DAY: Monday   TIME: 11:00 am TO 01:00pm

DATE: 27/05/2019   MAX MARKS: 60

Instructions: 1. All questions are compulsory.

              2. Figures to the right indicate full marks of the question.

              3. Use of a calculator or any electronic device is not allowed.

Q.1. A)   Attempt any one.   [08]

(i) State and prove the sandwich theorem for limit of function at a point.

(ii) If $\lim_{x \to p} f(x) = l$, then using $\varepsilon - \delta$ definition prove the following:

     (a) $\lim_{x \to p} |f(x)| = |l|$.   (b) $\lim_{x \to p} (\alpha f)(x) = \alpha l. \ \alpha \in \mathbb{R}$.

Q.1. B)   Attempt any two.   [12]

(i) If $\lim_{x \to p} f(x)$ exists, then show that the limit is unique.

(ii) Show that $\lim_{x \to 0} \cos \left(\frac{1}{x}\right)$ does not exist.

(iii) Draw the graph of f when (a) $f(x) = x^3$, $x \in \mathbb{R}$.   (b) $f(x) = \cos x$, $x \in [-\pi, \pi]$.

(iv) Using definition show that (a) $\lim_{x \to 0^-} \frac{1}{x} = \infty$.   (b) $\lim_{x \to \infty} x^2 = \infty$.

Q.2. A)   Attempt any one.   [08]

(i) If $f, g : I \to \mathbb{R}$ are continuous functions on I, where I is an open interval, then show that $f + g$ is continuous on I. Is the converse true? Justify your answer.

(ii) If $f : [a, b] \to \mathbb{R}$ is continuous, then prove that f is bounded.

Q.2. B)   Attempt any two.   [12]

(i) If $f : I \to \mathbb{R}$ is continuous at p, $p \in I$, I is an open interval, and $f(p) < 0$, then show that $\exists \ \delta > 0$ such that $f(x) < 0, \forall |x - p| < \delta$.

(ii) Show that $4x^3 - 7x^2 + 5 = 0$ has a real root. State the result used.

(iii) If $f : [a, b] \to \mathbb{R}$ is a continuous function and $x_1, x_2, \ldots, x_n$ are points of $[a, b]$, then show that there exists $c \in [a, b]$ such that $f(c) = \frac{f(x_1) + f(x_2) + \ldots + f(x_n)}{n}$.

(iv) Draw the graph of flooring function $f(x) = \lfloor x \rfloor$, $x \in [0, 5]$. Discuss continuity of f at p

P TO

Q.3. A) Attempt any one [06]

(i) If $f : (a, b) \to \mathbb{R}$ is differentiable at $c \in (a, b)$ and has local extremum at c, then prove that $f'(c) = 0$.

(ii) State Lagrange's mean value theorem. Hence prove that if $f : (a, b) \to \mathbb{R}$ is a differentiable function such that $\forall x \in (a, b)$ $f'(x) = 0$, then f is a constant function. Further, Give an example of a non constant function $f : A \to \mathbb{R}$, A is subset of $\mathbb{R}$ such that $\forall x \in A$ $f'(x) = 0$.

Q.3. B) Attempt any two. [12]

(i) Check the differentiability of $f : \mathbb{R} \to \mathbb{R}$ at $x = 0$, where

(a) $f(x) = \begin{cases} \frac{1}{x} \sin(x^2) & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases}$

(b) $f(x) = x|x|$.

(ii) If $y = e^x \cos x$, then prove that $y_2 - 2y_1 - 2y = 0$ and hence show that $y_{n+2} - 2y_{n+1} - 2y = 0$.

(iii) Find the intervals on which $f(x) = x + \frac{1}{x}$ is increasing or decreasing.

(iv) For $f(x) = \frac{1}{x}$, $g(x) = \frac{1}{x^2}$, $x \in [a, b]$, prove that c in the Cauchy mean value theorem is the harmonic mean of a and b.

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2

DAY: Monday   TIME: 11:00 am TO 01:00pm
DATE: 27/05/2019   MAX MARKS: 60

N.B.

- All questions are compulsory.
- Figures to the right indicate full marks.
- Symbols have usual meaning unless otherwise stated.
- Draw a neat diagram wherever necessary.
- Use of log table or non-programmable calculator is allowed.

Q.1 (A)   Attempt any ONE of the following.
  (i)   a) Determine the value of α so that
          $\vec{A} = 2\hat{\imath} - \alpha\hat{\jmath} + \hat{k}$ And $\vec{B} = \hat{\imath} + 3\hat{\jmath} - 8\hat{k}$ are perpendicular.
        b) Evaluate: 8
          $(\hat{\imath} + 2\hat{\jmath} + 3\hat{k}). (\hat{\imath} + 3\hat{\jmath} + 5\hat{k}) \times (\hat{\imath} + \hat{\jmath} + 6\hat{k})$

  (ii)   A vector $\vec{V}$ is called irrotational if $Curl\ \vec{V} = 0$
         (a) Find constants a, b and c so that
         $\vec{V} = (-4x - 3y + az)\hat{\imath} + (bx + 3y + 5z)\hat{\jmath} + (4x + cy + 3z)\hat{k}$ is irrotational.
         (b) Show that $\vec{V}$ can be expressed as the gradient of scalar function.   8

  (B)   Attempt any THREE of the following.
  (i)   Determine a unit vector perpendicular to the plane of $\vec{A} = 2\hat{\imath} - 6\hat{\jmath} - 3\hat{k}$
        and $\vec{B} = \widehat{4\imath} + 3\hat{\jmath} - \hat{k}$.   4
  (ii) Distinguish between scalar field and vector field.   4

  (iii) If $\varphi = 2xz^4 - x^2y$ find $\vec{\nabla}\varphi$ and $|\vec{\nabla}\varphi|$ at the point (2,-2,-1).   4
  (iv) Suppose $\vec{V} = \vec{\omega} \times \vec{r}$, Prove $\vec{\omega} = \frac{1}{2} curl\ \vec{V}$
        Where $\vec{\omega}$ is a constant vector.   4
  (v)   If $\vec{A} = 2yz\,\hat{\imath} - x^2y\hat{\jmath} + xz^2\hat{k}$
            $\vec{B} = x^2\hat{\imath} + yz\hat{\jmath} - xy\hat{k}$
            $\varphi = 2x^2yz^3$ Then find
            (a) $(\vec{A}.\vec{\nabla})\varphi$
            (b) $\vec{A}.\vec{\nabla}\varphi$ 4

Q.2 (A)   Attempt any ONE of the following.

  (i)   Discuss the general solution of a linear first order ordinary non homogeneous
        equation with variable coefficients by obtaining the integrating factor and
        particular integral.   8

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(ii) A series combination of a inductance (L) and a resistance (R) is connected across a source of constant emf (E). Derive the expression and draw the graph for the growth of current using differential equation $L \frac{di}{dt} + iR = \frac{E}{L}$ obtained from loop method for the above circuit.

8

(B) Attempt any THREE of the following.

(i) Solve $y'' + 6y' + 9y = 0$.

4

(ii) A charged capacitor discharges through a series resistance. Derive the expression for instantaneous charge $q_{(t)}$ when initial charge on the capacitor is $q_{(m)}$.

4

(iii) Show that the following differential equation is exact and hence find its solution :
$(5x + 3y + 7) dx + (8y + 3x + 6) dy = 0$.

4

(iv) If N is the number of radio nuclei in a sample at time t, then the rate of radio nuclei decay is proportional to N itself. The differential equation describing the radioactive decay is $\frac{dN}{dt} = -\lambda N$, where λ is called the decay constant. Solve the equation when N_0 is the initial number of radio nuclei in the sample.

4

(v) If a RL series circuit is made of L = 100 mH and R = 100 Ω connected to a 20 volts battery. Then find instantaneous current after time t = 0.02 S and t = 0.2 S.

4

Q.3 (A) Attempt any ONE of the following.

