3 Hours   Total Marks : 80

(1) N.B.:- Question no 1 is compulsory.
(2) Attempt any THREE questions out of remaining FIVE questions.

1)a) Solve $\left[\log(x^2+y^2)+\dfrac{2x^2}{x^2+y^2}\right]dx+\left(\dfrac{2xy}{x^2+y^2}\right)dy=0$ (4)

b) *Solve* $(D^4+2D^2+1)y=0$ (3)

c) Evaluate $\displaystyle\int_0^\infty e^{-x^5}dx$ (3)

d) Express the following integral in polar co-ordinates: $\displaystyle\int_0^{\frac{a}{\sqrt{2}}}\int_y^{\sqrt{a^2-y^2}} f(x,y)\,dx\,dy$ (4)

e) Prove that $E=1+\Delta=e^{hD}$ (3)

f) Evaluate $I=\displaystyle\int_0^{\pi/2}\int_{\pi/2}^{\pi}\cos(x+y)dx\,dy$ (3)

2 a) Solve $\dfrac{dy}{dx}+\dfrac{y}{x}\log y=\dfrac{y}{x^2}(\log x)^2$.   (6)

b) Change the order of integration and evaluate $I=\displaystyle\int_0^2\int_{\sqrt{2y}}^2\dfrac{x^2\,dxdy}{\sqrt{(x^4-4y^2)}}$ (6)

c) Evaluate $\displaystyle\int_0^{\pi/2}\dfrac{dx}{1+a\sin^2 x}$ and deduce that $\displaystyle\int_0^{\pi/2}\dfrac{\sin^2 xdx}{(3+a\sin^2 x)^2}=\dfrac{\pi\sqrt{3}}{96}$ (8)

3 a) Evaluate $I=\displaystyle\int_0^a\int_0^x\int_0^{x+y}e^{x+y+z}dxdydz$ (6)

b) If mass per unit area varies as the square of the ordinate of a point, find the mass of a lamina bounded by the cycloid $y=a(1-\cos\theta)$, $x=a(\theta+\sin\theta)$ and the ordinates from the two cusps and the tangents at the vertex   (6)

c) Solve $(2x+1)^2\dfrac{d^2y}{dx^2}-6(2x+1)\dfrac{dy}{dx}+16y=8(2x+1)^2$ (8)

4 a) *Show that the length of the arc of the parabola* $y^2=4ax$ *cut off by the line* (6)

$3y=8x$ *is* $a\left[\log 2+\dfrac{15}{16}\right]$

b) *Solve* $\dfrac{d^3y}{dx^3}-7\dfrac{dy}{dx}-6y=\cos x\cosh x$ (6)

[TURN OVER

c) Using fourth order Runge-Kutta method, find u(0.4) of the initial value problem (8) $u' = -2tu^2$, u(0)=1 take $h = 0.2$.

5 a) Use method of variation of parameters to solve $\dfrac{d^2y}{dx^2} - 5\dfrac{dy}{dx} + 6y = e^{2x}x^2$. (6)

b) Using Taylor's series method, obtain the solution of $\dfrac{dy}{dx} = 3x + y^2, y(0) = 1$ (6)

Find the value of y for x = 0.1 correct to four decimal places

c) Find the value of the integral $\displaystyle\int_0^1 \dfrac{x^2}{1+x^3}\,dx$ by taking h= 0.2 , using (8)

(i) Trapezoidal Rule (ii) Simpson's 1/3 Rule.
Compare the errors with the exact value of the integral

6 a) A condenser of capacitance C is charged through a resistance R by a steady (6) voltage. The charge Q satisfies the DE $R\dfrac{dQ}{dt} + \dfrac{Q}{c} = V$. If the plate is chargeless find the charge and the current at time 't'

b) Evaluate $\displaystyle\iint \dfrac{(x^2 + y^2)^2}{x^2 y^2}\,dxdy$ over the region common to $x^2 + y^2 - ax = 0$ and (6)

$x^2 + y^2 - by = 0,\ a > 0, b > 0$?

c) Find the volume common to the right circular cylinder $x^2 + y^2 = a^2$ and (8)
$\quad x^2 + z^2 = a^2$

(2 Hours)   **[Marks : 60]**

N.B. (1) Question no 1 is compulsory.
   (2) Attempt any three questions from the remaining questions.
   (3) Assume suitable data and symbols if requited.
   (4) Figures on the right indicate full marks.

1. Attempt any five: 15
   (a) Why the Newton's rings are circular and fringes in wedge shaped film are straight?
   (b) What is Rayleigh's criteria of resolution? How to increase resolving power diffraction grating?
   (c) A fibre cable has an acceptance angle of 30° and core index of refractive index 1.4. Calculate the retractive index of cladding.
   (d) What is pumping in Laser? Give the types of puming.
   (e) An electron is bound in one dimensional potential well of width 2.5A° that of infinite height find its energy in first excited state.
   (f) How Lissajous figures are used to measure unknown frequency.
   (g) Why is superconductor is termed as perfect diamagnet?

