i) Meissner effect

ii) Curie Weiss law

CO4 (5 + 5 = 10 m

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Total no of pages: 02 *Roll no.....*

1st_SEMESTER
MSc. (Biotechnology)

END SEMESTER EXAMINATION *Nov2024*
MSBT 101 : Biochemistry

Time: 3 Hours *Max. Marks : 40*

Note : Answer any 5 questions. Question 1 is compulsory. Assume suitable missing data, if any.

1. Give suitable explanations for the following answers.: [20](CO# 1, 3)

a) Describe the monomeric carbohydrate and type of linkage present in following disaccharides. [6]

i. **Sucrose**
ii. **Lactose**
iii. **Maltose**
iv. **Trehalose**
v. **Cellobiose**
vi. **Gentiobiose**

b) Define specific heat capacity and heat of vaporization. What is the value of water's specific heat capacity and heat of vaporization? [2]

c) Differentiate between heteropolysaccharide and homopolysaccharide. Support answer with applications and examples. [2]

d) What is the difference between essential and non- essential amino acid? [2]

e) Which amino acid is the metabolic precursor of niacin, serotonin? [2]

f) Tyrosine is a metabolic precursor of which harmone in human body? [2]

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g) Differentiate between O-linked and N-linked oligosaccharide. [2]

h) Describe cohesive and adhesive property of water. [2]

2. Describe different types of lipoprotein complexes and movement of lipid in the body including Exogenous, Endogenous and reverse transport pathway with diagram. [5] CO#3

3. Briefly describe kreb cycle. Illustrate each step with suitable reaction and illustration.

4. Briefly describe the process of photosynthesis with suitable examples. Also illustrate about '*light*' and '*dark*' reaction. [5] CO#5

5. Describe Michaelis-Menton equation of enzyme catalysis. [5] CO#2

6. Briefly describe active and passive transport of biomolecules across biomembrane. [5]CO#4

7. Briefly describe different stages of protein folding. Also explain regulation of protein folding at each stage. [5] CO#1

Total no. of Pages:1 341 Roll no.....

1st SEMESTER

M.Sc. Biotechnology

END TERM EXAMINATION *Nov-2024*

COURSE CODE: MSBT103 **Cell & Developmental Biology**

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

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

Q.1 Write very short notes on: [10] [CO 1;2]
(i) Endo- and exocytosis
(ii) Atomic Force Microscopy
(iii) Chloroplast structure and function
(iv) Nucleus

Q.2 Write short notes on: [10] [CO 2; 3]
(i) Chromatin organization and function
(ii) Structure and function of endoplasmic reticulum

Q.3 Describe any TWO of the following briefly: [10] [CO 4]
(i) Use of fucus and volvox as model plants
(ii) Differentiation of germ layers
(v) Homeotic gene effects in Drosophila

Q.4 Explain any TWO of the following: [10] [CO 4; 5]
(i) Heterosis and Apomixis
(ii) Tumor suppressor genes and oncogenes
(iii) Mating cell types in yeast

Q.5 Describe in brief : [10] [CO 5]
(i) the "cells of the immune system"
(iv) Sex-determination in Drosophila

Total No. of Pages: 3

Roll No. .....

M.Sc. BT

FIRST SEMESTER

END TERM EXAMINATION *November-2024*

MSBT 105 Molecular Biology

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

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

Q.1 [A] Attempt any TWO of the following **[4 marks]** [CO1] [BTL1,2]

(a) Compare and contrast Watson-Crick and Hoogsteen base pairs. Clearly mention the positions of atoms involved in H-bond formation

(b) How is G-quadruplex formed? What are its various polymorphic forms?

(c) Discuss the mechanisms of action of any two chemical mutagens

(d) Write four points of differences between B-DNA and A-DNA

[B] Give an analysis of any TWO of the following **[4 marks]** [CO2] [BTL5]

(a) Simultaneous action of DNA Pol I on two Okazaki fragments

(b) Cofactor requirement of DNA ligase

(c) *ori* C as the site of regulation of replication

(d) Errors during DNA synthesis by DNA polymerase III

Q.2 [A] Attempt any TWO of the following **[4 marks]** [CO1,2] [BTL1,2]

(a) Explain the mechanism of prokaryotic mismatch repair of DNA lesion and the role of methylation in the process

(b) Write a note on photoreactivation giving details of enzyme and its local free radical mechanism

(c) Explain the role of 'RecA' or 'UvrABC excinuclease' or 'DNA glycosylase' in the repair of DNA damage

P.T.O.

[B] Analyze the structure of DNA polymerase III with respect to any TWO of the following **[4 marks]** [CO2] [BTL4,5]

(a) Increased processivity and role of ATP

(b) Assembly of catalytically competent Mg^{2+} binding pocket

(c) Proper orientation and positioning of dNTP

Q.3 [A] Assign explanation(s) for any TWO of the following **[4 marks]** [CO3] [BTL4,5]

(a) Phosphorylation of RNA polymerase II impacts both transcription and post-transcriptional processing

(b) Action of LacR is regulated by inducer and presence of lactose

(c) σ subunit of bacterial RNA polymerase is specificity factor and promotes melting

(d) Flap is a topological structure of bacterial RNA polymerase which aids in prokaryotic transcription termination

[B] Discuss the mechanism of antitermination and attenuation of transcription, taking example of *trp* operon. Evaluate the control of *trp* operon with respect to Trp levels **[4 marks]** [CO3] [BTL1,2,5]

Q.4 [A] Attempt the following **[4 marks]** [CO4] [BTL1,2]

(a) Write in brief about the actions of any two of the following enzymes / RNA in post-transcriptional processing of RNAs - ADAR, RNaseP, Sen endonuclease, C/D box snoRNA, Guide RNA

(b) Give a descriptive account of editing of apolipoprotein B pre-mRNA

[B] Analyze the roles of various proteins / ribonucleoproteins in spliceosomal splicing of GU-AG introns from eukaryotic nuclear pre-mRNA. Also give an elaborate account of the process **[4 marks]** [CO4] [BTL5]

Q.5 [A] Attempt the following **[4 marks]** [CO5] [BTL2,4,5]

(a) Evaluate any one of the following with respect to translation and explain its significance in detail

(i) Wobbling between 3rd base of codon and 1st base of anticodon

(ii) Interaction between SD sequence and 3' end of 16S rRNA

P.T.O.

(b) Explain any one of the following

(i) Significance of EF-Tu in translation and its recycling

(ii) Changing interactions between various types of RNAs on ribosome during translocation step and acquisition of hybrid states

[B] Attempt any ONE of the following **[4] [CO5] [BTL1,2]**

(a) Giving a descriptive account of the structure of GroEL-ES complex, explain its mechanism for substrate protein folding

(b) Enumerate various properties of inteins and explain their splicing mechanism

*** END ***

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ODD SEMESTER

M.Sc. BIOTECHNOLOGY

END TERM EXAMINATION Nov-2024

MSBT107: ANALYTICAL TECHNIQUES

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

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

1. Answer all of the following questions:

[a] Explain how can FRET be used to study interactions in live cells. [3][CO 1][BTL3]

[b] What is the principle of Raman Spectroscopy? In Raman spectrum, what are Stokes and Anti-Stokes lines? [3][CO 1][BTL1]

[c] Identify the chromatographic technique that involves the purification of enzymes based on their specificity to a particular substrate or cofactor. With the help of a suitable example, explain its procedure and discuss its advantages. [2][CO 2][BTL4]

2. Answer all of the following questions:

[a] While performing SDS-PAGE, what is the purpose of casting a stacking gel and a separating gel? [2][CO 2][BTL3]

[b] A protein of 75kDa by size-exclusion chromatography is run on a reducing (with beta-mercaptoethanol) SDS-PAGE gel showing 2 bands of 25kDa and 50kDa. The same sample is run on a non-reducing SDS-PAGE gel and shows a single band of about 75kDa. What is the most likely explanation for this result? [2][CO 2][BTL4]

[c] What are two different types of density gradient centrifugation techniques for separating particles? Give points of differences between them. [4][CO 3][BTL2]

3. Attempt any TWO questions out of the following:

[a] How can you determine the relative molecular mass of a particle using Sedimentation Equilibrium method? [4][CO 3][BTL3]

[b] If ultracentrifuge speed is 62000 rev/min., calculate

(i) the angular velocity (ω in radian per second) and the centrifugal field, G, at a point equivalent to 5.0 cm from centre of rotation.

(ii) How many 'times g' is this equivalent to? [4][CO 3][BTL5]

[c] Explain the procedure to validate that competitive binding is the fundamental concept of radioimmunoassay. [4][CO 4][BTL3]

4. Answer all of the following questions:

[a] Briefly explain Townsend avalanche effect and schematically present the instrumentation of a Geiger Mueller counter for the detection of radioactivity. [2][CO 4][BTL2]

[b] Potassium-40 has a half-life of 1.25 billion years. If you start with 8.0 grams of K-40, how many grams will remain after 2.5 billion years? [2][CO 4][BTL5]

[c] What is the principle behind XRD technique? Describe the steps involved in determination of 3D structure of a protein by X rays. [4][CO 5][BTL1]

5. Attempt any **TWO** of the following questions:

[a] Describe the steps involved in solid phase peptide synthesis. [4][CO 5][BTL1]

[b] Describe in detail how MALDI-TOF can be used in analysis of biomolecules such as DNA and proteins. [4][CO 5][BTL3]

[c] Explain how whole-cell entrapment in three different types of matrices can be done. [4][CO 5][BTL2]

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First SEMESTER

M.Sc.-Biotechnology

END TERM EXAMINATION *Nov-2024*

MSBT 109- BIOSTSISTICS AND COMPUTER APPLICATIONS

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

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

Q.1 Answer all the following questions:

a) What is cluster analysis? [2][CO#4][BTL#2]

b) Under what condition is the normal distribution usually used as an approximation to the binomial distribution? [2][CO#2][BTL#4]

c) What are the data types in PERL? [2][CO#3][BTL#2]

d) What is a molecular dynamics simulation? [2][CO#5][BTL#2]

e) Calculate the expected frequencies for cells of a contingency table in chi-square test of independence. [2][CO#5][BTL#4]

Q.2a) Describe the various databases that deal with DNA and protein structure. [5][CO#3][BTL#2]

b) Explain the database management with reference to biological and clinical data. [5][CO#3][BTL#2]

Q.3a) Outline the significance of force fields and molecular energy minimization in protein structure comparision. [5][CO#5][BTL#4]

b) Outline the main steps in pattern recognition in a flow chart. Differentiate between syntactic and statistical methods of pattern recognition in detail. [5][CO#3][BTL#4]

Q.4a) What is the rationale behind homology modelling. Outline the various steps involved of homology modelling in the detail. [5][CO#5][BTL#4]

b) Outline the flow chart for X-ray crystallographic technique with the help of an appropriate diagram. [5][CO#4][BTL#3]

Q.5a) Illustrate the Microarray techniques for gene expression experiments. Also explain the major goals of a microarray technique. [5][CO#4][BTL#4]

b) What are Hidden Markov Models (HMMs)? How a simple prediction strategy can be developed using a first order Markov Chain model for gene prediction problem? [5][CO#4][BTL#3]

Q.6a) Explain the different methods that can be used to carry out cluster analysis. Enumerate the advantages and disadvantages of Non Hierarchical cluster analysis methods. [5][CO#2][BTL#3]

b) Let x be a continuous random variable that has a normal distribution with a mean of 117.6 and a standard deviation of 14.6. Find the probability that x assumes a value,

I. between 77.9 and 98.3

II. between 85.3 and 142.6 [5][CO#2][BTL#3]

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THIRD SEMESTER M.Sc. [MSBT]

END SEMESTER EXAMINATION NOV-2024

MSBT 201: Bioprocess Engineering & Technology

Time: 3:00 Hours Max. Marks: 40

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

Q.1 (a) Explain the different methods for maintenance and preservation of Industrially important microorganisms. [4] (CO1)

(b). How specific growth rate of a bacterial cell varies in non-growth associated product formation. Define the term inactivation factor. [3+1=4] [CO1, CO2]

Q.2 (a) What do you mean by fluidization velocity. Elaborate the working of pneumatic bioreactor with diagram. [1+3=4] [CO2]

OR

Discuss the construction of a bioreactor along with diagram. [4] [CO2]

[b] CSTR volume 750 L contains 8g/L glucose as a feed flowing with flow rate of 150 L/h. Microbial system follows Monod model with μ_m= 0:4 h^{-1}, Ks = 1.5 g/L, Yx/s= 0.5 g cell mass/g substrate. Determine cell produced at steady state condition. [4] [CO2]

Q.3 (a) Write the principle involved during Crystallization. Explain the working of draft tube baffle crystallizer. [1+3=4] [CO3]

Or

Discuss different types of filters used in DSP. How Filtration efficiency and rate of filtration changes during filtration process. [3+1=4]

(b) Elaborate the different methods of cell disruption. [4] [CO3]

4. A) Describe the process of risk asessment in determining the appropriate biosafety level for a given research project. What factors are considered in this assessment? [5] (CO#5) (BTL4

B) Discuss the key differences between biosafety level 1and biosafety level 2. [5] (CO#5) (BTL3)

OR

How do biosafety levels BSL1 to BSL4 differ in terms of containment and safety measures? [10] (CO#5) (BTL 4

5. A) What are the unique features of Indian Patent Act 1970? [5] (CO#4) (BTL

B) Where are the patent offices located in India?Discuss the role Indian Patent offices in implementation and enforcement of India Patent Act 1970. [5] (CO#4) (BTL

Total no. of pages. 3 Roll No.....