(i) The equation of resultant motion of superposition of two perpendicular SHMs of the same period is given by $\frac{x^2}{A_1^2} + \frac{y^2}{A_2^2} - \frac{2xy}{A_1 A_2} \cos \cos \delta = \delta$
where δ is the phase difference between the component motions and A_1 and A_2 their amplitudes. Draw the path traced out by the resultant oscillations using graphical method when $\delta = 0$ and $\delta = \frac{\pi}{2}$.

8

(ii) Show that the velocity of transverse waves on a string is given by $v = \sqrt{\frac{T}{\mu}}$ where T is tension in the string and μ is mass per unit length of the string. Derive an expression for the frequency of the transverse wave if the string of length L is divided in P segments.

8

(B) Attempt any THREE of the following.

(i) State and explain superposition principle.

4

(ii) A particle is subjected simultaneously to two SHMs of the same frequency and in the same direction. If their amplitudes are 5 mm and 3 mm respectively and the phase difference is 30°, find the amplitude and the phase constant of the resultant motion.

4

(iii) A flexible string of length 0.95 m is stretched by a force of 70 Newton. The mass of the string is 1.5 g. calculate the frequency of vibration of the string if it vibrates in 5 segments.

4

(iv) Define: (a) Progressive waves (b) Stationary waves (c) Transverse waves and (d) Spherical waves.

4

(v) A progressive wave propagates according to expression
$y = 0.05 \cos \cos (75 x - 4t)$ where all quantities are expressed in SI units.
Calculate: (a) frequency (b) wavelength (c) speed of wave (d) wavenumber

4

1. Attempt all questions.
2. Figures to the right indicate full marks.
3. Use of log tables or non-programmable calculators is allowed.

Q1.   Answer **any three** of the following.   [15]

A   Give postulates of "Kinetic Theory of Gases"

B   i) Define compressibility factor (z).

ii) Under ideal condition what is the value of 'z'?

iii) Calculate the value of z for 130 g of CH_4 at 273K and at pressure $150 \times 10^4 N.m^{-2}$. The volume of gas is $11.4 dm^3$.

Given: R= $8.314 J.mol^{-1}K^{-1}$, C= 12, H = 1.

C   Explain Joule Thomson effect. Show that it is isoenthalpic.

D   i) What is chemical equilibrium? Explain.

ii) What is K_P and K_C?

iii) Write K_P and K_C for reaction $A_{(g)} + B_{(g)} \leftrightharpoons C_{(g)} + D_{(g)}$

E   Explain any two factors affecting the state of equilibrium.

Q.2.   Answer **any three** of the following.   [15]

A.   Give classification of gases with suitable examples. On the basis of above classification predict the nature of H_2S gas.

B.   Discuss method of preparation of potassium dichromate paper.

C.   Explain the term solubility product with any one example.

D.   Describe Lewis concept for acids and bases with suitable example.

E.   Explain Pearson's principle of hard and soft acids and bases.

Q.3.   Answer **any three** of the following.   [15]

A.   Discuss the mechanism of chlorination of methane.

B.   What are the characteristics of aromatic compounds?

C.   Explain the mechanism of Markovnikov's addition of HX to an alkene.

D.   How will you synthesize

i) cis-2-butene from butyne

ii) cyclohexene from 1,3-butadiene.

E.   Discuss the following.

i) ozonolysis of alkene.

ii) cracking of alkanes

Q.4.   Answer any five of the following.   [15]

a)   Define: (i) ideal gas (ii) real gas (iii) average speed of gas molecules
b)   State and explain concept of entropy with appropriate example.
c)   Derive Van der Waals equation for pressure correction.
d)   Explain chromyl chloride test for confirmation of chloride ions.
e)   Describe the factors affecting the Lewis base strength.
f)   Explain poisoning of metal catalysts on the basis of HSAB concept.
g)   Label the following as aromatic/anti-aromatic/non aromatic.

i)   ii)   iii)

h)   Explain Friedel Crafts alkylation.
i)   Discuss the general mechanism of electrophilic aromatic substitution
      reaction.

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DAY: Tuesday

DATE: 28/05/2019

TIME: 11:00 am TO 01:00pm

MAX MARKS: 60

N.B.

- All questions are compulsory.
- Figures to the right indicate full marks.
- Symbols have usual meaning unless otherwise stated.
- Draw a neat diagram wherever necessary.
- Use of log table or non-programmable calculator is allowed.

Q.1 (A)   Attempt any ONE of the following.

(i)   Let $\varphi = x^2 y^3 z^6$ 8

(a) In what direction from the point P (1, 1, 1) is the directional derivative of φ a maximum?

(b) What is the magnitude of this maximum?

(ii)   Suppose $F = x^2 z + e^{\frac{y}{x}}$ and $G = 2z^2 y - xy^2$ 8

Find (a) $\vec{\nabla}(F + G)$ at the point (1, 0, -2).

(b) $\vec{\nabla}(FG)$ at the point (1, 0, -2).

(B)   Attempt any THREE of the following.

(i)   Find the area of triangle having vertices at P (1, 3, 2), Q (2,-1, 1), R (-1, 2, 3).   4

(ii)   Sketch the graph of

a) $y = x^2 - 2$

b) $y = \frac{1}{x-1}$, also state kind of symmetry exist in the above graphs.   4

(iii)   Find the angle between

$\vec{A} = 2\hat{\imath} + 2\hat{\jmath} - \hat{k}$ And $\vec{B} = 7\hat{\imath} + 24\hat{k}$.   4

(iv)   Distinguished between scalar field and vector field.   4

(v)   If $\vec{\nabla}\varphi = (y^2 - 2xyz^3)\hat{\imath} + (3 + 2xy - x^2 z^3)\hat{\jmath} + (6z^3 - 3x^2 yz^2)\hat{k}$, find φ.   4

Q.2 (A)   Attempt any ONE of the following.

(i)   A series combination of a inductance (L) and a resistance (R) is connected   8
across a source of constant emf (E). Derive the expression and draw the
graph for the growth of current using differential equation $L \frac{di}{dt} + iR = \frac{E}{L}$
obtained from loop method for the above circuit.

(ii)   Find the value of μ in the given exact differential equation and solve the   8
equation :

x (x² + 2 y²)dx + y (μ x² + 2 y²) dy = 0

(B)   Attempt any THREE of the following.

(i)   Solve $\frac{dy}{dx} + \frac{5}{x} y = x^7$ using general solution method.   4

(ii)   Discuss the decay of current in an RL circuit through which a initial current
       'i_m' is flowing. The differential equation describing the process is   4
       $L \frac{di}{dt} + iR = 0$.

(iii) Solve the equation $y'' - 14y' + 49 = 0$.   4

(iv)   Consider a body starting from rest and falling under gravity. What will be
       its velocity after t' seconds.   4

(v)   If the following equation is an exact equation, find the solution for it
       $(xy^2 + 37)dx + (x^2 y + 5)dy = 0$.   4

Q.3 (A)   Attempt any ONE of the following.
     (i)   Explain the beats phenomenon of superposition of two collinear SHM of
            slightly different frequencies. Obtain an expression of amplitude and phase   8
            constant of the resultant motion.

     (ii)   Obtain an expression for the velocity of transverse waves on a string.
            Derive an expression of frequency of transverse wave in a string of length L   8
            having P segments.

     (B)   Attempt any THREE of the following
     (i)   Differentiate between progressive waves and stationary waves.   4

     (ii)   Define group velocity (Vg) and phase velocity (Vp). Show that   4

$$V_g = V_p + k\frac{dV_p}{dK}$$

     (iii) Two collinear SHMs of same frequency acting on a particle are given by

            $X_1 = 4 \sin (\pi t + \frac{\pi}{4})$

                                                                                           4

            $X_2 = 3 \sin (\pi t + \frac{\pi}{2})$. Calculate resultant amplitude and phase
            constant. Write the equation of resultant SHM.

     (iv)   Use graphical method to draw a Lissajous figure when two mutually
            perpendicular SHMs with frequency ratio 1:2 are acting simultaneously on   4
            a particle with phase difference $\delta = \frac{\pi}{2}$.