2. (a) For Newton's ring, prove that diameters of nth dark ring is directly proportional   08
       to the square root of natural number. In Newton's ring experiment the diameter
       of nth and $(n+8)^{th}$ bright rings ar 4.2mm and 7mm respectively. Radius of curvature
       of lower surface of lens is 2m. Determine the wavelength of light used.

   (b) What is monomode and multimode fibre? Explain the term V-number calculate   07
       the no of modes an optical fibre of 40 µm will transmit as its core and cladding
       retractive indies are 1.5 and 1.46 respectively. Wavelength of light used is 1.5
       µm.

3. (a) What is the fundamental principle of a Hologram? How is it produced and how   08
       is the image constructed by it ?
   (b) Why we see beautiful colours in thin film when it is exposed to sunlight?   07
       Obtain expression for path difference between two reflected rays in thin
       transparent film of uniform thickness and write the conditions of maxima &
       minima.

TURN OVER

4.   (a)   What is grating element? Derive condition for absent spectra in plane transmission   **05** grating and explain with example.

        (b)   What is Heisenbregs' uncertainty principle? An electron has a speed of 300 m/   **05** sec. With an accuracy of 0.001%. Calculate the certainty with which we can locate the position of an electron.

        (c)   What do you mean by critical magnetic field and critical temperature ?   **05** A lead superconductor with $Tc=7.2k$ has critical magnetic field of 6.5×10^3 A/ m at absolute zero. What would be the magnitude of critical magnetic field at 5k temperature ?

5.   (a)   In plane transmission grating the angle of diffraction for the second order principal   **05** maxima for the wavelength 5×10^{-5}cm is 35°. Calculate the no. of lines/cm on diffraction grating.

        (b)   Derive one dimensional time independent Schrodinger wave equation for matter   **05** wave.

        (c)   With neat diagram explain the construction and working of Atomic force   **05** Microscope.

6.   (a)   The electron which is at rest is accelerated through a potential difference of   **05** 200V.
             Calculate : i)   The velocity of electron
                         ii)   De-Brouglie wavelength
                         iii) Momentum.

        (b)   Explain how Lissajous figures are used to determine the phase difference between   **05** two A.C. signals.

        (c)   What are nano materials? Explain any two methods for synthesis of   **05** Nanoparticles.

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QP Code : 530104

(2 Hours) [Total Marks : 60

N.B. : (1) Question **No. 1** is compulsory.
    (2) Attempt **any three** from remaining **five** questions.
    (3) **Figures** to the **right** indicates **full** marks.
    (4) Atomic weights : H=1, C=12, N=14, O=16, S=32, Cl = 35.5, Ba= 137.3, Mg =24, Na =23, Ca=40,

1. Answer **any five** from the following :-   15
    (a) Gold and platinum do not get corroded in atmospheric oxygen. Explain.
    (b) Define octane number of gasoline, Name any two anti-knock agents.
    (c) Give compositions, properties and uses of Duralumin.
    (d) Give classifications of composite material.
    (e) What is green chemistry? List the six principles of green chemistry.
    (f) A coal sample was subjected to ultimate analysis 2.45 g of coal on combustion in a Bomb-Colorimeter gave 0.67 of $BaSO_4$. Calculate percentage of sulphur.

2. (a) How do the following factors affect the rate of corrosion?   6
    (i) Position of metal in galvanic series.
    (ii) pH of medium
    (iii) Relative areas of anodic and cathodic parts.
  (b) What is Biodiesel? Explain method to obtain biodiesel from vegetable oil.   5
What are the advantages of biodiesel.
  (c) Calculate percentage atom economy for the following reactions with respect   4
to Acetophenone.

$$C_6H_6 + CH_3COCl \xrightarrow{Alcl_3} C_6H_5COCH_3 + HCL$$
Benzene   Acetophenone

3. (a) A Gaseons fuel has the following compositions by volume :-   6
    H= 25%, CO = 20%, CH_4=30% C_3H_8 =20%
    O_2 = 2% N_2=1%, CO_2= 2% .
Calculate volume and weighted of air required for complete combustion of $1m^2$ of fuel (molut of air = 28.949)
  (b) Explain conventional and greener route of synthesis of Adipic Acid. Highlight   5
the green chemistry principle involved.
  (c) Discuss Differential Aeration corrosion with a suitable examples.   4

[TURN OVER]

2

(a) What is powder -metallurgy? List the various steps involved in powder metallurgy mention the aim of each step.   6

(b) What is cathodic protection? Describe impressed current method of corrosion control.   5

(c) Discuss the influence of any two chemical factors on adhesion action.   4

(a) What is cracking? Explain in detailed fixed bed catalytic cracking with suitable diagram.   6

(b) What is an alloy? Explain any four purposes of alloying with suitable examples.   5

(c) Write a note on ' Sandwich panel' type layered composites.   4

(a) What are metallic coatings? Distinguish between galvanizing and Tinning.   5

(b) Calculate the weight and volume of air needed for complete combustion of 2 kg of coal containing :-
C=54%, H=6.5 %, O=3% , W=1.8%
mol. wt of air = 28.949).   5