THIRD SEMESTER **M. Sc. (BIOTECHNOLOGY)**

END SEMESTER EXAMINATION **NOV-2024**

MSBT-217 NANOBIOTECHNOLOGY

Time: 3.00 Hours **Max. Marks: 50**

Note: Answer Five questions. Question No. 1 is compulsory. Assume suitable missing data, if any.

Q 1. Answer all the following questions briefly [(2×9) CO-1-5]

a. What are homing peptides, write down two homing peptides and their application in cancer treatment.

b. Describe what are molecular beacons, and how it can be used for biosensing.

c. Explain the working principle behind electrochemical etch stop method.

d. State the difference between Wet and Dry etching, write down three isotropic etchants and mention the reaction mechanism of any one.

e. Discuss about engineering of pharmaceutical nanosystem to develop next generation *nanosystems* for "smart" drug delivery.

f. Describe the two techniques for nanofabrication; along with suitable figures discuss its applications.

g. What is Pharmacokinetics and Pharmacodynamics? describe dose response curve.

h. What are immuno-sensors? Discuss about SPR based immuno-sensing technology.

i. Briefly explain the mechanism of microwave assisted one-pot synthesis of metallic nanostructure in solution.

Q 2. Answer all the following questions [(2×4) CO-1]

a. How does the following techniques influence the Photolithography process

1. Oxidation
2. Soft baking
3. UV exposure
4. Developing Solution

b. What are physiochemical transducers explain with suitable examples, and briefly discuss the various immobilization methods involved in the development of Biosensors.

Q 3. Answer all the following questions **[(2×4) CO- 2, 4]**

a. What is nanotoxicology? Discuss how does physiochemical properties of nanomaterials influence ROS generation. Briefly outline the diseases associated with nanomaterials and explain the toxicological mechanism involved.

b. Fabricate a cantilever using bulk micromachining and surface micromachining technique, how does cantilever sensing is applied in medical and diagnostics.

Q 4. Answer all the following questions **[(2×4) CO- 4]**

a. Briefly describe the methods for fabricating microgrooves patterns using lithography technique.

b. Discuss the application of nanomaterial in targeted drug delivery system, what are the modification techniques used to enhance the acceptability of nano-drug. Briefly discuss the role of nanomaterial in clinical diagnostics and treatment of diseases

Q 5. Answer all the following questions **[(2×4) CO- 3, 4]**

a. Define Biomaterials and along with its classification briefly describe, what is the significance of cell-surface interactions in the area of regenerative medicine, discuss the application of biomaterials in implants and prosthesis.

b. Explain the principle of bio-barcode assay. What are its advantages and significance in current scenario?

Q 6. Answer all the following questions **[(2×4) CO- 3, 4]**

a. Briefly explain bio-reduction mechanism for synthesis of silver nanoparticle. With schematic illustration explain the bactericidal mechanism of silver nanoparticles.

b. Describe the crystal structure of Silicon. Discuss the physical and chemical properties of silicon and its compounds and why Silicon is most widely used semiconductor in MEMS, explain.

Q 7. Answer all the following questions **[(2×4) CO- 4, 5]**

c. Describe lab-on-a-chip, discuss about its fabrication process and explain its application in medical diagnostics.

d. Briefly describe the various techniques involved in vapor based synthesis of nanomaterial. How can we get 0-D, 1-D, 2-D and 3-D nanostructures using nanosynthesis methods, explain with suitable example.

-END-

Total no. of pages: 03

Roll No. .....

III[rd] SEMESTER

M.Sc. Biotechnology

End Term Examination

Nov 2024

Course Code: MSBT241

Course Title: Molecular Therapeutics

Time: 3:00 Hours

Max. Marks: 50

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

1. **Fill in the blanks** *[1x10= 10 marks]*(CO#3,4,5) (BTL1)

i. In gene silencing, the enzyme _____ cleaves double-stranded RNA into small fragments called siRNAs.

ii. Small interfering RNA (siRNA) works by binding to the _____, which then guides the siRNA to the complementary mRNA for degradation.

iii. The enzyme _____ is often used in hybridoma technology to ensure only fused hybrid cells survive in HAT medium

iv. The clotting factor _____ is also known as anti-hemophilic factor and is deficient in Hemophilia A.

v. _____ vaccines use only a specific part of the pathogen, such as a protein or sugar, to stimulate an immune response.

vi. _____ are cytokines that help to activate antiviral defenses by inducing the production of antiviral proteins in cells.

vii. Insulin analogs are modified forms of insulin that differ from human insulin in their _____, which alters their absorption and activity profile.

viii. _____ insulinanalogs are designed to more closely mimic the body's natural insulin secretion in response to meals.

ix. Recombinant _____ is used to promote red blood cell production in patients with anemia, especially in those undergoing chemotherapy or dialysis.

x. The vaccine for _____, developed using recombinant DNA technology, is effective in preventing liver cancer caused by chronic infection with this virus.

2. Write details explanation of the following questions

[2x5=10] (CO#2,3) (BTL 1, 5)

(A). Explain the process of monoclonal antibody production using hybridoma technology? (*5 marks*)

(B). Compare and contrast reproductive cloning and therapeutic cloning in terms of techniques and outcomes.

or

(A). Discuss the clinical applications of recombinant DNA technology in the production of therapeutic proteins ?

(B). Discuss the role of cytokines in the tumor microenvironment and their impact on cancer progression?

3. Write the details explanation of the following questions

[2x5=10] (CO#4,5) (BTL 3, 4)

A. What is gene silencing? Describe the mechanisms of RNA interference (RNAi) and its role in gene silencing?

or

Explain the difference between CRISPR-Cas9-based gene editing and CRISPR-Cas9-based gene silencing. Provide examples where each would be used in genetic research.

B. Explain the entire process of cloning for human growth hormone production, starting from gene isolation to the final protein expression in bacterial cells.

or

What are insulin analogs, and how do they differ from regular insulin in terms of their pharmacokinetics?

4. Describe the following questions [2x5=10] (CO#2, 3) (BTL 1, 2)

A. What are the differences between streptokinase and urokinase in terms of their origin and therapeutic applications?

B. What is the role of streptokinase in clot-busting therapy, and how does it help in the treatment of myocardial infarction?

5. Describe the following questions **[2x5=10] (CO#3, 5)(BTL 4, 5)**

A. How are insulin analogs produced using recombinant DNA technology, and why are they preferred over traditional insulin in certain cases?

B. What are immunosuppressants? Explain their role in preventing organ rejection in transplant patients.

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Total no. of Pages: Roll no.....

First SEMESTER

END TERM EXAMINATION *Nov-2024*

COURSE CODE MSMA-101 **COURSETITLE** Abstract Algebra

Time: 03:00 Hours *Max. Marks: 50/60*

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

Q.1 Define a cyclic group with an example. Show that there are $\phi(n)$ generators of a group of order n. [5][CO1][BTL2]

Q.2 State and prove Lagrange's theorem. Discuss whether the converse hold true or not. [5][CO1][BTL4]

Q.3 Define a quotient group with an example. Show that a subgroup N is normal in G iff $xN = Nx$ for all $x \in G$. [5][CO2][BTL1]

Q.4 State and prove second fundamental theorem of group isomorphism. [5][CO3][BTL5]

Q.5 Let G be a finite group of order n and p, a prime divisor of n. Then show that G has an element of order p. [5][CO2][BTL6]

Q.6 State and prove Sylow's second Theorem. [5][CO1][BTL1]

Q.7 Define an integral domain with an example. Show that every finite integral domain is a field. [5][CO2][BTL3]

Q.8 Define Maximal ideal with an example. Let R be a commutative ring with 1. Show that an ideal M is a maximal ideal iff R/M is a field. [5][CO2][BTL2]

Q.9 Define principal ideal domain with an example. Show that the ring $R = \{n/m : m, n \in Z, n \text{ is odd}\}$ is a principal ideal domain. [5][CO3][BTL6]

Q.10 Define Euclidean domain with an example and show that every ideal of an Euclidean domain is principal ideal. [5][CO4][BTL3]

Q.11 Define embedding. State and prove the embedding theorem. [5][CO3][BTL2]

Q.12 Define unique factorization domain with an example. If R is a UFD then show that an element in R is prime iff it is irreducible. [5][CO4][BTL6]

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First Semester

End Term Examination

M. Sc

November, 202

MSMA-103, Real Analysis

Time: 3 Hours

Max. Marks: 50

Note: Attempt any five and all questions carry equal marks.

(1) (a) Let A and B be two subsets of the metric space (X, ρ). Then show that

(*i*) A^0 is open.

(*ii*) if $A \subseteq B$, then $A^0 \subseteq B^0$.

(*iii*) $A^0 \cap B^0 = (A \cap B)^0$ and $A^0 \cup B^0 \subseteq (A \cup B)^0$. (CO1)(L2)

(b) Let (X, ρ) be a complete metric space and $\{F_n\}$ be a non-empty closed subset of X, for all $n \in \mathbb{N}$ such that $F_{n+1} \subset F_n$ and $diam\,(F_n) \to 0$. Then show that $\bigcap_{n=1}^{\infty} F_n$ contains exactly one point. (CO2)(L2)

(2) (a) Define a function $f : [0, \pi/2] \to \mathbb{R}$ by

$$f(x) = \begin{cases} \cos^2 x, & \text{if } x \in \mathbb{R} \\ 0, & \text{otherwise.} \end{cases}$$

Find the upper and lower Riemann integrals of f over $[0, \pi/2]$. Is it Riemann integrable ? (CO4)(L5)

(b) Let a, c, b be real numbers with $a < c < b$. And consider any function $f : [a, b] \to \mathbb{R}$ which is integrable over $[a, c]$ and over $[c, b]$. Then prove that $f \in \mathcal{R}[a, b]$, and

$$\int_a^b f = \int_a^c f + \int_c^b f. \qquad (CO4)(L5)$$

(3) (a) Explain the compactness. Prove that a compact subset of a metric space is closed. (CO2)(L3)

(b) Let $\mathfrak{B}([a, b])$ denote the set of bounded functions on the interval, that is, $f \in \mathfrak{B}([a, b])$ if there exists $M > 0$ such that $|f(x)| \leq M$

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for all $x \in [a, b]$. For $f, g \in \mathfrak{B}([a, b])$

$$\rho(f, g) = \sup_{x \in [a,b]} |f(x) - g(x)|.$$

Show that $(\mathfrak{B}([a, b]), \rho)$ is a metric space. (CO1)(L3)

(4) (a) Define the product of two metric spaces (X, ρ_X) and (Y, ρ_Y) and show that a sequence $\{(x_n, y_n)\}$ in the product metric space $(X \times Y, \rho)$ with $\rho = \rho_X + \rho_Y$ is Cauchy if and only if $\{x_n\}$ and $\{y_n\}$ are Cauchy sequences in X and Y, respectively. (CO3)(L2)

(b) Define the continuity of function in a metrics space. Let (X, ρ_1) and (Y, ρ_2) be two metric spaces and $f : X \to Y$. Then show that f is continuous if and only if $f^{-1}(G)$ is open in X whenever G is open in Y (CO3)(L4)

(5) Let $f : [0, 1] \to \mathbb{R}$ be a continuous function, and let $B_n(x)$ $(\in \mathcal{P})$ be the Bernstein function. Then for each $\varepsilon > 0$, there exists $n_0 = n_0(\varepsilon) \in \mathbb{N}$ show that

$$|f(x) - B_n(x)| < \varepsilon,\ 0 \leqslant x \leqslant 1 \text{ and } n \geqslant n_0, \qquad (CO4)(L3)$$

(6) (a) Show that every open cover of a sequentially compact metric space has a Lebesgue number. (CO2)(L5)

(b) Define the connectedness in a metric space. Let (X, ρ_X) be a metric space and Y be a subset of X. Then show that Y is disconnected if and only if there exist non-empty sets A, B such that

$$Y = A \cup B;\ \overline{A^X} \cap B = \phi;\ A \cap \overline{B^X} = \phi,$$

where $\overline{A^X}, \overline{B^X}$ denote the closure of A or B in (X, ρ_X). (CO2)(L2)

Total No. of Pages: 02 363 Roll No:.....