     (v)   A flexible string of length 0.88 m is stretched by a force of 56 Newton. The
            mass of the string is 1.25 g. calculate the frequency of vibration of the
            string if it vibrates in 5 segments.   4

DAY: Tuesday

TIME: 11:00 am TO 01:00pm

DATE: 28/05/2019

MAX MARKS: 60

N.B. 1. All questions are compulsory.
    2. Use of calculator is allowed.
    3. Figures to the right indicate marks.

Q.1   Attempt any TWO sub- questions.

i)   a) Show that correlation coefficient is not affected by shift of origin and change in   (04)
         scale.
      b) Derive the formula for Spearman's rank correlation coefficient using Karl   (06)
         Pearson's correlation coefficient.

ii)   a) Explain the term "regression analysis". Show that regression coefficients are   (07)
         unaffected by shift of origin.
      b) Illustrate interpretation of different values of Karl Pearson's coefficient   (03)
         correlation(r).

iii) a) Fit a second degree polynomial curve to the following data:-   (05)

x	2	4	6	8	10
y	35	100	200	350	540

      b) What is meant by curve fitting? How will you fit $y = ab^x$?   (05)

iv)   a) Obtain the regression equation of y on x by method of least square.   (08)
      b) Explain the concept of coefficient of determination.   (02)

Q.2   Attempt any TWO sub- questions.

i)   a) What do you understand by time series? Discuss the different models used in   (05)
         time series analysis.
      b) Describe least square method of estimating trend in time series.   (05)

ii)   Explain the various components of a time series with examples.   (10)

iii) a) Explain the semi-average method with its merits and demerits.   (05)

b) Determine seasonal indices for various quarters by using simple average method (05) from the following data:-

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
2001	62	72	90	80
2002	63	70	85	74
2003	64	65	86	80
2004	63	74	84	78
2005	67	74	81	82

iv) Discuss briefly with its merits and demerits. (10)
   I) Method of moving averages   II) Least square method to estimate linear trend.

Q.3   Attempt any TWO sub-questions.

i) Explain the following price index number:- (10)
   I) Laspeyre's index number
   II) Paasche's index number
   III) Fisher's Index number
   IV) Dorbisch - Bowley's index number
   V) Marshall - Edgeworth's index number

ii) a) Explain what is meant by I) Fixed base index number II) Chain base index (05)
   number.
   b) Verify whether Marshall - Edgeworth's index number satisfies factor reversal test. (05)

iii) a) Calculate Cost of living index number by using I) Family budget method (05)
   II) Aggregate expenditure method.

Commodity	Base Price	Base Quantity	Current Price	Weight
A	20	12	18	3
B	22	15	15	6
C	13	13	24	7
D	24	18	36	4

b) Write short notes on :- (05)
   I) Splicing on index number series
   II) Time reversal test

iv) Explain time reversal test and show that Laspeyre's and Paasche's index number do (10) not satisfy time reversal test but Fisher's index number satisfies time reversal test.

********** End**********

DAY: Tuesday

DATE: 28/05/2019

TIME: 11:00 am TO 01:00pm

MAX MARKS: 60

NOTE: 1. All questions are compulsory
      2. Figures to the right indicate full marks
      3. Draw neat and labeled diagram wherever necessary.

Q.1 Answer the following.
   a) Explain briefly, the salient features of sub-phylum Cephalochordata   (08)
   b) Give an account of general features of class Osteichthyes.   (07)
                                    OR
Q.1 Write notes on: (15)

   a) Class Enteropneusta
   b) Class Larvacea
   c) Sub-phylum Vertebrata

Q.2 Answer the following.
   a) Define Mutualism. Discuss types of mutualism with examples.   (08)
   b) Define food chain. Describe any one type of food chain with examples.   (07)
                                 OR
Q.2 Explain the following.   (15)
   a) Age structure
   b) J-shaped survivorship curve
   c) Concept of Niche

Q.3 Answer the following.
   a) Explain Pavlov's conditioned reflex experiment.   (08)
   b) Give an account on fixed action plan in ethology.   (07)

                     OR
Q.3 Discuss the following: (15)
   a) Adaptive and evolutionary significance of mimicry
   b) Instrumental learning
   c) Camouflage- as protective behaviour

Q.4 Write notes on :   (15)

   a) Characters of class Amphibia   OR   a) Features of class Mammalia

   b) S-shaped survivorship curve   OR   b) Antibiosis

   c) Mullerian mimicry   OR   c) Types of taxes in behaviour

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DAY: Wednesday   TIME: 11:00 am TO 01:00pm

DATE: 29/05/2019   MAX MARKS: 60

N.B. : 1. All questions are compulsory.
   2. Figures to the right indicate full marks.
   3. Use of logarithmic table/ non-programmable calculator is allowed.

1. Answer **any three** of the following: [15]

   A. Define the term degree of ionization. What are the factors that affect the degree of ionization ?
   B. Derive the Henderson's equation for basic buffer.
   C. Explain the different types of interactions of electromagnetic radiations with matter.
   D. Calculate the frequency, wave number and energy associated with a radiationhaving $\lambda = 525$ nm ($c = 3 \times 10^8$ ms^{-1}, $h = 6.62 \times 10^{-34}$Js).
   E. Differentiate between amorphous and crystalline solids.
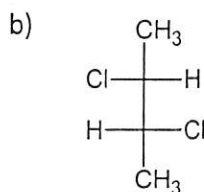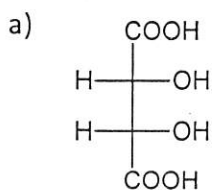
2. Answer **any three** of the following: [15]

   A. Explain the application of VSEPR theory for predicting the shape and bond angle in XeF_2.
   B. Explain any two factors that favour covalent character in an ionic compound.
   C. What is an ionic bond ? Mention the general characteristics of ionic bonds and ionic compounds.
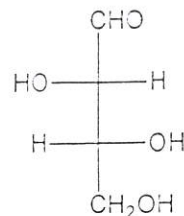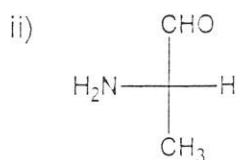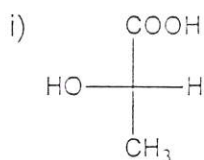   D. With stepwise explanation, balance the following redox reaction:
   $$Cr_2O_7^{2-} + C_2O_4^{2-} + H^+ \leftrightarrow Cr^{3+} + CO_2 + H_2O$$
   E. 25.0 cm^3 of 0.5M Fe^{2+} solution is titrated against 0.5M Ce^{4+} solution. Calculate the emf of the system when (a) 20.0 cm^3 & (b) 25.0 cm^3 of Ce^{4+} solution is added from a burette.(Given: $E^0_{Fe3+/Fe2+} = + 0.77$ V & $E^0_{Ce4+/Ce3+} = + 1.44$ V).

3. Answer **any three** of the following: [15]

   A. Draw different conformations of ethane using saw-horse and Newmann projection formulae. Discuss their relative stabilities.
   B. Convert the following structures to Newmann and saw-horse projection formulae.

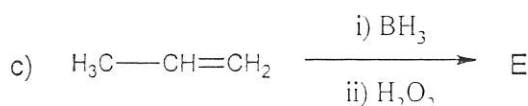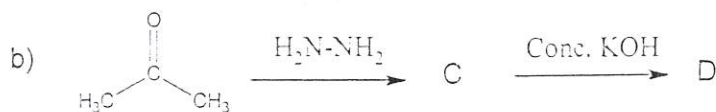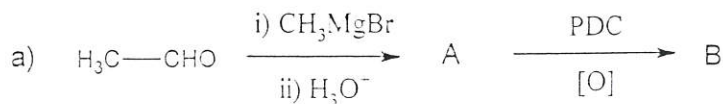C. a) Assign D/L nomenclature to the following compounds

i)
```
        COOH
         |
  HO ——|—— H
         |
        CH₃
```

ii)
```
        CHO
         |
 H₂N ——|—— H
         |
        CH₃
```

iii)
```
        CHO
         |
  HO ——|—— H
         |
   H ——|—— OH
         |
       CH₂OH
```

b) Draw the geometrical isomers of 1,2-dimethylcyclopropane.