(c) Write a note on following :-   5
  (i) Compacting   (ii) Sintering

QP CODE : 530203

(3 Hours) [Total Marks: 80]

N.B.
1. Q.no.1 is compulsory
2. Attempt any **three** out of the remaining five questions
3. Figures to **right** indicate **full** marks
4. Assume suitable data if necessary but justify the same

Q.1.
a. Explain the significance of pointers in C   4
b. What is an algorithm? How do you develop an algorithm?   4
c. Explain the following statement with example:
     i. continue   ii. break   4
d. Explain any two functions of string.h   4
e. Explain the following functions- floor(), ceil(), trunc(), sqrt()   4

Q.2.
a. Write a program to display prime numbers between 1 to 1000   5
b. What is recursion? Write a program to compute fibonacci series using recursion.   5
c. Write a C program to add two distances(feet-inch system) entered by user, using structures   10

Q.3.
a. Write a C program to check if the given number is a palindrome or not   6
b. Write a C program to print following pattern   6

     E
     E D
     E D C
     E D C B
     E D C B A

c. Write a program to calculate sum of digits of a given n digit number using recursion   8

Q. 4.
a. Write a program to sort given 10 numbers in ascending order   10

b. Write a program to calculate the sum of following series: 10

$$(1!/1) + (2!/2) + (3!/3) + (4!/4) + (5!/5) + ... + (n!/n)$$

Q.5.
a. Write a program to compute matrix multiplication and transpose of a matrix   10

b. Write a program to count number of vowels and consonants in a given sentence   10

Q.6.
a. Explain the difference between call by value and call by reference with example   8

b. Explain different storage classes   8

c. What is a file? Explain the following file handling functions in c-fopen(), fread(), fwrite()   4

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Q.P. Code : 530402

(3 Hours)   [Total Marks: 60

NB: i) Question one is **Compulsory**, solve any THREE from remaining questions.
ii) All dimensions are in mm.
iii) Use **First angle** method of projection.
iv) Assume suitable dimension if it is necessary.

Q.1 (a) Draw an involute to a circle of diameter 50 mm. Also draw a tangent and Normal to the [6]
curve at any point.

(b) The pictorial view of a machine part shown in figure. Draw the following views
i) Front view from X   [4]
ii) Top view   [5]

[TURN OVER

Q.2   A right circular cone of diameter 50mm and axis 65mm is lying on HP on one of its end
       generators. Draw projections on the cone when the plane containing the axis and generator on   [15]
       HP is inclined 45 degrees to VP.

Q.3   The figure shows the pictorial view of an object , draw
       i)   Sectional front view section along A-A   [5]
       ii)   Top view.   [4]
       iii)   Left hand Side view   [4]
       iv)   Insert major dimensions.   [2]

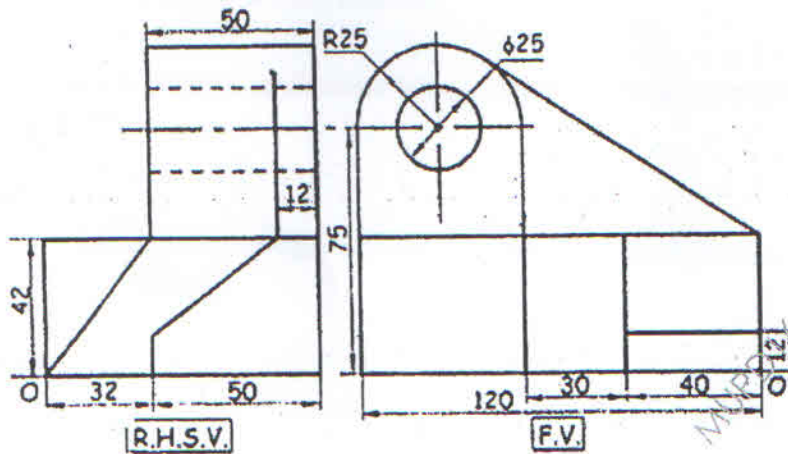

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[TURN OVER

Q.4 (a) A square prism of side of base 30m and axis length60mm , is resting on HP on one of its **[6]** corners with its base making an angle 45⁰ to HP. Draw its projections

(b) Front view and RHS view of an object is shown below. Draw an isometric view of the object. **[9]**

Q.5 A cone of diameter 60mm and height 75mm is resting on H.P. on its base, it is cut by a section **[15]** plane inclined to HP and perpendicular to VP such that the true shape of the section is a parabola with axis is equal to 60mm. Draw,
   i)   Front view (ii) Sectional Top view (iii)True shape of section
   ii)   Develop the lateral surfaces of the retained portion of the cone after section.

Q.6 (a) The T.V. of a line PQ (True length 90mm) is inclined at 50⁰ to XY while the line is inclined **[9]** 30 degrees to VP. The end P is 10mm in front of V.P. 20mm above the H.P and the end Q is fourth quadrant. Draw its projections. Determine true inclination of the line with HP.
   (b)   Front view and Side View of an object are shown in figure, draw an isometric view. **[6]**