FIRST SEMESTER **M.Sc[Maths**

END SEMESTER EXAMINATION Nov. 202

MSMA105, Ordinary Differential Equations

Time: 3.0 Hours Max. Marks: 50

Note: *Attempt **ANY FIVE** questions, however Q(1) is compulsory. Assume suitable missing data, if any.*

1. State and prove the existance and uniqueness theorm for the IVP:

$$\frac{dy}{dx} = f(x,y),\ y(x_0) = y_0.$$

[10 marks] [CO-1,2][L2

2. Solve the initial value problems (IVP):

$$\frac{dX}{dt} = \begin{bmatrix} 2 & -5 & 0 \\ 0 & 2 & 0 \\ -1 & 4 & 1 \end{bmatrix} X, \text{ with } X(0) = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}.$$

[10 marks] [CO-3,4][L2,L5

3. Solve the initial value problems (IVP) using matrix method:

$$\frac{dX}{dt} = \begin{bmatrix} 1 & 3 \\ 3 & 1 \end{bmatrix} X + \begin{bmatrix} 2e^t \\ 2t \end{bmatrix}, \text{ with } X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}.$$

[10 marks] [CO-2,5][L3,L5

4. (a) Discuss ordinary and singular point for the ODE:

$$2x^2(x-5)y'' - xy' + (x-5)y = 0$$

[3 marks

(b) Solve $x^2y'' + (x^2 - 3x)y' + 3y = 0$ about $x = 0$. [7 marks

[CO-3][L3,L5

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5. (a) Discuss Strum-Liouville problems with properties. [5marks]

(b) Solve $y'' + \lambda y = 0,\ y(0) = 0, y(\pi/2) = 0.$ [5 marks]

[CO-1,4][L3,L4]

6. (a) Define stability and asymptotic stability for an ODE with an example. [5marks]

(b) Analyze qualitatively the first order non-linear ODE:

$$y' = y^3 - 3y + 2$$

[5 marks][CO-1,5][L4,L6]

Total no. of Pages: 03 Roll no.....

I SEMESTER **M.Sc.**

END TERM EXAMINATION ***NOV-2024***

COURSE CODE: MSMA107

COURSE TITLE: Discrete Mathematics

Time: 3 Hours *Max. Marks: 50*

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

Q1(i) In a lattice L, $b \leq a$ & $d \leq c$ then prove that $(b + d) \leq (a + c)$. (CO1,3)

(ii) Let L be the set of all divisors of 4 and M be the set of all divisors of 9. Define $a \leq b$ in L & M iff a *divides* b. Draw the Hasse diagram of $L \times M$. (CO1,3)

Q2(i) Find the Disjunctive normal form of

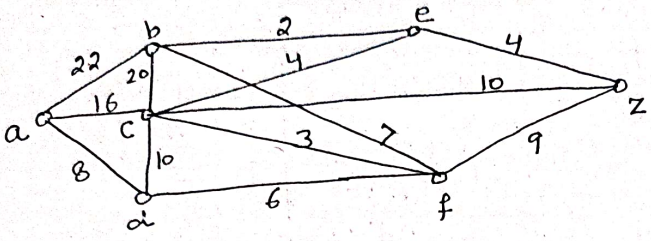
(a) $(x_1 + x_2)$ (b) $(x_1x_2 + x_3)$ (CO2,3)

(ii) Prove that any complemented distributive lattice is a Boolean algebra. (CO3)

Q3(i)Prove that a connected graph is Eulerian iff all of its vertices are of even degree. (CO4)

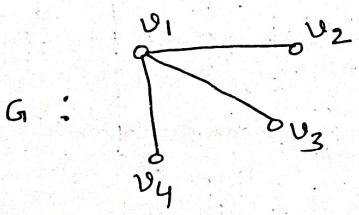
(ii) Suppose G is a graph with 12 edges. If G has 6 vertices each of degree 3 and the rest have degree less than 3, what is the minimum number of vertices G can have? (CO4)

Q4(i) Apply Dijkshtra's algorithm, find the shortest path from a to z for the graph below:



(CO4)

Q4(ii) Find the chromatic polynomial $P(G,\lambda)$ of the graph given below by describing each step. (CO4)



Q5(i) Construct a minimum state automaton equivalent to the finite automaton whose transition table is given below:

State/Σ	a	b
→ q_0	q_1	q_0
q_1	q_0	q_2
q_2	q_3	q_1
q_3	q_3	q_0
q_4	q_3	q_5
q_5	q_6	q_4
q_6	q_5	q_6
q_7	q_6	q_3

Explain each step in the construction. Also draw the transition table. (CO3)

(ii) Let $G = (\{S, A\}, \{0,1,2\}, P, S)$, *where* $S \to 0SA2,\ S \to 012,$ $2A \to A2,\ 1A \to 11$. Show that $L(G) = \{0^n 1^n 2^n : n \geq 1\}$ (CO3)

Q6(i) Solve the following recurrence relation using generating function

$$a_{n+2} - 2a_{n+1} + a_n = 2^n,\ a_0 = 2, a_1 = 1$$

(CO1)

(ii) Re-write the following arguments using predicates and quantifiers and check the validity

(a) All humans are good
Shyam is a human
Therefore, Shyam is good

(b) All intelligent persons are engineers
John is not an engineer
Therefore, John is not intelligent

(CO2)

Total no. of Pages: 367 Roll no.....

FIRST SEMESTER M.Sc.(MATHS)

END TERM EXAMINATION Nov -2024

COURSE CODE: MSMA 109

COURSE TITLE: MATHEMATICAL STATISTICS

Time: 03:00 Hours Max. Marks: 40

Note: Assume suitable missing data, if any.

Q.1 (i) An urn contains 2 white balls and 3 black balls, from which 3 balls are drawn one by one and they laid aside without noticing their colours. Then one more ball is drawn. Find the probability that it is white. [4][CO1] [L2,L5]

(ii) If a person gains or losses an amount equal to the number appearing when a balanced die is rolled once according to whether the number is even or odd, how much money can he expect from the game in the long run. [4][CO1] [L2,L5]

Q.2 (i) The distribution function of a random variable X is:

$$F(x) = cx^3, \quad 0 \le x < 3$$
$$= 1, \quad x \ge 3$$
$$= 0, \quad x < 0$$

If $P(X = 3) = 0$ then find the constant c and the probability density function. [4][CO2] [L4,L5]

(ii) Among the 300 employees of a company, 240 are union members, whereas the others are not. If six of the employees are chosen by lot to serve on a committee that administers the pension fund, find the probability that four of the six will be union members. [4][CO2] [L2,L3]

Q.3 (i) Find the mean and standard deviation of Binomial distribution. [4][CO3] [L1,L5]

(ii) The probability that a pen manufactured by a company will be defective is $\frac{1}{10}$. If 12 such pens are manufactured, find the probability that at least two will be defective. [4][CO3] [L3,L5]

OR

If the mean of the binomial distribution is 3 and the variance is $\frac{3}{4}$, find the probability of obtaining at most 3 successes. [4][CO3] [L3,L5]

Q.4 (i) State Central limit theorem. The number of students who enroll in a course conducted by an institute is a poisson random variable with mean 100. The institute decided that if the number enrolling is 120 or more, the institute will run the course in two separate section, whereas if fewer than 120 students enrol it will teach all of the students in a single section. Find the probability that the institute would make two sections. (Use central limit theorem). [4][CO4] [L1,L3]

(ii) An unbiased coin is tossed 400 times. Find the probability that the number of heads will lie between 190 and 210. [Given area under standard normal curve enclosed between $z = 0$ and $z = 1.05$ is 0.3531]. [4][CO4] [L2,L5]

OR

The mean of a normal distribution is 50 and 5% of the values are greater than 60. Find the standard deviation of the distribution. [Given area under standard normal curve enclosed between $z = 0$ and $z = 1.64$ is 0.45] [4] [CO4] [L2,L5]

Q.5 (i) The foreman of ABC mining company has estimated the average quantity of iron are extracted to be 36.8 tonnes per shift and the sample standard deviation to be 2.8 tonnes per shift. Construct a 90% confidence interval around this estimate supposing the quantity of iron ore is normally distributed. [Given $P(|t|>2.353) = 0.10$]. [4][CO5] [L4,L5]

(ii) The mean breaking strength of the cables supplied by a manufacturer is 1800 with a standard deviation 100. By a new technique in the manufacturing process, it is claimed that the breaking strength of the cables have increased. In order to test this claim, a sample of 50 cables is tested. It is found that the mean breaking strength is 1850. Can we support the claim at 0.01 level of significance?[Given that $P(Z > 2.33) = 0.01$] [5][CO5][L2,L5]

OR

Following data represents the total mileages obtained by the vehicles of the same type run on three different gas fuels

Gas 1	220	251	226	246	260
Gas 2	244	235	232	242	225
Gas 3	252	272	250	238	256

At $\alpha = 0.05$, test the hypothesis that the average mileage obtained is not affected by the type of the gas used. (Given $F_{(2,12)[0.05]}=3.88$) [5][CO5][L2,L5]

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THIRD SEMESTER
M.Sc. Mathematics
END TERM EXAMINATION
November 2024

Course Code: MSMA201 Course Title: Functional Analysis
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) $C^1[a,b]$ is a normed space equipped with the norm

$$\|v\| = \max_{t\in[a,b]} |v(t)| + \max_{t\in[a,b]} |v'(t)|.$$

[2] [CO1][BTL2]

(b) $L^p[0,1]$ is a Hilbert space if and only if $p = 2$. [2] [CO1][BTL2]

(c) If V is an infinite dimensional normed space and $T : V \to V$ is a compact linear operator, then $0 \in \sigma(T)$. [2] [CO5][BTL2]

(d) Every Hilbert space contains an orthonormal basis. [2] [CO3][BTL2]

(e) For a bijective continuous linear operator $T : V \to W$ (V, W being Banach spaces), T need not be an isomorphism. [2] [CO4][BTL2]

(2) (a) Prove that if the dual space V' of a normed space V is separable, then V itself is separable. [5] [CO2][BTL3]

(b) Prove that $B(V,W)$ is a Banach space if W is a Banach space. [5] [CO1][BTL3]

(3) (a) Let ϕ be a sublinear functional on a real vector space V. Further, let ψ be a linear functional which is defined on a subspace W of V satisfying $\psi(v) \le \phi(v)$ for every $v \in W$. Show that ψ has a linear extension $\bar{\psi}$ from W to V satisfying $\bar{\psi}(v) \le \phi(x)$ for every $v \in V$. [5] [CO2][BTL4]

(b) Show that the dual space of ℓ^p is ℓ^q, where $\frac{1}{p} + \frac{1}{q} = 1$. [5][CO2][BTL3]

(4) (a) State and prove the closed graph theorem. [5] [CO4][BTL3]

(b) Show that a sequence $\{\phi_k\}_{k=1}^{\infty}$ of bounded linear functionals on a Banach space V is weak* convergent, the limit being a bounded linear functional on V, if and only if (i) the sequence $\{\|\phi_k\|\}_{k=1}^{\infty}$ is bounded, (ii) the sequence $\{\phi_k(v)\}_{k=1}^{\infty}$ is Cauchy for every v in a total subset W of V. [5] [CO3][BTL5]

(5) (a) Let V and W be two Banach spaces and $\{T_k\}_{k\geq 1}$ be a sequence of bounded linear operators between V and W, and $\mathcal{D}$ a dense subset of V. Suppose that (i) there exists $T(v) = \lim_{k\to\infty} T_k(v)$ for all $v \in \mathcal{D}$, and (ii) $\{T_k(v)\}_{k\leq 1}$ is bounded for all $v \in V$. Then $T : \mathcal{D} \to W$ defined by $T(v) = \lim_{k\to\infty} T_k(v)$ extends to a bounded linear operator $T : V \to W$ such that

$$\|T\| \leq \lim_{k\to\infty} \inf \|T_k\|.$$

[5][CO3][BTL4]

(b) Let T be a bounded linear operator on a complex Banach space. Show that the spectral radius $r_\sigma(T)$ of T is

$$r_\sigma(T) = \lim_{k\to\infty} \sqrt[k]{\|T^k\|}.$$

[5] [CO5] [BTL5]

(6) (a) Let the operator $T : \ell^2 \to \ell^2$ be defined by

$$T(x_1, x_2, \ldots, x_k, \ldots) = (0, x_1, x_2, \ldots, x_k, \ldots).$$

Show that T is linear and bounded. Find the adjoint operator T^*. [5] [CO4][BTL4]

(b) Let V be a normed space and $T : V \to V$ a compact linear operator. Prove that

(i) the set E of eigenvalues of T is countable.

(ii) $\lambda = 0$ is the only possible point of accumulation of E. [5] [CO5][BTL4]

-END-

End Term Examination
II Semester (M.Sc.), Nov-Dec 2024
Operations Research (MSMA-203)

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

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

Q 1. Consider the following LPP problem and its optimal tableau:

$$\text{Max} \quad 2x_1 + x_2 - x_3$$
$$\text{subject to}$$
$$x_1 + 2x_2 + x_3 \leq 8$$
$$-x_1 + x_2 - 2x_3 \leq 4$$
$$x_1, x_2, x_3 \geq 0$$

	$y^{(1)}$	$y^{(2)}$	$y^{(3)}$	$y^{(4)}$	$y^{(5)}$
$x_1 = 8$	1	2	1	1	0
$x_5 = 12$	0	3	−1	1	1
16	0	3	3	2	0

Attempt Any 2 parts :

(a) Find the new optimal solution if the coefficient of c_1 in the objective function is changed to +1 and Determine the new optimal solution if the coefficient of x_2 in the objective function is changed from 1 to 6.