D. How will you convert
   a) Ethyl chloride to propan-1-amine
   b) Propionic acid to ethylamine
   c) Calcium propionate to pentan-3-one

E. Complete the following reactions

a) H_3C-CHO $\xrightarrow[\text{ii) } H_2O^-]{\text{i) } CH_3MgBr}$ A $\xrightarrow[\text{[O]}]{\text{PDC}}$ B

b)
$$\text{(acetone)} \xrightarrow{H_2N\text{-}NH_2} C \xrightarrow{\text{Conc. KOH}} D$$

c) $H_3C-CH=CH_2$ $\xrightarrow[\text{ii) } H_2O_2]{\text{i) } BH_3}$ E
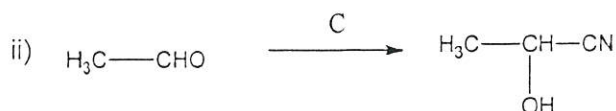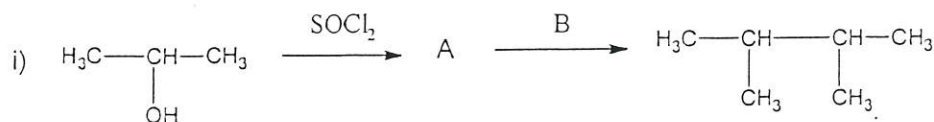
4. Answer any five of the following: [15]

a. Calculate the degree of ionization of 0.2 M solution of hydrocyanic acid, HCN. ($K_a = 4.9 \times 10^{-10}$)

b. Explain the Planck's theory of quantization of energy of radiations.

c. Determine the Miller indices of the following crystal planes whose intercepts are as follows (i) 2a, 3b, 3c (ii) a/2, 2b, ∞.

d. What are isoelectronic species? Justify whether N_3^- & CO_2 are isoelectronic or not.

e. Draw the Lewis dot structures of NH_3 and CCl_4.

f. Construct the Latimer diagram for Manganese and calculate E^0 for $MnO_4^- + 3e^- \rightarrow MnO_2$. (Given : $E^0 = +0.56$ V for $MnO_4^- + e^- \rightarrow MnO_4^{2-}$ & $E^0 = +2.66$ V for $MnO_4^{2-} + 2e^- \rightarrow MnO_2$).

g. Explain in brief the erythro and threo nomenclature.

h. How will you convert :
   i)   n-propyl alcohol to isopropyl alcohol
   ii) acetaldehyde to acetaldoxime

i. Complete the following reactions :

i)
```
        H₃C——CH—CH₃
             |
             OH
```
$\xrightarrow{SOCl_2}$ A $\xrightarrow{B}$
```
   H₃C—CH———CH—CH₃
        |        |
       CH₃      CH₃
```

ii) H_3C-CHO $\xrightarrow{C}$
```
   H₃C—CH—CN
        |
        OH
```

****

DAY: Wednesday   TIME: 11:00 am TO 01:00pm
DATE: 29/05/2019   MAX MARKS: 60

Instructions: All questions are compulsory.
                    Figures to the right indicate full marks of the question.

Q.1 A   Attempt ANY ONE from the following: [08]
     (i)   (a) Prove that any consistent system with more variables than
               equations has infinitely many solutions.
            (b) Prove that any linear system has no solutions, unique solution or
               infinitely many solutions.
     (ii)   (a) Prove that every elementary matrix is invertible and its inverse is
               also an elementary matrix.
            (b) Prove that if A is invertible then AX = B has unique solution.

     B   Attempt ANY TWO from the following: [12]
     (i)   Using Gaussian elimination method determine the solution set of the
            following and describe the solution set geometrically:
            $3x + 4y − 5z = 0$; $x + 2y − 3z = 0$; $4x + 6y -8z = 0$; $x + y − z = 0$.
     (ii)   Determine the conditions, if any, on a and b in order to guarantee that
            the following linear system has no solutions, unique solution or
            infinitely many solutions:
            (p) $3x + 4y = a$; $-2x + y = b$
            (q) $6x − 2y = a$; $3x − y = b$
     (iii) Express the matrix $\begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$ and its inverse as a product of elementary
            matrices.
     (iv)   Prove that the sequence of row operations which transforms a square
            matrix A to the identity matrix I will give A^{-1} if they are applied to I in
            the same order.

Q.2 A   Attempt ANY ONE from the following: [08]
     (i)   Let $V = \{(x, y) \mid x, y \in \mathbb{R}\}$. The vector addition is defined by
            $(x_1, y_1) + (x_2, y_2) = (x_1 + x_2, y_1 + y_2)$ where $x_1, x_2, y_1, y_2 \in \mathbb{R}$.
            Verify all properties of vector addition for vector space V over $\mathbb{R}$.

(ii)　(a) Define Linearly dependent and Linearly Independent set.

(b) Prove that in a real vector space superset of a linearly dependent set is linearly dependent.

B　Attempt ANY TWO from the following:　　　　　　　　　　[12]

(i)　Let $W = \{ (x, y, z) \mid 3x + y - z = 1 \text{ and } x, y, z \in \mathbb{R} \}$ be a subset of $\mathbb{R}^3$. Prove that W is a subspace of $\mathbb{R}^3$.

(ii)　Let $(V, +, .)$ be a real vector space with $\bar{0}$ as additive identity in V. Let $x, y, z \in V$ and $\alpha \in \mathbb{R}$ then prove that

(i) $x + y = x + z \Rightarrow y = z$

(ii) $\alpha . \bar{0} = \bar{0}$

(iii) $0 . x = \bar{0}$

(iii) $\alpha . x = \bar{0} \Rightarrow \alpha = 0 \text{ or } x = \bar{0}$

(iii)　(a) Find $L(S)$ for $S = \left\{ \begin{pmatrix} -1 & 3 \\ 2 & 1 \end{pmatrix}, \begin{pmatrix} 2 & 1 \\ 4 & -1 \end{pmatrix} \right\}$ in $\mathcal{M}_{2 \times 2}(\mathbb{R})$

(b) Check whether $v = (-1, -4) \in L(S)$ where $S = \{ (1, -3), (4,6) \}$ in $\mathbb{R}^2$

(iv)　In a real vector space $\mathbb{R}^3$, for $v_1 = (1,0,1)$, $v_2 = (-1,1,0)$ and $v_3 = (0,1,1)$ prove that $L(\{v_1, v_2\}) = L(\{v_2, v_3\})$

Q.3　A　Attempt ANY ONE from the following:　　　　　　　　[08]

(i)　Let $(V, +, .)$ be a real vector space and $B = \{v_1, v_2, ..., v_n\}$ be a subset of V. Then prove that B is a basis of V if and only if B is a maximal linearly independent set in V.

(ii)　Let $(V, +, .)$ be a finitely generated real vector space with $dim V = n$. Let $S = \{v_1, v_2, ..., v_t\}$ where $t < n$, be a linearly independent subset of V, then prove that S can be extended to form a basis of V

B　Attempt ANY TWO from the following:　　　　　　　　[12]

(i)　Find the basis and dimension of subspace $W = \{ a + bx + cx^2 + dx^3 \mid a, b, c, d \in \mathbb{R}, 2a + b = 0 \ \& \ b - 2c = 0 \}$ of a real vector space $P_3(x)$, Where $P_3(x)$=Set of all real polynomials of degree≤ 3.

(ii)　Is the set $S = \{(1,2,0)\}$ linearly independent. Justify your answer. If S is linearly independent then extend it to a basis of $\mathbb{R}^3$.

(iii)　Prove that any two basis of a finitely generated vector space have same number of elements.

(iv)　Prove that elementary row operations preserve column rank of a matrix.

***** End *****

FYBSc   S E M E S T E R - I I   ADDI. CUM SUPPL. EXAMINATION – MAY- 2019
SUBJECT : MATHEMATICS - II

DAY: Thursday   TIME: 11:00 am TO 01:00pm
DATE: 30/05/2019   MAX MARKS: 60

Instructions: All questions are compulsory.
              Figures to the right indicate full marks of the question.

Q.1 A   Attempt ANY ONE from the following: [08]
     (i)   (a) Prove that if S and T are solutions of a homogeneous system then
              αS + βT is also a solution of the system for any real numbers α and β.
           (b) Prove that any linear system has no solutions, unique solution or
              infinitely many solutions.
     (ii) Define an invertible matrix and prove that
           (a) inverse of a matrix, if exists, is unique.
           (b) product of two invertible matrices is invertible.

     B   Attempt ANY TWO from the following: [12]
     (i)   Using Gaussian elimination method determine the solution set of the
           following and describe the solution set geometrically:
           x + 5y − 3z = 0; x + 2y − 3z = 0; 2x + 7y -6z = 0; x + 8y − 3z = 0.
     (ii) Determine the conditions, if any, on a and b in order to guarantee that
           the following linear system has no solutions, unique solution or infinitely
           many solutions:
           (p) x + 3y = a; -2x + y = b
           (q) 6x − 4y = a; 3x − 2y = b
     (iii) Express the matrix $\begin{bmatrix} -3 & 1 \\ 2 & 2 \end{bmatrix}$ and its inverse as a product of elementary
           matrices.
     (iv) Solve the following system by finding inverse of the coefficient matrix
           using elementary row operations:
           2x − y + 3z = 6; x − 2y + z = 7; y + 4z = 0.

Q.2 A   Attempt ANY ONE from the following: [08]
     (i)   Let $V = \{ a_0 + a_1 x + a_2 x^2 + a_3 x^3 \mid a_i \in \mathbb{R}, i = 0,1,2,3\}$. The vector
           addition is defined by $\sum_{i=0}^{3} a_i x^i + \sum_{i=0}^{3} b_i x^i = \sum_{i=0}^{3}(a_i + b_i)x^i$, for
           every $a_i, \ b_i \in \mathbb{R}$. Verify all properties of vector addition for vector
           space V over $\mathbb{R}$.
     (ii) Let $(V, +, .)$ be a real vector space and W_1, W_2 be two subspaces of
           V, then
           (a) Prove that $W_1 \cap W_2$ is a subspace of V.
           (b) Prove or disprove that $W_1 \cup W_2$ is a subspace of V.

B Attempt ANY TWO from the following: [12]

(i) Let $W = \left\{ \begin{pmatrix} a & b \\ c & d \end{pmatrix} \mid a + d = 0 , \ b + c = 0 \text{ and } a, b, c, d \in \mathbb{R} \right\}$ be a subset of a real vector space $M_{2 \times 2}(\mathbb{R})$. Prove that W is a subspace of $M_{2 \times 2}(\mathbb{R})$.

(ii) Let $(V, +, .)$ be a real vector space with $\overline{0}$ as additive identity in V. Let $x, y, z \in V$ and $\alpha \in \mathbb{R}$ then prove that
   (i) $x + y = x + z \ \Rightarrow \ y = z$
   (ii) $x + x = x \ \Rightarrow \ x = \overline{0}$
   (iii) $\alpha . \overline{0} = \overline{0}$
   (iv) $0 . x = \overline{0}$

(iii) (a) Find $L(S)$ for $S = \{(1, -1), (3, 1)\}$ in $\mathbb{R}^2$
   (b) Check whether $v = 2 + x^2 \in L(S)$ where
       $S = \{ -2 + 4x, \ 6 - x + x^2 \}$ in $P[x]$

(iv) In a real vector space V,
   (a) if $v_1 = 2v_2 - 3v_3$ then check whether $\{v_1, v_2, v_3\}$ is linearly dependent or linearly independent.
   (b) Let S and T be finite subsets of V such that $S \subseteq T$. Prove that $L(S) \subseteq L(T)$

Q.3 A Attempt ANY ONE from the following: [03]

(i) Let $(V, +, .)$ be a real vector space and $B = \{v_1, v_2, \ldots, v_n\}$ be a basis of V. Then prove that B is a basis of V if and only if every vector in V can be uniquely expressed as a linear combination of elements of B.

(ii) Let $(V, +, .)$ be a real vector space and $B = \{v_1, v_2, \ldots, v_n\}$ be a subset of V. Then prove that B is a basis of V if and only if B is a minimal generating set of V.

B Attempt ANY TWO from the following: [12]

(i) Find the basis and dimension of
   $W = \{ (x, y, z) \mid x, y, z \in \mathbb{R}, 2x + y - z = 0 \text{ and } -8x + y - 3z = 0\}$

(ii) Let set $S = \{(1, 1), (-1, 2), (5, 0)\}$ be a subset of $\mathbb{R}^2$. Find a subset of S which forms a basis of $\mathbb{R}^2$.

(iii) Is $S = \{ 1 + x \}$ linearly independent. Justify your answer. If S is linearly independent then extend S to form a basis of $P_2[x]$=Set of all real polynomials in x of degree ≤ 2

(iv) Let A be any matrix, prove that row rank of A = column rank of A.

***** *End* *****

DAY: Thursday

DATE: 30/05/2019

TIME: 11:00 am TO 01:00pm

MAX MARKS: 60

N.B.   1.   All questions are compulsory
      2.   Figures to the right indicate full marks
      3.   Use of non-programmable calculator is permitted
      4.   Symbols have their usual meanings unless otherwise stated.

Q. 1   A   Attempt ANY ONE.   8 M
    i.   A sinusoidal voltage is applied across a series LCR combination. Derive an expression for the total impedance and the current through the circuit. Draw the phasor diagram when the inductive reactance is greater than the capacitative reactance.
    ii.   Which AC bridge is used to find the unknown inductance in terms of the known capacitance? Obtain the condition of balance. On which principle it works?

    B   Attempt ANY THREE.   12 M
    i.   A 50 mH inductance is in series with a 50 Ω resistance and an AC voltage source of frequency 1000 Hz. The input voltage is 2 volt peak. Find the circuit impedance and the r.m.s current.
    ii.   In a Wien's bridge, if R_1= 1kΩ R_2 = 2kΩ C_1=C_2= 0.22µF and R_4= 2.2kΩ. Find the value of R_3 to balance the bridge and the frequency of the AC input voltage.
    iii.   A coil of 10 Ω resistance has an inductance 0.01 H is connected in series with a capacitor across 200 V mains. What must be the capacitance in order that maximum current occurs at frequency of 50 Hz? Find also the current and the voltage across the capacitor.
    iv.   Define half power frequencies in resonance.
    v.   Obtain the condition of balance for DeSauty's bridge.

Q. 2   A   Attempt ANY ONE.   08 M
    i.   State and prove reciprocity theorem with the help of a suitable network.

    ii.   Obtain the expressions for efficiency and ripple factors for a full wave bridge rectifier.

    B   Attempt ANY THREE.   12 M
    i.   Define ac current amplification factors α and β for CB and CE configurations respectively for a transistor amplifier. Hence, obtain relation between them.
    ii.   Determine the maximum power that can be delivered to a load by the following circuit:

P.T.O.
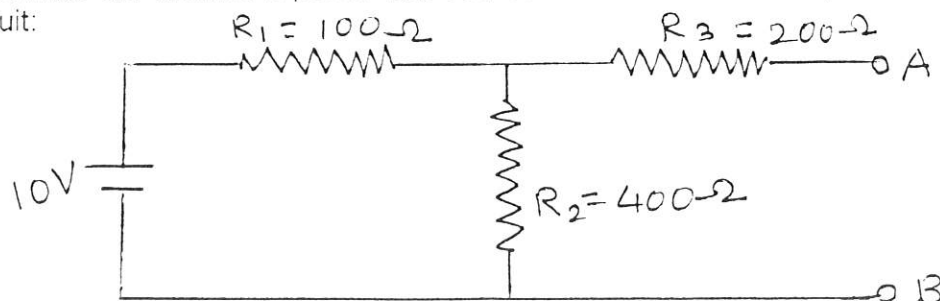
iii. In a bridge rectifier without filter, each diode has forward resistance 4Ω. The input ac voltage from secondary of transformer is $50\sin314t$. If the load resistance is $1K\Omega$, find the percentage efficiency of a rectifier.

iv. Explain, why NAND and NOR gates are known as universal building blocks. Hence, discuss NOR gate as a OR gate.

v. State the following theorems for the electrical networks:
a) Superposition theorem.　　b) Norton's theorem.