(b) Analyze the impact on the optimal solution if a new constraint, $x_2 + x_3 = 3$, is added.

(c) Update the table if b is changed to $(10, 4)^T$ in the original linear programming problem (LPP). What can you infer from this adjustment?

[CO1][BTL2,4,5]

Q 2. Attempt Any 2 parts .

(a) A workshop has six machines, A, B, C, D, E and F. Two jobs have to be processed through each of these machines. The processing time on each machine and technological sequence of jobs is given below.

Job 1 : $A \to C \to D \to B \to E \to F$,
Job 2 : $A \to C \to B \to D \to F \to E$.

	Time in hours on machine					
	A	*B*	*C*	*D*	*E*	*F*
Job 1	20	30	10	10	25	15
Job 2	10	15	30	10	20	15

In which order should the jobs be done on each of the machines to minimize the total time required to process the jobs? Also find the minimum elapsed time.

(b) A machine operator has to perform three operations: turning, threading, and knurling on a number of different jobs. The time required to perform these operations (in minutes) for each job is known. Determine the order in which the jobs should be processed in order to minimize the total time required to turn out all the jobs. Also, find the idle times for the three operations.

Job	Time for turning (minutes)	Time for threading (minutes)	Time for knurling (minutes)
1	3	8	13
2	12	6	14
3	5	4	9
4	2	6	12
5	9	3	8
6	11	1	13

(c) Use Gomory's cutting plane method to solve the following mixed integer LPP and explain graphically.

$$\text{Max} \quad z = 2x_1 + x_2$$
$$\text{subject to}$$
$$x_1 + x_2 \leq 5$$
$$6x_1 + 2x_2 \leq 21$$
$$x_1, x_2 \geq 0$$
$$x_1 \text{ integer.}$$

[CO2,CO3][BTL1,2,3,4,6]

Q 3. There are seven activities in a project and the time estimates are shown in the table (time in weeks t_O, t_L, t_P):
The logical order of activities are:

1. Activities A and B start at the beginning of the project.
2. When A is completed, C and D start.
3. E can start when B and D are finished.

Activities	t_O	t_L	t_P
A	2	6	10
B	4	6	12
C	2	3	4
D	2	4	6
E	3	6	9
F	6	10	14
G	1	3	5

4. F can start when B, C and D are completed and is the final activity.
5. G can start when F is finished and is the final activity of the project.

(a) What is the expected time of the duration of the project?

(b) What is the probability that project will be completed in 22 weeks?

[CO2,CO4][BTL1,3]

Q 4. (a) Use the concept of dominance to solve the game.

A ↓ /B →	I	II	III	IV
I	3	2	4	0
II	3	4	2	4
III	4	2	4	0
IV	0	4	0	8

(b) Formulate the given game in the pay off matrix as linear programming problem for both the players A and B. Also discuss the dual concept:

A/B	1	2	3
1	3	−4	2
2	1	−3	−7
3	−2	4	7

[CO1,CO2][BTL2,4,6]

Q 5. Arrival rate of telephone calls at a telephone booth is according to Poisson distribution, with an average time of 9 minutes between consecutive arrivals. The length of telephone call is exponentially distributed with a man of 3 minutes. Find:

Attempt Any 2 parts:

(a) Determine the probability that a person arriving at the booth will have to wait. Also, Find the average queue length that forms from time to time.

(b) The telephone company will install a second booth when conveniences that an arrival would expect to have to wait at least four minutes for the phone. Find the increase in flow of arrivals, which will justify a second booth. Also, Find the fraction of a day that the phone will be in use.

(c) What is the probability that an arrival will have to wait for more than 10 minutes before the phone is free?
What is the probability that they will have to wait for more than 10 minutes before the phone is available and the call is also complete?

[CO4,CO5][BTL3,5,6]

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

3rd SEMESTER M.Sc. (Math)

END SEMESTER EXAMINATION (Nov-Dec 2024)

MSMA 211: Number Theory

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

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

Q1. a) Discuss integers x and y satisfying gcd(56, 72) = 56x + 72y. [5] [CO1][BTL2]

b) Let N be a positive integer, then formulate the rule to check when the number N is divisible by 11. [5] [CO2][BTL6]

OR

Solve the following system of congruences:

$$5x + 3y \equiv 1 \pmod 7,$$
$$3x + 2y \equiv 4 \pmod 7.$$

[5] [CO2][BTL3]

Q2. a) If m and n are relatively prime positive integers, then illustrate that $m^{\phi(n)} + n^{\phi(m)} \equiv 1 \pmod{mn}$. [5][CO3][BTL3]

b) Verify that $\tau(n) = \tau(n+1) = \tau(n+2) = \tau(n+3)$ holds for $n = 3655$ and 4503. [5][CO3][BTL2]

Q3. a) Show that for $n > 2$, $\phi(n)$ is an even number. [5][CO3][BTL3]

b) Using a table of indices for a primitive root of 13, solve the congruence: $4x^9 \equiv 7 \pmod{13}$.

[*Hint: 2 is a primitive root.*] [5][CO4][BTL3]

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Q4. a) If a has order k *mod* n, then conclude that

$$a^i \equiv a^j \pmod{n} \quad iff \quad i \equiv j \pmod{k}.$$

[5][CO4][BTL

b) For an odd prime p, then summarize that the congruence $x^{p-2} + \ldots\ldots + x^2 + x + 1 \equiv 0 \pmod{p}$ has exactly $p -$ incongruent solutions, and they are the integers $2, 3, \ldots, p$

[5][CO4][BTL

Q5. a) If a is a quadratic residue of an odd prime p, then show tha is a quadratic residue or non-residue of p accordingly if

$p \equiv 1 \pmod{4}$ *or* $p \equiv 3 \pmod{4}$. [5][CO5][BTL

OR

If p and q are odd primes satisfying $p = q + 4a$ for some a establish that $(a/p) = (a/q)$ and, in particular, $(6/37) = (6/1$

[5][CO5][BTL

b) Use Gauss lemma to discuss the Legendre symbol $\left(\frac{11}{23}\right)$.

[5][CO5][BTL2]

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Total no. of Pages:2 Roll no.....

3rd SEMESTER

M.Sc.

END TERM EXAMINATION Nov-2024

COURSE CODE: MSMA 213

COURSE TITLE: Mathematical Modeling and Simulation *Time: 03:00 Hours* *Max. Marks: 40*

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

Q.1 Develop a model for an infectious disease where there is immunity for only some of those who recover; others 'recover' to become permanent carriers, who can still cause infections. Thus susceptibles, S(t), may be infected by either infectious individuals, I(t), or carriers, C(t). A carrier can infect others at a reduced rate compared to infectious individuals but shows no symptoms.

(a) Give a suitable compartment diagram for this model.

(b) Assume there is a fixed proportion q of those recovering from the infection become carriers. Assume transmission rates β_1 for normal infectives and β_2 for carriers and assume that individuals remain infective for a mean time γ^{-1}. Give equations for the number of susceptibles, S(t), the number of infectious, I(t), the number of carriers, C(t) and the number of recovered who are immune, R(t).

(c) Give at least one example of an infectious disease that could be modelled by the equation you have developed.

[5][CO1,2][BTL 2,3]

Q.2 Discuss the stability of the following system with the help of phase portrait

$$\dot{x} = x + y$$

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$\dot{y} = 4x - 2y$

subject to the initial condition $((x_0, y_0) = (2, -3)$. [7][CO3][BTL3,5]

Q.3 Consider that breeding of rabbits is happening starting with one pair of rabbits. Every month, each pair of rabbits produces one pair of offspring. After one month, the offspring is adult and will start reproduction. Describe the long term behaviour of the rabbit population. [7][CO2,3][BTL 3]

Q.4 Use Routh Hurwitz criterion the discuss the stability of

$s^5 + s^4 + 2s^3 + 2s^2 + s + 1.$ [7][CO2,4,5][BTL2,3,5]

Q.5 Use Lyapunov function to prove the stability of the following model:

$\ddot{x} + sinx = 0$ [7][CO 3,4,5,][BTL 4]

Q.6 Calculate the critical points of the constant Harvesting model

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{k}\right) - H.$$

Discuss the behaviour of the model at these points. Examine if bifurcation exists at any of these points. If yes, discuss the type of bifurcation which exist. Finally sketch the bifurcation diagram of fixed point.

[7][CO 2,4,5,][BTL 4,5]

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Total no. of Pages: 03

Roll no.....

III SEMESTER

M.Sc. (Mathematics)

END TERM EXAMINATION *Nov-2024*

COURSE CODE: MSMA219 **COURSE TITLE: Database Management System**

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

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

Q.1 Define attribute in an ER diagram. Discuss the mechanism of attribute inheritance and aggregation with the help of an example. [5][CO2][BTL1]

Q.2 Using the given relational schemas: [1+2+2][CO2][BTL3]

Employees (EmpID, Name, ManagerID, DeptID, Salary)
Departments (DeptID, DeptName)
Bookings (BookingID, UserID, StartDate, EndDate)
Users (UserID, UserName)
Sales (SalesID, Region, ProductID, SalesAmount)
Products (ProductID, ProductName, Price)

Write an SQL query for the following:

i. Count how many users as totalusers have made at least one booking.
ii. Find all users who have no bookings.
iii. Find all products where the total sales exceed $5,000.

Q.3 Explain the Armstrong axioms. Also, provide suitable example to describe each. [5][CO1][BTL2]

Q.4 Consider the given schema: [1+2+2][CO2][BTL3]

Suppliers (sid, sname, address)

Parts (pid, pname, color)

Catalog (sid, pid, cost)

Determine the relational algebraic query for the following:

i. Find the *sids* of suppliers who supply some red or green part.

ii. Find the *pids* of parts supplied by at least two different suppliers.

iii. Find the Supplier ids of the suppliers who supply a red part that costs less than 100 dollars and a green part that costs less than 100 dollars.

Q.5 Consider the relation *R* (A, B, C, D, E, F, G, H), with all the attributes contain atomic values. F = {CH→G, A→BC, B→CFH, E→A, F→EG} is a set of functional dependencies. [2+3][CO3][BTL3]

a) Determine all the candidate keys of *R*.

b) Examine and explain the highest normal form of *R*.

OR

For the relational schema R (A, B, C), determine the canonical cover for the given set of functional dependencies, FD: {A→BC, B→AC, C→AB}. [5][CO3][BTL3]

Q.6 Analyze the number of collisions and resolve them using quadratic probing after inserting the keys 10, 22, 31, 44, 50, 55, 77 into a hash table of size 9 using the division method hash function. [5][CO4][BTL4]

OR

Consider a hash table of size $m=9$. The division method hash function is used and all the collisions are resolved by chaining. The following keys are inserted in the order: 5, 28, 19, 15, 20, 33, 12, 17, 10. Assess and state what are the maximum, minimum and average

chain lengths in the resultant hash ... collisions in hashing. [5][CO4][BTL5]

Q.7 Define conflict serializable schedule? Evaluate and explain whether the given schedules are conflict serializable or not: [5][CO5][BTL2]

i. Schedule *S1*:

T1	T2	T3	T4
	R(x)		
		W(x)	
W(x)			
	W(y)		
	R(z)		
			R(x)
			R(y)

ii. Schedule *S2*:

T1	T2	T3	T4
R(A)			
	R(A)		
		R(A)	
			R(A)
W(B)			
	W(B)		
		W(B)	
			W(B)

Q.8 Assess whether each given schedule is strict, cascadeless, and/or recoverable: [5][CO5][BTL5]

S1: r1(X); w1(X); r2(X); r3(Y); w3(Y); c3; r2(Y); w2(Y); c2; c1;

S2: r1(X); r2(X); r2(Y); w2(Y); c2; r1(Y); w1(X); c1;

S3: r1(X); r2(X); w2(X); r1(Y); w1(Y); c1; r3(Y); w3(Y); c3; c2;

S4: r1(X); w1(X); r2(X); w2(Y); r3(Y); w3(Z); c3; w1(Y); c1; c2;

S5: r1(X); r2(X); r1(Y); w1(X); r3(Y); w3(Y); c3; w2(X); c2; c1;

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THIRD SEMESTER M.Sc|Mathematics|

END SEM EXAMINATION NOV./DEC.-2024

MSMA-221 Integral Transforms and Equations

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

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

Q.1 (a) Evaluate the following using convolution theorem.