Q. 3　A　Attempt ANY ONE.　　　　　　　　　　　　　　　　　　　03 M

i. Derive the expression for the potential energy of a discrete point charge distribution.

ii. What are Helmholtz coils? Draw a neat diagram. Show that the uniform magnetic field is produced midway between the coils, when the coils are separated by a distance equal to the radius of either coil.

B　Attempt ANY THREE.　　　　　　　　　　　　　　　　　　　12 M

i. A circular coil has a radius of 0.05 m and has 90 turns. It carries a current of 0.23 A. Find the magnetic field at a point. distance 0.1 m from the centre. Given: $\mu_0 = 4\pi \times 10^{-7}$ S.I. units.

ii. State and explain Biot-Savart's law.

iii. Calculate the potential energy stored in the system of 3 point charges (-80 µC, 20 µC, 10 µC), placed at the corners of a triangle with equal sides of 1.5 m. Given: $\varepsilon_0 = 8.85 \times 10^{-12}$ S.I. units.

iv. Obtain the expression for the work done to move a point charge, from point A to point B, in an electric field of intensity $\overline{E}$.

v. What is Solenoid? Draw a neat diagram.

******Best of Luck******

DAY: Thursday

DATE: 30/05/2019

TIME: 11:00 am TO 01:00pm

MAX MARKS: 60

N.B. :   1. All questions are compulsory.

2. Figures to the right indicate full marks.

3. Use of logarithmic table/ non-programmable calculator is allowed.

1. Answer **any three** of the following: [15]

A. Derive the Henderson's equation for acidic buffer.

B. Calculate the pH of a buffer solution containing 0.1 M each of NH_4OH and NH_4Cl. ($K_b = 1.8 \times 10^{-5}$). What will be the change in pH on adding 10 ml of 0.01 M HCl to 1 L of buffer solution?

C. Explain the mechanism by which a buffer solution tries to maintain its pH.

D. A substance absorbs radiation of $\lambda = 600$ nm. Calculate the frequency and wave number of the absorbed radiation. ($c = 3 \times 10^8$ ms^{-1}, $h = 6.62 \times 10^{-34}$ Js)

E. State and explain the three laws of crystallography.

2. Answer **any three** of the following: [15]

A. Showing all the steps, balance the following redox reaction occurring in alkaline medium. $MnO_4^- + C_2O_4^{2-} \rightarrow MnO_4^{2-} + CO_3^{2-}$

B. Construct the Latimer diagram for Thallium and calculate E^0 & ΔG^0 for $Tl^+ + e^- \rightarrow Tl$. (Given : $E^0 = +1.25$ V for $Tl^{3+} + 2e^- \rightarrow Tl^+$ & $E^0 = +0.72V$ for $Tl^{3+} + 3e^- \rightarrow Tl$).

C. Applying VSEPR theory, predict the shape and bond angle in XeF_4.

D. Discuss the effects of charge and size of the ions on the covalent character in ionic compounds.

E. a) Write a note on dative bond.

b) Distinguish between iodometry and iodimetry.

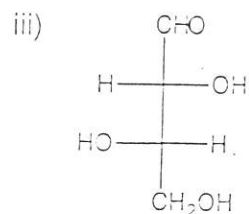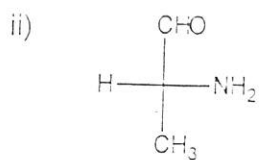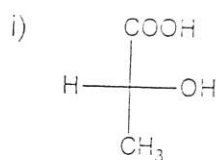3. Answer **any three** of the following: [15]

A. Draw different conformations of propane using saw-horse and Newmann projection formulae. Discuss their relative stabilities.

B. Convert the following structures to Newmann and Fischer projection formulae
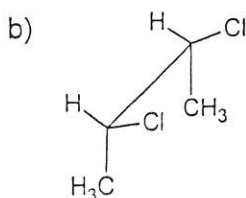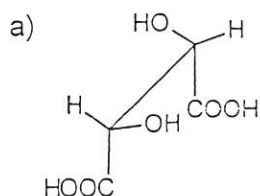
C. a) Assign D/L nomenclature to the following compounds

i)
```
        COOH
         |
   H ————— OH
         |
        CH₃
```

ii)
```
        CHO
         |
   H ————— NH₂
         |
        CH₃
```

iii)
```
        CHO
         |
   H ————— OH
         |
   HO ———— H
         |
        CH₂OH
```

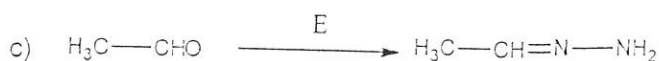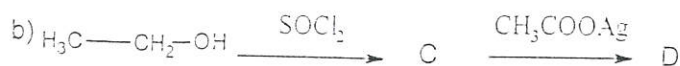b) Draw the geometrical isomers of 1,3-dimethylcyclobutane.

D. How will you convert

    a) 2-bromopropane to propan-1-ol

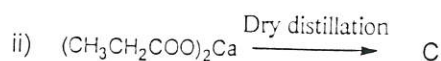   b) Acetone to propane

    c) Butan-2-amine to butan-2-ol

E. Complete the following reactions

a)
$$H_3C-\underset{\underset{Cl}{|}}{HC}-CH_2-CH_3 \xrightarrow[]{\text{Alcoholic KOH}} A \xrightarrow[\text{ii) Zn, H}_2\text{O}]{\text{i) O}_3} B$$

b)
$$H_3C-CH_2-OH \xrightarrow[]{SOCl_2} C \xrightarrow[]{CH_3COOAg} D$$

c)
$$H_3C-CHO \xrightarrow[]{E} H_3C-CH=N-NH_2$$

4. Answer any five of the following: [15]

    a. Deduce the expression for ionic product of water.

    b. Draw a neat and labelled diagram of different energy levels.

    c. Determine the Miller indices of the following crystal planes whose intercepts are as follows (i) a, 2b, 2c (ii) ∞, ∞, c/2.

    d. What are isoelectronic species? Justify whether PO_4^{3-} & SO_4^{2-} are isoelectronic or not.

    e. Calculate the emf of the system when 25.0 cm³ of 0.01M Ce^{4+} solution is added from a burette to 20 cm³ of 0.01M Fe^{2+} solution. (Given: $E^0_{Fe3+/Fe2+}$ = + 0.77 V & $E^0_{Ce4+/Ce3+}$ = + 1.44 V).

    f. Define the following :

        (i)   electrochemical series

        (ii)   covalency of an element

        (iii) redox titration curve

    g. Complete the following reactions :

i)
$$H_3C-CH_2-Cl \xrightarrow[]{\text{Alc. KCN}} A \xrightarrow[]{\text{Na + ethanol}} B$$

ii)
$$(CH_3CH_2COO)_2Ca \xrightarrow[]{\text{Dry distillation}} C$$
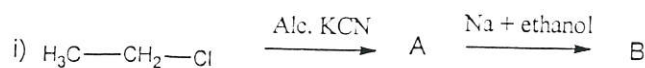
    h. How will you convert

        (i)   Ethyl chloride to N-methylethanamine

        (ii)   acetone to acetone oxime

    i. Draw the erythro and threo forms of tartaric acid.

****

DAY: FRIDAY   TIME: 11:00 am TO 1:00pm

DATE: 31/05/2019   MAX MARKS: 60

N.B. (1) All questions are compulsory.

(2) Figure to the right indicate marks.

Q.1   Attempt any <u>TWO</u> sub questions: 20

(a) (i) Define continuous random variable. Give some examples.

(ii) Define cumulative distribution function (c.d.f.) for continuous random variable. State its important properties.

(iii) Let X be a random variable with p.d.f.

$f(x) = kx^3$; $0 < x < 1$

     $= 0$; otherwise

Find k.

(b) If X is continuous random variable then define

(i) r^{th} raw moment about zero (ii) r^{th} central moment (iii) mean

(iv) variance (v) median.

(c) (i) State Important properties of probability distribution of continuous random variable.

(ii) What is $P(a < x < b)$ in terms of cumulative distribution function of continuous random variable.

(iii) Find cumulative distribution function of a random variable X having probability density function given by,

$f(x) = x$; $0 < x < 1$

     $= 2 - x$; $1 \leq x < 2$

     $= 0$; otherwise

(d) (i) The probability density function of a continuous random variable is given by,

$f(x) = 6x(1-x)$; $0 < x < 1$

     $= 0$; otherwise

Find mean, variance and $P(0 < x < 0.5)$.

(ii) " A continuous random variable assumes finitely many values ". State true or false with reason.

(iii) For a continuous random variable X, in usual notation prove that

$V(ax + b) = a^2 V(x)$, where a and b are constants.

P.T.O.

Q.2   Attempt any TWO sub-question: 20

(a)   (i) Define rectangular (Uniform) distribution and derive its mean and variance.

(ii) "mean and median of rectangular distribution is same". State true or false with reason.

(b)   (i) Define exponential distribution with parameter m. Obtain an expression for mean and median of the distribution.

(ii) State and prove memory less property of exponential distribution.

(c)   Define normal probability distribution. State important properties of normal distribution.

(d)   (i) Define standard normal variable. Explain graph of standard normal distribution.

(ii) State the condition when Binomial distribution can be approximated to Normal distribution.

(iii) Under what condition Poisson distribution can be approximated to Normal distribution.

Q.3   Attempt any TWO sub- question: 20

(a)   (i) Define (I) Population (II) Sample (III)Estimate (IV) Statistic.
       (ii) State central limit theorem (C.L.T).

(b)   (i) Explain Sampling distribution of sample proportion.
       (ii) State confidence interval for population mean 'μ'.

(c)   (i) Define (I) Null and Alternative hypothesis (II) Critical region .
       (ii) Let x>1 be the critical region for testing $H_0 : \theta = 2$ Vs $H_1 : \theta = 1$ on the basis of a single observation from the population having Probability distribution function,
       $f(x , \theta) = \theta e^{-\theta x}$; x > 0
                      = 0   ; otherwise
       Obtain the value of the size of type I and type II error.

(d)   Explain the procedure to test H_0: $P=P_0$ (specified) considering alternative hypothesis as (i) $H_1 : P > P_0$ (ii) $H_1 : P < P_0$ (III) $H_1 : P \neq P_0$ based on large sample at level of significance α .

DAY: FRIDAY   TIME: 11:00 am TO 1:00pm
DATE: 31/05/2019   MAX MARKS: 60

N.B.   1.   All questions are compulsory
        2.   Figures to the right indicate full marks
        3.   Use of non-programmable calculator is permitted
        4.   Symbols have their usual meanings unless otherwise stated.

Q. 1   A   Attempt **ANY ONE**.   8 M
        i.   Find the condition of balance for Wien's bridge. How would you determine the
              frequency of the AC supply?
        ii.   A sinusoidal voltage is applied across a series CR combination. Derive an
              expression for the total impedance and the current through the circuit. Draw the
              phasor diagram.

        B   Attempt **ANY THREE**.   12 M
        i.   In a series CR circuit, the supply voltage is 10 V and the current is 2 mA. The
              voltage across R is 8V. If supply frequency is 50 Hz, find R, C and phase
              difference.
        ii.   In a DeSauty's bridge, the balance condition is obtained when $R_1 = 800\Omega$, $R_2 =$
              1200Ω, and $C_1 = 0.47\mu F$, Find the value of the other capacitor.

        iii. In a Wien's bridge, if $R_1 = R_2 = 1k\Omega$, $R_4 = 1k\Omega$ $C_1 = 0.1\mu F$ $C_2 = 0.2\mu F$. Find the value
              of R_3 to balance the bridge and the frequency of the applied AC voltage.
        iv.   In an AC bridge $\hat{Z}_1$ is a pure inductance, $\hat{Z}_2$ a purecapacitance, $\hat{Z}_3$ and $\hat{Z}_4$ are pure
              resistances. Can the bridge be balanced?
        v.   In a series LCR circuit discuss the condition of resonance. Find the resonance
              frequency.

Q. 2   A   Attempt **ANY ONE**.   08 M
        i.   State and prove maximum power transfer theorem. Obtain an expression for
              maximum power delivered to the load.
        ii.   Discuss the construction and operation of full wave bridge rectifier. State its
              advantages over centre-tap full wave rectifier.

        B   Attempt **ANY THREE**.   12M
        i.   Obtain an expression for efficiency of full wave bridge rectifier.
        ii.   For a transistor as an amplifier, draw the diagrams of various configurations.
              Define current amplification factors (β_{dc} and β_{ac}).
        iii. State and explain De Morgan's first theorem.
        iv.   What is the role of filter circuits in a rectifier? Explain any one of them.

        v.   Determine Thevenin's equivalent of the following circuit. Hence find the load
              voltage and load current.
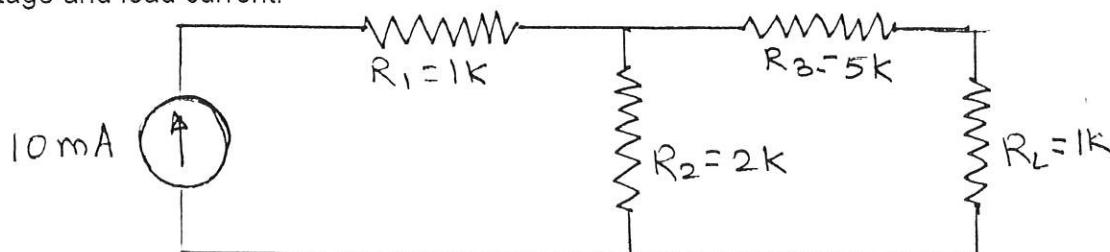
Q. 3 **A** Attempt **ANY ONE.**   08 M

i. Derive the expression for the magnetic field at a point on the axis of a circular loop carrying current. Also, obtain the expression for the magnetic field at the centre of the loop.

ii. Show that the potential energy in a system of N discrete point charges is given by

$$W = \frac{1}{2} \sum_{i=1}^{N} q_i V(r_i)$$

B Attempt **ANY THREE.**   12 M

i. What are Helmholtz coils? Draw a neat diagram. Write the expression for the total magnetic field at the axial point, at certain distance from the first coil.

ii. A very long solenoid of length 110 cm and of radius 0.01 m, has 800 turns. It carries a current of 0.5 A. Calculate the magnetic field at

(a) the midpoint of the solenoid.

(b) endpoint of the solenoid.

Given: $\mu_0 = 4\pi \times 10^{-7}$ S.I. units

iii. Define the term 'Potential difference between two points'.
The work done to move a charge of 12 µC from point A to point B, is 60 µJ.
Find the potential difference between two points A and B.
Which point is at a higher potential?

iv. Define electric field intensity $(\vec{E})$. Obtain the expression for electric field at a point due to the system of discrete point charges.

v. State and explain Coulomb's law. Also, briefly explain the principle of superposition of forces in electrostatics.

******Best of Luck******

DAY: FRIDAY   TIME: 11:00 am TO 1:00pm
DATE: 31/05/2019   MAX MARKS: 60

NOTE:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw neat and labeled diagrams wherever necessary.