$L^{-1}\left(\frac{1}{(s^2+1)(s^2+9)}\right)$ [4M] [CO1, L1]

(b) Solve $\frac{d^2x}{dt^2} + n^2x = \sin(nt+\alpha)$, *if* $x(0) = 1, \quad x'(0) = 0$ using Laplace transform. [6M] [CO1, L3]

Q.2 (a) Using Parseval's identity, prove that

$\int_0^\infty \frac{dt}{((a^2+t^2)(b^2+t^2)} = \frac{\pi}{2ab(a+b)}$ [5M] [CO1, L1]

(b) Classify the following integral equations as Fredholm or Volterra and further classify its kind, linear or non-linear, homogeneous or non-homogenous.

(i) $u(x) = x + \int_0^1 (x-t)^2 u(t)dt,$

(ii) $u'(x) = 1 + \int_0^x e^{-2t}u^2(t)dt$ [5M][CO2, L4]

Q.3 (a) Covert the following integral equation into boundary value problem.

$u(x) = x^2 + \int_0^1 k(x,t)u(t)dt$, where $k(x,t) = \begin{cases} 6t, & 0 \le t \le x \\ 6x, & x \le t \le 1 \end{cases}$ [5M] [CO2, L2]

(b) Find the eigen values and eigen functions of the integral equation using direct computation method

$u(x) = \lambda \int_0^{2\pi} \sin(x-t)\, u(t)dt.$ [5M] [CO3, L5]

(P.T.O.)

Q.4 (a) Covert the following initial value problem into Volterra Integral equation.

$y''' - 2y'' + y = x, \quad y(0) = 1, y'(0) = 0, y''(0) = 1$ [5M][CO2, L2]

(b) Solve the following integral equation by finding resolvent Kernel

$u(x) = f(x) + \lambda \int_0^1 e^{x-\xi}u(\xi)d\xi$ [5M] [CO3, L3]

Q.5 (a) Using Hilbert -Schmidt theorem to solve the integral equation

$u(x) - \lambda \int_0^1 k(x,t)u(t)dt = x,$

where $k(x,t) = \begin{cases} t, & 0 \le x \le t \\ x, & t \le x \le 1 \end{cases}$ [5M] [CO4, L3]

(b) Solve $u(x) = 1 - \int_0^x (x-t)u(t)dt$ using successive approximation method. [5M] [CO5, L5]

Q.6 (a) Construct Green's function for the boundary value problem

$y''(x) + \mu^2 y(x) = 0, \quad y(0) = 0, y(1) = 0.$ [4M] [CO4, L4]

(b) Convert Volterra integral equations of first kind to second kind and solve the resulting integral using Laplace transform

$e^x - cosx = \int_0^x e^{x-t}u(t)dt.$ [6M] [CO5, L6]

Q.7(a) Find the Fourier cosine transform of

$f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$ [4M] [CO1, L1]

(b) Use the direct computation method to solve the integral Equation

$u(x) = 2x + e^x - \frac{3}{4}\int_0^1 xt\, u(t)dt.$ [6M] [CO3, L4]

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Integrated B.Sc.-M.Sc. in Chemistry

SEMESTER EXAMINATION **Dec 2024**

Course Code: IMSAC101
Course Title: Inorganic Chemistry 1

Time: 3H] [Max. Marks: 40]

nstructions: Attempt any 5 questions.

ues1. Explain the following
A) Why is 1s orbital spherically symmetrical?
B) Why is the shape of d_{z2} different from that of d_{x2-y2}?
C) What is a nodal point?
D) Orthogonality of wave function. (8) [CO1]

ues2. A) Why is it more difficult to remove the 4s valence electron from Copper than to remove the 4s valence electron from Potassium.
B) What are the possible values of quantum numbers for electron in 4f and 4d orbitals?
C) Which of the orbitals 1p, 2s, 2p, 3f are not possible? Give reasons.
D) Write short note on Aufbau Principle. (8) [CO2]

ues3. A) Calculate the enthalpy of formation ΔH_f of MgF_2 from the following data

Sublimation Energy of Mg(s)	= 146.4 kJ/mol
Dissociation Energy of F_2	= 158.9 kJ/mol
Ionization Enthalpy of Mg(g) to $Mg^{2+}(g)$	= 2184.0 kJ/mol
Electron gain enthalpy of F(g) to $F^-(g)$	= –334.7 kJ/mol
Lattice energy of MgF_2 (U_o)	= –2922.5 kJ/mol

B) What is Lattice energy? Write Born-Lande equation for calculating lattice energy. (8) [CO3]

Ques4. Explain the following
A) The ionization of Mg to Mg^{2+} require three times as much energy as Mg to Mg^+.
B) Lithium salts are slightly covalent while sodium salts are ionic.
C) AlF_3 is a high melting solid while $AlCl_3$ is a low melting solid.
D) F is more electronegative and has less electron affinity than Cl. (8) [CO3]

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Ques5. A) Draw MO energy level diagram of CO. Write MO configuration for O_2 and N

B) Discuss the geometry and shape of the following molecules/ions on the bas VSEPR theory.

XeO_3, ClF_3, I^{3-}, SO_4^{2-} (8) [C

Ques6. A) Differentiate between

i) Bonding and Anti-bonding molecular orbitals.

ii) Sigma and pie bonds

B) i) Using LCO method, draw the shapes of molecular orbitals formed by combination of p-p atomic orbitals, both axial as well as sideways.

ii). Despite the same hybridization, explain why H_2O is angular whereas N pyramidal (8) [C

Total No. of Printed Pages: 02 525 Roll No.....

Integrated B.Sc and M.Sc in Chemistry

Ist SEMESTER EXAMINATION **Dec 2024**

IMSAC 103 Organic Chemistry 1

[Time: 3H] [Max. Marks: 40]

Instructions: Attempt any 5 questions.

Q1 a) Draw the Fischer projection for all the possible stereoisomers of butane-2,3-diol. State the correlation among these stereoisomers? Comment on the optical activity of these isomers.

b) Comment on the stereochemistry of the products formed when *cis* and *trans* isomers of but-2-ene reacts with bromine solution. (4,4)

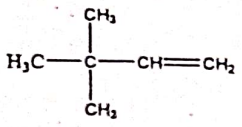
Q2 a) State limitations of Wurtz reaction. How Corey-House synthesis overcomes these limitations? Explain with suitable example.

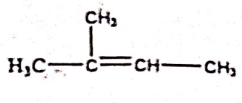
b) How will you chemically distinguish between 1-butyne and 2-butyne? (4,4)

Q3 Complete the following reaction with product(s) including stereochemistry wherever applicable.

i) $H_3CC{\equiv}CCH_3 \xrightarrow[\text{Liq. } NH_3]{Na}$

ii)  $\xrightarrow[\text{Cold}]{\text{Dil. aq. } KMnO_4}$

iii)  $\xrightarrow{HCl}$

iv)  $\xrightarrow[Zn/H_2O]{O_3/CCl_4}$

(2,2,2,2)

7 526

Q4. a) Alkenes are more reactive than alkynes towards electrophilic addition reactions, explain. Why peroxide effect is observed in case of addition of HBr.

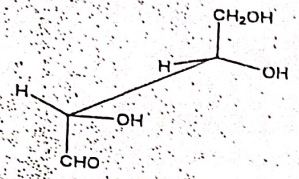
b) Carry out the following conversions

i) Ethane to *n*-butane

ii) Prop-1-yne to Pent-2-yne. (4,4)

Q5. a) Convert the following into Fischer projection and assign R and S configuration:

i)



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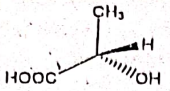

b) Write down the conformations of *n*-butane and discuss their stability order. (4,4)

Q6. a) Discuss the mechanism of hydroboration of propene.

b) Give stepwise synthesis of acetylene using 1,2-dichloroethane. (4,4)

Q7. Write short notes on any two of the following (include mechanism):

a) E1 and E2 reactions

b) Oxymercuration-Demercuration reaction

c) Acidity of terminal alkynes (4,4)

Total No. of Printed Pages: 02 S27 Roll No.....

Integrated B.Sc and M.Sc in Chemistry

I[st] SEMESTER EXAMINATION **Dec 2024**

IMSAC 105 Physical Chemistry 1

[Time: 3H] [Max. Marks: 40]

structions: Attempt any 5 questions.

. a) Define activity coefficient. Derive Nerst equation for measuring EMF of a Daniell cell in terms of activity.

b) Calculate the EMF of a zinc-silver cell at 30°C when activity of Zn^{2+} ions is 0.5, the activity of Ag^{+} ions is 10. Standard reduction potentials at 30°C are:

(i) Ag^{+}, Ag electrode = + 0.799 volt

(ii) Zn^{2+}, Zn electrode = -0.76 volt

(R = 8.314 joule/degree/mol, F= 96500 coulombs) (4,4)

. a) Write the anodic, cathodic half-cell reactions, overall reaction and Nerst equation for the cell:

$Fe \mid Fe^{2+} \mid\mid Cl^{-} \mid Cl_2 \mid Pt$

b) The EMF of the standard Weston cell with the cell reaction:

$Cd(Hg) + Hg_2SO_4 + 8/3\ H_2O \leftrightarrow CdSO_4 . 8/3\ H_2O$

Is 1.0185V at 25°C. Calculate $\Delta G°$, $\Delta S°$ and $\Delta H°$. (4,4)

. a) Explain the mechanism of enzyme catalysed reactions with the derivation of Michaelis Menten equation.

b) Explain the working of a catalyst with the help of the diagram. (4,4)

. a) Derive an expression for the rate constant of second order reaction involving one reactant only.

b) What are promoters and inhibitors, discuss with the help of examples. (4,4)

5. a) Define temperature coefficient. Discuss the effect of temperature on the rate of the reaction.

b) Write Arrhenius equation showing the effect of temperature on the reaction rate. How does it help in the calculation of activation energy of a reaction (graphical method)? (4,4)

6. a) Order and molecularity of the reaction may not be same. Explain

b) The half-life period of a substance is 50 minutes at a certain concentration. When the concentration is reduced to one half of the initial concentration, the half-life period is 25 minutes. Calculate the order of the reaction. (4,4)

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Q7. Write short notes on any two (explain with example):

a) Reference electrode

b) Concentration Cells

c) Reversible and Irreversible cells

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Total No. of Pages:02 *Roll No. ... .*

First Semester
Int B.Sc. and M.Sc.
IMSAC107 Basic Chemistry-I

END TERM EXAMINATION *Dec-2024*
Time: 3 Hours *Max. Marks: 50*

Note: Question no. 10 is compulsory. Attempt any 9 Questions in total. Assume suitable missing data, if any

Q1. a) Differentiate between ionic and covalent bond with suitable examples. [2 Marks] [CO1]

b) What is polarizing power and polarizability? How is it related to the covalency? [3 Marks] [CO1]

Q2. a) Explain heterolytic and homolytic fission with suitable examples. [2 Marks] [CO2]

b) The stability order for carbocations is 3°>2°>1° while it is reverse for carbanions. Explain. [3 Marks] [CO2]

Q3. Explain the structure of PCl_5 on the basis of VSEPR and VBT theory. [5 Marks] [CO1]

Q4. Methane, Ammonia and Water molecule, all contains a total of four electron pair around the central metal atom but their shape is different. Explain. [5 Marks] [CO1]

Q5. Explain hydroboration oxidation reaction with mechanism. [5 Marks] [CO2]

Q6. Differentiate between S_N1 and S_N2 reaction with suitable example. [5 Marks][CO3]

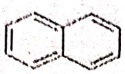
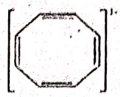
Q7. Write short note on Wurtz reaction and Wurtz Fittig reaction. [5 Marks][CO4]

Q8. Explain following with suitable examples: [5 Marks][CO3]

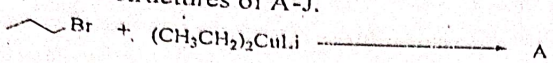
a) Hofmann's rule and Zaitsev rule.

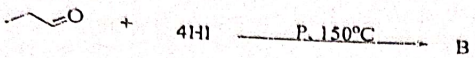
b) Markovnikov's and Anti-markovnikov's rule.