Q1. Answer the following.
   a) Give an account of water soluble vitamins.   (08)
   b) Give a brief account of amino acids.   (07)

OR

Q1. Answer the following
   a) Write an explanatory note on glycerides.   (05)
   b) Describe the biological role of vitamin A and its deficiency. (05)
   c) Describe the quaternary structure of proteins.   (05)

Q2. Answer the following.
   a) Define health and add a note on factors that influence health. (08)
   b) Describe WHO programme on smallpox eradication.   (07)

OR

Q2. Write short notes on the following
   a) Standards of potable water.   (05)
   b) First aid   (05)
   c) Leprosy.   (05)

Q3. Answer the following.
   a) Give an account of principle and working of pH meter.   (08)
   b) Describe in detail the thin layer chromatography.   (07)

OR

Q3. Write short notes on the following;
   a) Laminar airflow.   (05)
   b) Chemicals and procedure for PAGE   (05)
   c) Analytical balance.   (05)

Q4. Write short notes on the following

   a) Biological functions of vitamin E   OR   a) Complex lipids.   (05)
   b) Water footprint   OR   b) Ill effects of self medications   (05)
   c) Working of a Colorimeter   OR   c) Working of a Centrifuge   (05)

DAY: SATURDAY   TIME: 11:00 am TO 1:00pm
DATE: 01/06/2019   MAX MARKS: 60

Note: 1. Attempt all question
           2. All questions are compulsory.
           3. All questions have internal choice.

Q.1.   Explain the concept of Privatisation and discuss its causes and   (15)
        consequences on Indian economy.
                                    OR
Q.1.   Discuss the problem of farmer suicide in India.   (15)

Q.2.   Explain in brief the articles of the Universal Declaration of Human Rights   (15)
        (UDHR).
                                    OR
Q.2.   Describe Right to Equality in detail.   (15)

Q.3.   Explain the term Environment? Discuss use of environment in daily life   (15)
        (Eco-tips).
                                    OR
Q.3.   Write a detail note on Poverty and Environment.   (15)

Q.4.   Explain In detail, significance of ethics in individual development toward   (15)
        building of peace and harmony in society.
                                    OR
Q.4.   Define stress and discuss important strategies to minimise stress.   (15)

Instructions: 1. All questions are compulsory.

2. Figures to the right indicate full marks of the question.

3. Use of a calculator or any electronic device is not allowed.

Q.1. A)   Attempt any **one**.   [08]

(i) Using $\varepsilon - \delta$ definition show that $\lim_{x \to p}(f + g)(x) = \lim_{x \to p} f(x) + \lim_{x \to p} g(x)$, whenever $\lim_{x \to p} f(x)$ and $\lim_{x \to p} g(x)$ exist.

(ii) Prove that $\lim_{x \to p} f(x) = l$ if and only if for all sequences $(x_n) \to p$, $x_n \neq p$, the corresponding sequences $\big(f(x_n)\big) \to l$.

Q.1. B)   Attempt any **two**.   [12]

(i) If $\lim_{x \to p} f(x) = l$, then show that f is bounded on some deleted neighborhood of p.

(ii) Show that $\lim_{x \to 0} x^2 \cos\left(\frac{1}{x}\right) = 0$, using $\varepsilon - \delta$ definition.

(iii) Draw the graphs of f when (a) $f(x) = \left(\frac{1}{2}\right)^x$, $x \in \mathbb{R}$.   (b) $f(x) = |x + 6|$, $x \in \mathbb{R}$.

(iv) Using definition, show that (a) $\lim_{x \to 0^-} \frac{1}{x} = -\infty$.   (b) $\lim_{x \to \infty} x^2 = \infty$.

Q.2. A)   Attempt any **one**.   [08]

(i) If $f, g : I \to \mathbb{R}$ are continuous functions on I, where I is an interval, then prove that $f \cdot g$ is continuous on I. Give an example of functions f and g for which the converse of the above statement does not hold.

(ii) If $f : [a, b] \to \mathbb{R}$ is continuous, then show that $\exists\, d \in [a, b]$ such that $f(d) = \sup_{x \in [a,b]} \{f(x)\}$.

Q.2. B)   Attempt any **two**.   [12]

(i) If $f : I \to \mathbb{R}$ is continuous at $p \in I$, I is an open interval, and $f(p) > 0$, then show that $\exists\, \delta > 0$ such that $f(x) > 0$, $\forall |x - p| < \delta$.

(ii) Draw the graph of ceiling function $f(x) = \lceil x \rceil$, $x \in [1, 4]$. Discuss continuity of f at p when $p = 1,\ 2,\ 3.5,\ 4$.

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(iii) If $f, g : \mathbb{R} \to \mathbb{R}$ are continuous functions such that for all $x \in \mathbb{Q}$, $f(x) = g(x)$, then show that for all $x \in \mathbb{R}$, $f(x) = g(x)$.

(iv) Show that the equation $x = \cos x$ has a real root. State the results used.

Q.3. A) Attempt any **one**.   [08]

(i) State and prove Rolle's theorem.

(ii) State and prove Caratheodory criterion and using it define differential of a function at a point.

Q.3. B) Attempt any **two**.   [12]

(i) State Leibniz rule for higher order derivatives and find n^{th} derivative of $y = \frac{x^2 - 6x + 5}{x - 4}$.

(ii) Find the maximum and minimum values of $f(x) = 5x^6 + 18x^5 + 15x^4 - 10$.

(iii) Find the intervals on which $f(x) = x^3 - 6x^2 + 15x + 13$ is increasing or decreasing.

(iv) Evaluate the following limits.

(a) $\lim_{x \to 0} \frac{e^x - e^{-x} - 2\ln(1+x)}{x \sin x}$.   (b) $\lim_{x \to 0} x \ln x$.

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DAY: MONDAY   TIME: 11:00 am TO 1:00pm
DATE: 03/06/2019   MAX MARKS: 60

1. Attempt all questions.
2. Figures to the right indicate full marks.
3. Use of log tables or non-programmable calculator is allowed.

Q1.   Answer **any three** of the following.   [15]

A   State and explain the following laws with the help of graph
     i) Boyle's law
     ii) Charle's law
B   Define and write mathematical formulae for the following
     i) Average speed
     ii) Most probable speed
     Show their position on the speed distribution curve of
     gas molecules (approximately).
C   What is Boyle's temperature? Explain the behavior of gas with neat
     labeled diagrams on the basis of PV versus P curves at Boyle's temperature and
     below and above Boyle's temperature.
D   Derive the relationship between K_P and K_C. Calculate the value of K_P
     for the following reaction:
     $A_{(g)} + B_{(g)} \leftrightharpoons P_{(g)}$ Given: $K_C = 2 \times 10^5$ at T = 300K, R = 8.314 J.mol^{-1}.K^{-1}.
E   i) Write the mathematical expression for free energy change (ΔG) for a
     reaction.
     ii) When the reaction will be spontaneous and non-spontaneous?
     iii) How temperatures affect the spontaneous nature of reaction?

Q.2.   Answer **any three** of the following.   [15]

A.   What is quantitative analysis? Explain the method of detection of Cl_2 gas.
B.   Why paper reagents are more advantageous than liquid and solid
     reagents? Discuss method of preparation of lead acetate paper.
C.   Explain uncommon ion effect with any one example.
D.   Discuss Arrhenius concept for acids and bases with suitable example.
E.   What is HSAB concept? Discuss the theories of HSAB concept.

Q.3.   Answer **any three** of the following.   [15]

A.   Explain mechanism of halogenation of benzene.
B.   Benzene is aromatic. Justify.
C.   Give the mechanism of addition of HBr to 1-butene in presence of peroxide.

[P.T.O.]

D.   How will you synthesize
        i) propyne from acetylene
        ii) ethyne from 1,2-dibromoethane.
E.   Discuss the following
        i) cracking of alkanes
        ii) Diels Alder reaction.

Q4.   Answer **any five** of the following.   [15]

a)   i) What is compressibility factor?
        ii) Calculate the compressibility factor for a gas with observed
        volume 1.5 dm^3 and ideal volume 2.0 dm^3.
b)   How does inert gas addition affect state of equilibrium of reversible gaseous
        phase reaction at equilibrium?
c)   What is entropy? Give its characteristics.
d)   Give method of preparation and use of dimethyl glyoxime paper.
e)   Describe the factors affecting the Lewis base strength.
f)   Explain Lux-Flood concept of acids and bases with any one example.
g)   Label the following as aromatic/anti-aromatic/non aromatic.
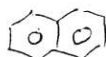
h)   Discuss chlorination of methane.
i)   Explain Friedel Crafts acylation.

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