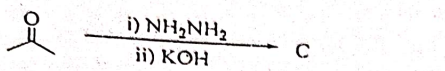
Q9. Explain whether the given compounds are aromatic or not. [5 Marks][CO5]

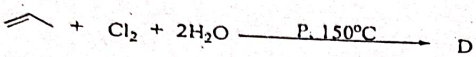
i)  ii)  iii)  iv)  v) 

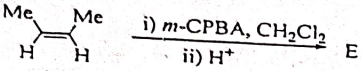
Q10. Give the structures of A-J. [10 Marks][CO5]

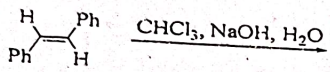
i) 

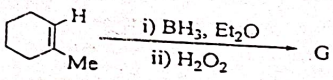
ii) 

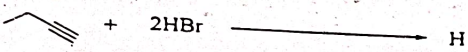
iii) 

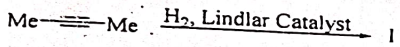
iv) 

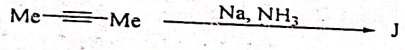
v) 

vi) 

vii) 

viii) 

ix) 

x) 

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Total no. of Pages: 2 531 Roll no..... 12

_____SEMESTER I **B.Sc.**

END TERM EXAMINATION ***Nov-2024***

COURSE CODE IMSPH 101_____ COURSE TITLE
Mathematical Physics____I_____

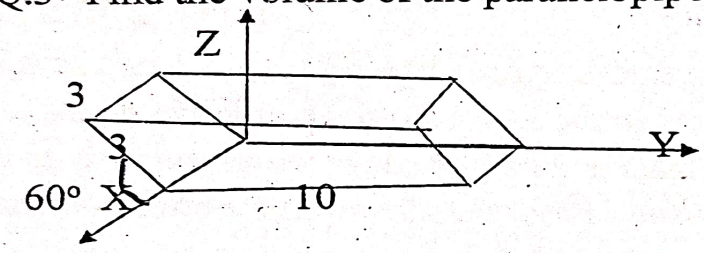
Time: 03:00 Hours *Max. Marks: 50*

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

Q.1 Solve :$(x+1)y' - y = e^x (x+1)^2$ [5][CO2][BTL2]

Q.2 Given the space curve $x=t$, $y=t^2$,$z=2t^3/3$ .Find Curvature and torsion. [5][CO2][BTL2]

Q.3 Find the volume of the parallelopiped shown using vector analysis



[5][CO3][BTL4]

Q.4 A RCL circuit connected in series has R=10 ohms,C=0.01 farad,L=0.5 henry, and an applied voltage E=12 volts.Assuming,no initial current and no initial charge at t=0 ,when the voltage is first supplied,find the subsequent current in the system. [6][CO3][BTL3]

Q.5 Solve: $y' - 5y = (x-1)\sin x + (x+1)\cos x$ [5][CO2][BTL2]

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Q.6 Find the laplace transform of : [6][CO2][BTL2]

(a) $\sin(3x/x)$ (b) ${}_0\int^x \sinh 2t\, dt$

Q.7 Find the inverse laplace transform of $[s/(s^2+a^2)^2]$ [5][CO2][BTL2]

Q.8 Solve by the method of laplace transform the equation:

$y'''+2y'' -y'-2y =0$, Given $y(0)=y'(0)=0$

$y''(0)=6$ [6][CO2][BTL2]

Q.9 Find $y(0.3)$,$y(0)=0$ using Euler's method with $h=0.1$ for the equation $y'= e^x$

Or [7][CO2][BTL2]

A 10 kg mass is attached to a spring having a spring constant of 140 N/m.The mass is stated in motion from the equilibrium position with an initial velocity of 1m/s in the upward direction and with an applied external force F(t)= 5sint . Find the subsequent motion of mass if the force due to air resistance is $-90\dot{x}$ N .

Total No. of Pages: 2 5333 Roll No. .....

FIRST SEMESTER Integ. B.Sc.-M.Sc. [IMSPH-103]

END SEMESTER EXAMINATION (December-2024)

INTRODUCTION TO MECHANICS (IMSPH-103)

Time: 3:00 Hours Max. Marks: 50

Note: Attempt all five questions.
This Paper has 2 sections
Attempt any three questions from section A and two from section B.
Assume suitable missing data, if any.
Write relevant answers within the time frame provided for the exam.

Section A

1[a] Discuss about the non-inertial frame of reference. Suppose two frame of reference S and S′ have common origin O and axis of S′ is rotating about inertial frame S. If a particle is changing its position in frame S′ and observed from S then find the expression for the fictitious force on the particle. (5M) [CO: 1, 2]

1[b] A bullet, of 10 g, is fired horizontally with a velocity 100 m/s at 60°N colatitute. (a) eastwards, (b) northwards. Calculate the magnitude of the Coriolis acceleration due to rotation of earth. (5M) [CO: 2]

2[a] Describe Michelson-Morley experiment in detail with figure including its aim and explain the physical significance of the negative results. (5M) [CO: 5]

2[b] Start with Lorentz transformation equations and deduce the mathematical expression for the law of addition of velocities. Show that in no case can the resultant velocity of an object be greater than speed of light. (5M) [CO: 5]

3[a] Explain isotropic and anisotropic materials. Also find the inter-relationship among K, α, β where K denotes bulk modulus and α and β are the linear and lateral strains per unit stress, respectively. (5M) [CO: 5]

3[b] Describe the Poiseuille's method for measuring the coefficient of viscosity of a liquid with corrected version. (5M) [CO: 5]

4. Write short notes of the following: (5×2M) [CO: 1, 5]

(a) Turbulent flow

(b) Viscosity.

(c) Galilean Invariance and

(d) Massless particle.

(e) Length contraction

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Section B

5[a] Derive expressions for gravitational potential for outside, inside and on the surface of a spherical shell. Use the proper diagram to explain. (5M) [CO: 1, 3]

5[b] A smooth straight tunnel is bored through the earth and a small particle is allowed to move in it from a position of rest. Find the periodic time of one vibration. Given: G = 6.67×10^{-8} c.g.s. units and the mean density of earth = 5.6 gm/cc. (2.5M) [CO: 2]

5[c] The radius of earth is 6.637×10^6 m, its mean density 5.57×10^3 kg^{-1} and gravitational constant 6.66×10^{-11} Nm^2kg^{-2}. Calculate the earth's surface potential. (2.5M) [CO: 2, 3]

6[a] Name (only) the conservation laws. What do you understand by central forces, describe with 2 examples. (3.5M) [CO: 1, 3]

6[b] Describe Kepler's laws of planetary motion. Discuss using diagrams and equations (if any). (4M) [CO: 1, 2]

6[c] Is gravitation force a fundamental and central force of nature? Define its maximum range, upto where it can operate. Support your statement, if gravitational force is a central force. (2.5M) [CO: 5]

END OF QUESTION PAPER

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Total No. of Pages: 2 Roll No.....

FIRST SEMESTER

Integrated B.Sc-M.Sc (Physics) (First Semester)

END - SEMESTER EXAMINATION DEC. 2024 IMSPH 105 ELEMENTS OF ELECTRICITY & MAGNETISM

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

Note: Attempt any five questions. Symbols have their usual meaning. Assume suitable missing data, if any.

Q1 (a) The diagonals of a parallelogram are given by vectors $(3\mathbf{i} + \mathbf{j} + 2\mathbf{k})$ and $(\mathbf{i} - 3\mathbf{j} + 4\mathbf{k})$. Find the area of the parallelogram. **[3]** [CO:2]

(b) What should be the orientation between unit vectors **A** and **B** such that their sum has unit magnitude ? **[2]** [CO:5]

(c) Find a unit normal to the surface $x^2y + 2xz = 4$ at point (2, -2, 3). **[3]** [CO:3]

Q2 (a) State Gauss's Law in Electrostatics. Find the electric field flux for spherical Gaussian surfaces around a positive and a negative point charge enclosed inside the sphere. Draw an appropriate figure to illustrate the above and show the direction of the electric flux lines. **[5]** [CO:5]

(b) A large plane charge sheet having surface charge density $\sigma = 2.0 \times 10^{-6}$ C m $^{-2}$ lies in the x–y plane. Find the flux of the electric field through a circular area of radius 1 cm lying completely in the region where x, y, z are all positive and with its normal making an angle of 60° with the z-axis. **[3]** [CO:3]

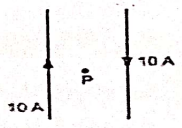
Q3 (a) Find the electric potential energy and the work done with appropriate figures for two point charges q and q_0 along a (i) straight line and (ii) an arbitrary path from charge q. What would be the effect on the potential energy if the two point charges have the same sign or the opposite signs ? **[3.5]** [CO:5]

(b) What is the role of a dielectric material placed in between the plates of a parallel plate capacitor? **[1.5]** [CO:2]

(c) Derive the Relation between polarization vector (P), displacement (D) and electric field (E) for a dielectric placed in an external field E_0 between the plates of a charged capacitor. Write down the expression for Gauss's law in dielectrics. **[3]** [CO:5]

Q4 (a) Using Biot Savart's law, find the magnetic field due to current in a long, straight wire. Draw an appropriate figure for the same. **[3]** [CO:5]

(b) A Figure below shows two long, straight wires carrying electric currents in opposite directions. The separation between the wires is 5. 0 cm. Find the magnetic field at a point P midway between the wires. **[3]** [CO:3]



(c) What are the properties of Dia-, Para- and Ferromagnetic substances? **[2]** [CO:2]

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Q5 (a) What causes the mechanism of electromagnetic damping & what is the method to minimize it? **[1.5]** [CO:2]

(b) Write down the Maxwell's equations and state its significant implications **[3]** [CO:5]

(c) An average induced emf of 0.20 V appears in a coil when the current in it is changed from 5.0 A in one direction to 5.0 A in the opposite direction in 0.20 s. Find the self-inductance of the coil. **[1.5]** [CO:3]

(d) State main differences between a conduction and a displacement current **OR** difference between self & mutual induction. **[2]** [CO:2]

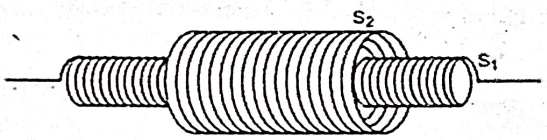
Q6 (a) State Faraday's Law of electromagnetic induction and Maxwell's counterpart to Faraday's law. **[3]** [CO:5]

(b) State Lenz's law. Define the term motional emf **OR** magnetic vector potential. **[3]** [CO:5]

(c) Calculate the energy stored in an inductor of inductance 50 mH when a current of 2.0 A is passed through it. **[2]** [CO:2]

Q7 (a) State Ampere's law and derive its expression. Compare it with Ampere-Maxwell law. **[4]** [CO:5]

(b) A solenoid S1 is placed inside another solenoid S_2 as shown in figure below. The radii of the inner and the outer solenoids are r_1 and r_2 respectively and the numbers of turns per unit length are n_1 and n_2 respectively. Consider a length l of each solenoid. Calculate the mutual inductance between them. **[4]** [CO:3]



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Total No. of Pages: 2

Roll No.....

FIRST SEMESTER

Integrated B.Sc-M.Sc (Physics) (First Semester)

END - SEMESTER EXAMINATION DEC. 2024 IMSPH 107 PHYSICS I

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

Note: Question no. 7 is compulsory. Attempt 4 other questions from Q1- Q6. Symbols have their usual meaning. Assume suitable missing data, if any.

Q 1(a) In view of the dynamics of a uniform/non-uniform circular motion of a particle, show in a figure the components of the radial and tangential acceleration in terms of velocity and what is the name and direction of the force which keeps the object in a circular motion. **[3]** [CO:3]

(b) What are the differences between centripetal and centrifugal force? Write down their formula's. **[2]** [CO:2]

(c) For circular turning on roads, what is the limit to the maximum value of friction for a safe turn? What is the tendency to be overturned by a cyclist if he turns around a curve at 15 miles/hour and if he doubles the speed? **[3]** [CO:5]

Q 2(a) Show the work-energy theorem derivation **OR** derivation of conservation of momentum. **[2.5]** [CO:5]

(b) Find the velocity of a bullet of mass 5 gms which is fired from a pistol of mass 1.5 kg. The recoil velocity of the pistol is 1.5 ms^{-1}. **[2.5]** [CO:2]

(c) Derive a Torque and Angular Momentum relationship. **[3]** [CO:5]

Q 3(a) What are the conditions for a body to be in static equilibrium? State the differences between translational and rotational equilibrium **[3.5]** [CO:3]

(b) Derive the expression of the Centre of Mass of a uniform semi-circular wire **OR** a straight rod. **[3]** [CO:5]

(c) Four particles A.B, C & D having masses m, 2m, 3m and 4m respectively are placed in order at the corners of a square of side a. Locate the centre of mass. **[1.5]** [CO:2]

Q 4(a) State two postulates of special relativity. **[2.5]** [CO:3]

(b) Explain the Law of Simultaneity **OR** Time Dilation **[2.5]** [CO:5]

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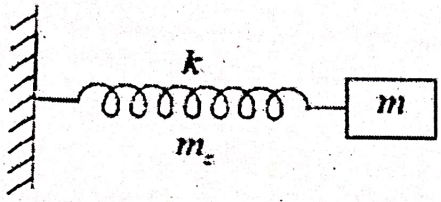
(c) A spaceship is moving away from the Earth with a velocity of 0.5c and fires a rocket whose velocity with relative to space is 0.5c (i) away from the earth; (ii) towards the earth. Calculate the velocity of the rocket as observed from the earth in two cases. **[3]** [CO:3]

Q 5(a) Explain the functioning of a Compound Microscope with an appropriate figure and derive its net Magnification. **[5]** [CO:5]

(b) Calculate the Magnification of an object placed 6.20 mm from a Compound Microscope that has 6 mm-focal length objective and a 50 mm-focal length eyepiece. The objective and eyepiece are separated by 23.0 cm. **[3]** [CO:3]

Q 6(a) How does a compound pendulum differs from a simple pendulum? **[3.5]** [CO:5]

(b) Determine the time period of the system of mass m attached with spring of mass m_s ($m_s << m$) and spring constant k. **[2.5]** [CO:2]



(c) Derive the relativistic kinetic energy of any particle of mass m. **[2]** [CO:5]

Q 7A(a) Derive the equations of motion of a Damped Harmonic Oscillator and discuss over-damped, critically damped and under-damped cases **[5]** [CO:5]

(b) An oscillator has a time period of 3 seconds. Its amplitude decreases by 5% each cycle. (a) By how much does its energy decrease in each cycle? (b) Find the time constant and (c) Find the Q-factor. **[3]** [CO:5]

OR

Q 7B(a) Derive the equations of motion of a forced Oscillator and discuss its Amplitude Resonance factor under low-, high- and resonance frequency cases. **[5]** [CO:5]

(b) The position of a particle moving along x-axis is determined by the equation:

$$d^2x/dt^2 + 2\,dx/dt + 8x = 16\,\text{Cos}\,(2t)$$

(i) What is the natural frequency of the vibrator ?

(ii) What is the frequency of the driving force? **[3]** [CO:3,3]

c. Glucose and Sucrose structure
d. Zwitterion and isoelectric point of protein
e. Force responsible for centrifugation
f. CRISPR-CAS9 technology
g. Characteristics of Protista

Total no. of pages: 4 Roll No. .....

I[st] SEMESTER Integrated B.Sc.-M.Sc. Biotechnology
End Term Examination Dec 2024

Course Code:IMSBT101

Course Title: Introduction to Biotechnology

Time: 3:00 Hours Max. Marks: 50

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

1. Write Short note on following (any 6) [2.5x6= *15 marks*]
(CO#1, 2, 3,4) (BTL 1, 2)

a. Stem cells
b. Bone cells
c. Microtubules
d. Smooth endoplasmic reticulum
e. Sedimentation
f. Promoter of Gene
g. Biofuels
h. Viruses

2. Answer any two of the following [2x5= *10 marks*]
(CO# 4, 5) (BTL 5, 6)

a. Calculate the superhelical density of a closed circular DNA with length 4500 bp. The linking number is 385. You have to calculate again the superhelical density if linking number (Lk) is 450. Based on the superhelical density, comment on

supercoiling of DNA and evaluate whether the DNA is positively or negatively supercoiled.

Or

A close circular B-DNA had 1200 bp. Calculate its relaxed linking number, The linking number is 111. Calculate change in linking number along with superhelical density. Comment whether DNA is in relaxed form or supercoiled based on change in linking number.

b. You are assigned to separate a mixture containing four components. The compounds with their concentration in solid phase as 10, 18, 24, 30 and their concentration in liquid phase as 2, 6, 8, 5 is observed. Calculate the Kd (distribution coefficient). Align all the compounds based on their affinity and justify how you have come to this conclusion.

Or

A plant containing 5 carotenoids was decided to get separated based on chromatography. The concentration of analyte in stationary and mobile phase are 10, 20, 30, 40, 80 and 3, 6, 7, 8, 9 respectively. Calculate Kd of all components. Comment on their affinity by comparison along with this explain, does by varying concentration of stationary and mobile, any effect on Kd can be observed.

3. Answer the following (any 2)

[2x5=10] (CO#2, 5) (BTL 2, 3)

a. Why in stem cell therapy, pluripotent cells are used as compared to monopotent or differentiated cells. Also comment on iPSC (induced pluripotent stem cells).

b. Explain the use of loading dye in horizontal and vertical electrophoresis along with their composition. You should write function of each component separately and how these two dyes are different from each other.

c. Differentiate between ion exchange and affinity chromatography using suitable examples of matrix and what are normally used mobile and stationary phase in these two.

4. Write the details explanation of the following question

[1x5=5] (CO#1, 2) (BTL 4, 5)

Why milk is liquid in nature, while curd is semi-solid in nature. Explain how this process is employed in industrial biotechnology along with the microbes used.

or

What is Ramachandran plot and how change in topology of amino acid has led to changes in its orientation. Explain with advantages and disadvantages.

5. Discuss in brief (any 5)

[2x5=10] (CO#1, 2, 3, 4,5) (BTL 4, 5)

a. Packaging of DNA
b. Flocculation and Floatation

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Total no. of Pages: 01 541 Roll no.....

I Semester
B.Sc.

End Term Examination **December- 2024**

IMSBT103 : Microbiology

Time: 3 hrs **Max. Marks: 40**

Note: Answer any 8 questions. Each Question is of 5 marks.

1. Derive the equation for bacterial inactivation kinetics. [CO-1]
2. What are the different types of pure culture techniques? Explain each technique with a flowchart. [CO-1]
3. Explain the functional anatomy of a bacterial cell with a diagram. [CO-2]
4. Derive the mathematical expression for bacterial growth. [CO-3]
5. What is microbial nutrition and growth? Define the term 'growth yield.' [CO-3]
6. Explain ribotyping and ribosomal RNA sequencing with a flowchart. [CO-4]
7. Explain the normal microflora of the oral cavity, including associated diseases and precautions. [CO-5]
8. Define taxonomy. Explain the nomenclature system and the importance of Bergey's Manual. [CO-4]
9. Explain the normal microflora of the gastrointestinal tract, along with associated diseases. [CO-5]
10. Daniel wants to degrade e-waste, heavy metals, plastics, and oil. Help him design a protocol starting from sample collection and isolation to the identification of microorganisms. Also, explain the term used for the removal of pollutants using living organisms. [CO-1]

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Total no of pages: 1

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Roll no.....

1st SEMESTER

MSc. (Biotechnology)

END SEMESTER EXAMINATION

Dec2024

Time: 3 Hours

IMSBT 105 : Biochemistry

Max. Marks : 40

Note : Answer any 5 questions. Question 1 is compulsory. Assume suitable missing data, if any.

1. Give suitable explanations for the following answers.: [20](CO# 1,2,3,4)
   a. Briefly describe atom and essential elements of biological system?
   b. Define metabolism. Briefly explain with example.
   c. What do you mean by polarity of water?
   d. Briefly describe specific heat capacity and heat of vaporization. What is water's specific heat capacity and heat of vaporization.
   e. What are the parameters on which strength of hydrophobic interaction depends?
   f. What do you mean by pH? Define buffer and its biological importance.
   g. Differentiate between essential and non- essential amino acids with example.
   h. What do you mean by bioenergetics. What are the laws of Bioenergetics.
   i. Differentiate between Standard Gibbs free energy and Absolute Gibbs free energy.
   j. Differentiate between Aerobic and Anaerobic glycolysis.

2. Describe Electron transport chain and oxidative photophosphorylation with explanation of each and every step. [5]CO#3

3. Briefly describe kreb cycle. Illustrate each step with suitable reaction and illustration. [5] CO#4

4. Briefly describe the process of Gluconeogenesis with suitable examples. [5] CO#4

5. Describe properties of water. [5] CO#1

6. Briefly describe active and passive transport of biomolecules across biomembrane.

7. Briefly describe lipid digestion, absorption and transport. Also describe regulation of fatty acid metabolism. [5] CO#5

Total No. of Pages- 3

Roll No. _____

B.Sc.-M.Sc. Integrated

END TERM EXAMINATION

December, 2024

IMSHU101: INTRODUCTORY MICROECONOMIC

TIME: 3:00 HRS.

MAX. MARKS: 50

NOTE: Attempt any five questions from the following.

1.a) The Law of Demand states that, all else being equal, when the price of a good rises, the quantity demanded for that good falls, and vice versa. Explain this law in detail. What are the main assumptions underlying this law? (CO2)(5)

b) A firm is selling a product at $30 per unit. It lowers the price to $28 per unit, and as result, the quantity demanded increases from 100 units to 120 units. Calculate the price elasticity of demanded (PED) and determine whether total revenue will increase or decrease due to the price change. (CO2)(5)

2.a) What is the difference between budget line and indifference curve? How do they work together to determine the consumer's equilibrium? (CO3)(5)

b) A consumer consumes 1, 2, 3, 4, and 5 units of a product. The total utility (TU) derived from consuming these units is given as follows:

Units of goods	Total utility
1	10
2	18
3	24
4	28
5	30

Calculate the marginal utility (MU) for each unit consumed and explain the concept of diminishing marginal utility. (CO3)(5)

3. a) Define substitution effect. Explains the difference between Hicks and Slutsky effect in the context of price change. (CO3)(5)

b) A consumer consumes two goods: Good X and Good Y. The consumer's income is $100. Initially, the price of Good X is $10 and the price of Good Y is $5. After a price change, the price of Good X falls to $8, while the price of Good Y remains unchanged. The consumer's optimal consumption bundle before the price change is 5 units of Good X and 10 units of Good Y. Calculate the total expenditure on both goods before and after the price change. (CO3)(5)

4. a) Consider a firm that produces goods using two inputs: labor (L) and capital (K). The production function of the firm is given by:

$$Q=f(L,K)$$

Where Q is the output produced, L is the amount of labor, and K is the amount of capital employed in production. Explain the concept of returns to scale and distinguish between increasing, constant, and decreasing returns to scale with reasons. (CO4)(5)

b) A firm uses labor to produce output. The following table shows the amount of labor (L) employed and the corresponding total output (TP) produced by the firm.

Labor	Total product (TP)
0	0
1	10
2	25
3	45
4	60
5	70
6	75

Calculate the Average Product (AP), and Marginal Product (MP) for each level. (CO4)(5)

5. Define scarcity and explain why it is considered the fundamental problem in economics. How does scarcity lead to the concept of choice in economic decision-making?

(CO1)(5)

b) Two countries, Country X and Country Y, produce two goods: Electronics and Textiles. The following table shows how much of each good they can produce with one unit of resources

Country	Electronics (unit per resource)	Textiles (unit per resource)
A	20	30
B	40	20

i) Determine which country has the absolute advantage in the production of Electronics and Textiles.

ii) Calculate the opportunity cost of producing one unit of Electronics and one unit of Textiles for each country. Using this information, determine which country has the comparative advantage in each good. (CO1)(5)

6. Explain the concept of market equilibrium in the context of a closed economy (without trade) and an open economy (with trade). How does the equilibrium price and quantity of a good differ in both scenarios? Use a simple supply and demand framework to explain the effects of opening an economy to international trade. (CO2)(5)

b) A consumer is deciding how much of Good X (apples) and Good Y (bananas) to consume. The total utility (TU) derived from different combinations of apples and bananas is given in the table below:

Apple (Good X)	Banana (Good Y)	Total utility
2	4	30
3	4	40
3	5	45

Calculate the Marginal Utility of Apples (MU_X) and the Marginal Utility of Bananas (MU_Y). Also Calculate the Marginal Rate of Substitution (MRS) when the consumer is consuming 3 apples and 4 bananas. (CO3)(5)

Total no. of Pages: 2 S45 Roll no. 2216

Integrated B.Sc. and M.Sc. I SEMESTER

END TERM EXAMINATION ***Dec-2024***

COURSE CODE: IMSHU103 **COURSE TITLE:** Mathematical Methods for Economics I

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

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

Q.1 (a) State and prove Absorption law for the sets A and B. [5][CO1][L2]

(b) Is the relation R on the set of integers $\mathbb{Z}$, defined by 'a is related to b iff $a + b$ is even', an equivalence relation? Justify your answer. [5][CO1[L3]

Q.2 (a) What is a differentiable function. If the cost of producing x units of a commodity is given by the formula $C(x) = p + qx^2$, find $C'(x)$, the marginal cost. [5][CO2][L3]

(b) Test the convergence of the series $\frac{1}{1.2^2} + \frac{1}{2.3^2} + \frac{1}{3.4^2} + \cdots$. [5][CO2][L4]

Q.3 (a) What do you mean by the limit of a function. Compute the following:

$$\lim_{x \to 4} \frac{x^2 - 16}{4\sqrt{x} - 16}.$$ [5][CO2][L3]

(b) Examine the concavity/convexity of the production function

$$Y(K) = A\,K^a \qquad (A > 0, a > 0)$$

defined for all $K \geq 0$. [5][CO3][L4]

Q.4 a) Consider the function f defined for all x by $f(x) = e^{x-1} - x$. Show that f is convex and find its minimum point. [5][CO3][L4]

(b) The total cost of producing Q units of a commodity is

$$C(Q) = 2Q^2 + 10\,Q + 32 \qquad (Q > 0).$$

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Find the value of Q which minimizes $C(Q)/Q = 2Q + 10 + 32/Q$, the average cost. [5][CO3][L4]

Q.5 (a) Use Cramer's rule to find the solution of the system of equations $x + 2y - z = -5;\ 2x - y + z = 6;\ x - 7 - 3z = -3.$ [5][CO4][L3]

(b) Discuss the definiteness of the matrix

$$\begin{pmatrix} 2 & -1 & 0 \\ -1 & 3 & -1 \\ 0 & -1 & 2 \end{pmatrix}.$$ [5][CO4][L4]

Q. 6 (a) Find the characteristic polynomial of the matrix

$$\begin{pmatrix} 6 & -1 & 5 \\ 4 & 1 & 2 \\ 3 & 0 & 1 \end{pmatrix}.$$ [5][CO4][L3]

(b) Measured in milligrams per litre, the concentration of a drug in the bloodstream t hours after injection is given by the formula

$$c(t) = \frac{t}{t^2+4}, \quad t \geq 0.$$

Find the time of maximum concentration. [5][CO5][L4]

Total no. of pages: 2

1st_SEMESTER Roll No._____

END SEMESTER EXAMINATION IMSc (ECO)

DEC 2024

IMSHU – 105 Statistics for Economics I

Time: 180 minutes Max. Marks: 50

Note: Attempt any Five questions. All are of equal marks. Assume missing data, if any.

1. a) Calculate the first four moments for the following frequency distribution about mean and comment upon the nature of frequency distribution. [5+5] [CO.1,CO2]

X	-4	-3	-2	-1	0	1	2	3	4
y	3	4	5	7	12	7	5	4	3

b) Show that the Karl Pearson's coefficient of correlation is independent of the change of origin and scale.

2. a) From the following data compute price index number for the year 2024 taking 2023 as the base year using simple aggregative method: [5+5] [CO.3]

Commodity	Prices in 2023	Prices in 2024
A	1	5
B	2	4
C	3	3
D	4	2

State the limitations of the above method.

b) Define Index numbers and compute Laspeyre's, Paache's and Fisher's index numbers for the following data.

Commodity	Base year		Current year	
	Qty	Price	Qty	Price
A	12	10	15	12
B	15	7	20	5
C	24	5	20	9
D	5	16	5	4

3. a) The probability that machine A will be performing a usual function in 5 years' time is 1/4, while the probability that machine B will still be operating usefully at the end of the same period is 1/3. Find the probability in the following cases that in 5 years' time: [5+5] [CO.4]

(i) Both machines will be performing a usual function.
(ii) Neither will be operating.
(iii) Only machine B will be operating.
(iv) At least one of the machines will be operating

b) A lot of 100 semiconductor chips contains 20 that are defective. Two chips are selected at random, without replacement, from the lot.

i) What is the probability that the first one selected is defective?
ii) What is the probability that both are defective?
iii) What is the probability that the second one selected is defective given that the first one was defective.

4. a) State and prove Bayes theorem. [5+5] [CO.4]

b) There are two identical urns containing respectively 4 white, 3 red balls and 3 white, 7 red balls. An urn is chosen at random and a ball is drawn from it. Find the probability that the ball drawn is white. If the ball drawn is white, what is the probability that it is from the first urn?

5. a) Verify that the function p(x) defined by [5+5] [CO.5]

$$p(x) = \begin{cases} \frac{3}{4}\left(\frac{1}{4}\right)^x, & x = 0,1,2 \dots \\ 0, & otherwise \end{cases}$$

is a probability mass function of a discrete random variable X. Find $P(X \leq 2)$.

b) A random variable X has the density function

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

Find the expectation and variance of X.

6. a) If the mean of a binomial distribution is 3 and the variance is 3/2. Find the probability of obtaining 3 successes. [5+5] [CO.5]

b) Define uniform distribution of a continuous random variable. Find its mean and variance.

Total No. of Pages 02 548 Roll No. .....

FIRST SEMESTER B.Sc[Mathematics]

END SEM EXAMINATION NOV./DEC.-2024

IMSMA-101 CALCULUS-I

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

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

Q.1 (a) If $y = e^{m\cos^{-1}x}$, find $y_n(0)$ by Leibnitz's theorem. [5M] [CO1, L1]

(b) Find the reduction formula for $I_m = \int_0^\infty e^{-x}\sin^m x\,dx$, where $m \geq 2$ and hence find I_4. [5M] [CO4, L3]

Q.2 (a) Trace the curve $x^3 + y^3 = 3axy$. [5M] [CO3, L4]

(b) Find the area included between the cardioids $r = a(1+\cos\theta)$ and $r = a(1-\cos\theta)$. [5M] [CO2, L5]

Q.3 (a) Expand $\tan\left(\frac{\pi}{4}+x\right)$ in ascending powers of x and hence, find the value of $\tan 45^0 30'$ to four places of decimals. [5M] [CO2, L2]

(b) If ρ_1 and ρ_2 be the radii of curvature at extremities of two conjugate diameters of an ellipse, prove that

$$\left(\rho_1^{2/3} + \rho_2^{2/3}\right)(ab)^{2/3} = a^2 + b^2.$$

[5M] [CO3, L6]

Q.4 (a) Find all asymptotes of the curve $y^2(x^2-a^2) = x^2(x^2-4a^2)$. [5M][CO3, L1]

(b) If $f(x) = \begin{cases} x^2\sin\left(\frac{1}{x}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}$. Discuss the continuity and differentiability of $f(x)$ at $x = 0$. [5M] [CO1, L4]

(P.T.O.)

Q.5 (a) Find the whole length of the hypocycloid $x = a\cos^3 t,\ y = b\sin^3 t$. [5M] [CO5, L5]

(b) Find the reduction formula for $\int \tan^n x\,dx$ and hence evaluate $\int_0^{\pi/4} \tan^5 x\,dx$. [5M] [CO4, L6]

Q.6 (a) Find the volume of the solid generated by the revolution of the curve $x^2y = a^2(a - y)$ about its asymptote. [5M] [CO5, L3]

(b) Find the surface of the solid generated by the revolution of the lemniscate $r^2 = a^2\cos 2\theta$ about the initial line. [5M] [CO5, L3]

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I[st] SEMESTER M. Sc.

END TERM EXAMINATION Dec--2024

COURSE CODE: IMSMA 103

COURSE TITLE: ANALYTICAL GEOMETRY

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

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

Q1. (i) If the straight lines whose direction cosines are given by $al+bm+cn=0, fmn+gnl+hlm=0$ are parallel, then show that one of the relations $\sqrt{af}\pm\sqrt{bg}\pm\sqrt{ch}=0$ is true. [5] [CO1]

(ii) Find the equations of the three planes through the points (3,1,1), (1,-2,3) parallel to the co-ordinate axes. [5] [CO2]

Q2. (i) Find the image of the point (-3,8,4) in the plane $6x-3y-2z+1=0$.
[5] [CO3]

(ii) Prove that the straight lines

$$\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z+10}{8},\ \frac{x-4}{1}=\frac{y+3}{-4}=\frac{z+1}{7}$$

intersect and find the plane through them. Also find their point of intersection. [5] [CO3]

Q3. (i) A plane passing through a fixed point (a,b,c) cuts the axes in A, B, C. Show that the locus of the centre of the sphere OABC is $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=2$. [5] [CO4]

(ii) Find the equation of the sphere for which the circle $x^2+y^2+z^2+7y-2z+2=0,\ 2x+3y+4z=8$ is a great circle.
[5] [CO4]

Q4. (i) Find the equation of the sphere which passes through the points $(1,0,0)$, $(0,1,0)$, $(0,0,1)$ and which touches the plane $2x+2y-z=15$. [5] [CO4]

(ii) Find the shortest distance between the straight lines

$$\frac{x-3}{-3}=\frac{y-8}{1}=\frac{z-3}{-1}, \quad \frac{x+3}{3}=\frac{y+7}{-2}=\frac{z-6}{-4}$$

and the equation of the line of shortest distance. [5] [CO3]

Q5. (i) Find the equation of the cone whose vertex is at $(1,2,3)$ and the guiding curve is the circle $x^2+y^2+z^2=9$, $x+y+z=1$. [5] [CO5]

(ii) Find the equation of the straight lines in which the plane $2x+y-z=0$ cuts the cone $4x^2-y^2+3z^2=0$. Find also the angle between them. [5] [CO5]

Q6. (i) Show that the equation to the plane containing the straight line $\frac{y}{b}+\frac{z}{c}=1, x=0$ and parallel to the straight line $\frac{x}{a}-\frac{z}{c}=1, y=0$ is $\frac{x}{a}-\frac{y}{b}-\frac{z}{c}+1=0$ and if $2d$ be the shortest distance between the lines then show that $\frac{1}{d^2}=\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}$. [5] [CO3]

(ii) Determine if the origin lies inside the acute or the obtuse angle formed by the two planes $x-2y+3z-5=0$ and $2x-y-z+3=0$. [5] [CO2]

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Ist_SEMESTER **Integrated B.Sc. & M.Sc.**

END SEMESTER EXAMINATION *December-2024*

IMSMA 105 : (Abstract Algebra I)

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

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

Q.1 (a) Compute $a^{-1}ba$ given a = (134), and b = (2354) in S_9. [5] [CO1]

(b) By using mathematical induction principle prove that $2.7^n + 3.5^n - 5$ is divisible by 24, for all $n \epsilon N$. [5] [CO1]

Q.2 (a) Find the values of γ and μ so that the equations [5] [CO2]

$$2x + 3y + 5z = 9, \quad 7x + 3y - 2z = 8,$$

$$2x + 3y + \gamma z = \mu$$

have (i) no solution, (ii) a unique solution, and (iii) an infinite number of Solutions.

(b) If $A = \begin{pmatrix} 5 & 3 & 1 \\ 2 & -1 & 2 \\ 4 & 1 & 3 \end{pmatrix}$, then prove that [5] [CO2]

$A^3 - 7A^2 - 5A + 13I = 0$, and hence find A^{-1}.

Q.3 (a) If $(ab)^n = a^n b^n$ holds for 3 consecutive integer value of n. Show that G is abelian. [5] [CO3]

(b) Show that the set $G = \{f_1, f_2, f_3, f_4, f_5, f_6\}$, where [5] [CO3]

$f_1(x) = x$, $f_2(x) = 1 - x$, $f_3(x) = \frac{1}{x}$, $f_4(x) = \frac{1}{1-x}$,

$f_5(x) = \frac{x-1}{x}$, $f_6(x) =$ $\forall\, x \in R \sim \{0,1\}$

is a group w.r.t. 'composite of functions'. Is it commutative or not?

Q.4 (a) If H and K are two subgroups of a group G, then $H \cup K$ is a subgroup of G if and only if either $H \subset K$ or $K \subset H$. [5] [CO4]

OR

Show that every cyclic group is abelian. Show by an example that the converse may not be true. [5] [CO4]

(b) Prove that every subgroup of an abelian group is abelian. [5] [CO4]

Q.5 (a) Let R be a ring. Prove that $a^2 - b^2 = (a + b)(a - b)$ if and only if R is a commutative ring, for all $a, b \in R$. [5] [CO5]

OR

Every ideal of a ring R is a subring of R, but the converse need not be true. [5] [CO5]

(b) Show that the ring Z_p of integers modulo p is a field if and only if p is prime. [5] [CO5]

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Q3 (a) Check the convergence and the divergence of the integrals

(i) $\int_a^{\infty} \frac{dx}{x^p}$, a > 0 (ii) $\int_1^2 \frac{\sqrt{x}}{\log x}\, dx$.

(b) Define Gamma function $\Gamma(\alpha)$ and find the value of $\Gamma(\frac{1}{2})$. $CO_{1,4,5}$, $L_{3,4,5}$

Q4 (a) Define the beta function $\beta(m,n)$ and show that $\beta(m,n) = \Gamma(m)\Gamma(n)\backslash\Gamma(m+n)$

(b) Find the interval of convergence of the power series

$\sum_{n=1}^{\infty} \frac{x^n}{n^n}$. $CO_{1,4,5}$, $L_{3,4,5}$

Q5. (a) Show that the sequence $< f_n >$,where

$f_n(x) = x^n$ for all x in R,
$f(x) = 0$, for all x in R

converges uniformly to f on [0, k] for k <1.

(b) Change the order of integration and hence evaluate

$\int_0^1 \int_{x^2}^{2-x} xy\, dydx$. $CO_{1,4,5}$, $L_{4,5,6}$

Q6. (a) Evaluate by using spherical polar co-ordinates

$\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-x^2-y^2}} dzdydx$.

(b) Find the volume of the ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ using double integration. $CO_{1,4,5}$,$L_{3,5,6}$

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END SEM EXAMINATION Dec-2024

SEM-1 IMSMA- 107: GEC- 1

MATHEMATICS-1

Time : 3 hrs Max. Marks: 50

Attempt any 5 questions. All questions carry equal marks. Assume any missing data.

Q1. (a) Define the continuity of a function at a point c in R and use the definition to show that the function $f(x) = x$ for all x in R is continuous at c in R.

(b) Find the maximum and minimum distance of the point (3, 4, 12) from the sphere $x^2+ y^2+ z^2= 1$. $CO_{1,2}$, $L_{1,2}$

Q2. (a) Find the curvature at the point (3a\2, 3a\2) of the folium $x^3+ y^3 =3axy$.

(b) Trace the curve $x^3 + y^3 =3axy$. $CO_{1,2,3}$, $L_{12,3}$