2021

Time :As in Programme

Full Marks : 80

The figures in the right-hand margin indicate marks.

Answer ALL questions.

PART - I

1. Answer all questions. $1 \times 12 = 12$

(a) Does L Hospital's Rule is applicable to the limit

$$\lim_{x \to 0} \frac{x+17}{2x+3}$$

(b) Define Convex function

(c) Write the value of the limit $\lim_{x \to 0} \frac{\log(1+x)}{x}$

(d) Give an example of a function which is Riemann integrable but not monotonic

(e) Define Norm of a partition.

(f) Does the function $\frac{1}{x}$ is Riemann integrable on $[0, 1]$. justify.

(g) $\int\limits_{1}^{\infty} \frac{dx}{x^p}$ Converges if_____

(h) Define conditional convergence of an integral.

[1]

(i)   The Beta function $B(p,q) = \int_0^1 t^{p-1}(1-t)^{Q-1}$

dt conuerges if_____.

(j)   Give example of sequence of continuous function Converging to a discontinuous function.

(k)   Define uniform convergence of series of fucntions.

(l)   Find the pointwise limit of $f_n(x) = x^n$ if it exists.

Part - II

2.   Answer any Eight questions of the following. $2 \times 8 = 16$

(a)   Find the point of inflexion of the function $f(x) = x^3$.

(b)   Find the value of $\lim_{x \to 0} \dfrac{1 - \cos x}{x^2}$

(c)   Evaluate the limit $\lim_{x \to \infty} \dfrac{x^n}{e^x}$

(d)   Show that $\int_1^\infty \dfrac{\sin x}{x^p} dx$ converges absolutely for $p > 1$.

(e)   Compute the integral $\int_0^1 \dfrac{1}{x^p} du, \; p < 0$

(f)   Is pointwise convergence preserues Continuity. Justify your answer.

(g)   Compute $L(f, P)$ if $P = \left\{ 0, \dfrac{1}{3}, \dfrac{2}{3}, 1 \right\}$ is a partition of $[0, 1]$ and $f(x) = x$.

(h)   Give examples of tab functions f and g which are not integrable such that f + g and fg are integrable.

[2]

(i) Show that $\sum \dfrac{\sin nx}{n^l}$ is uniformly and absolutely convergent $\forall x \in R, \partial > 1$

(j) State when term by term differentiation of the series is permissible.

Part - III

3. Answer any Eight questions from the following. $3 \times 8 = 24$

(a) Evaluate the limit $\lim\limits_{x \to 0} x^x$

(b) Using Taylor's theorem find a polynomial $f(x)$ of degree 2 which satisfies $f(1) = 2, f'(1) = -1$ and $f''(1) = 2$

(c) Verify the Lauchy's Men value theorem for the function x^2 and x^3 in $[1,2]$ and also find a point $c \in (1,2)$ of this theorem.

(d) If P and Q be two partition of [a, b] such that P C Q, then show that $L(f,P) \le L(f,Q)$

(e) Show that a constant function is integrable.

(f) If $f, g \in R[a,b]$, then show that $fg \in R[a,b]$

(g) Prove that if an integral is absolutely convergent then it is convergent

(h) Compute the integral $\displaystyle\int_{\infty}^{\infty} \dfrac{dx}{1+x^2}$

(i) Show that $\sum r^n \cos^{nx}, 0 < r < 1$ converges uniformly $\forall x \in R$

(j) Show that the series $\sum \dfrac{\sin^{nx}}{n^2}$ can be integrated term by term.

[3]

Part - IV

4. (a) Find the local maximum and minimum of

$$f(x) = 8x^5 - 15x^4 + 10x^2$$

Or

Using the mean value theorem prove that

$$\frac{x}{1+r^2} < tan^{-1}x < x, x > 0$$

5. (a) Show that every continuous function an [a, b] is integrable.

Or

If f and g are Riemann integrable, then prove that f+g is riemann integrable.

6. (a) Show that uniform convergence implies pointwise convergence but not conversly.

Or

Test the convergence of the integral $\int_{0}^{\infty} e^{-t} t^{p-1} dt$

7. (a) State and prove Weierstrass M-test

Or

Discuss the convergence of the series

$$\sum \frac{z^n}{(n+1)^t}, t \in R$$

●●●

2021

Time :As in Programme

Full Marks : 80

The figures in the right-hand margin indicate marks.

Answer ALL questions.

GROUP-A

1. Answer the following questions: $1 \times 12 = 12$

   (a) What cycle is $(b_1 \ b_2 \dots b_n)^{-1}$?

   (b) Write symmetry of a square?

   (c) Let $x, y \in R$ is composition $x.y = |x + y|$ associative. (Yes / No)

   (d) What is the order of product of a pair of disjoint cycles of length 8 and 12?

   (e) How many abelian groups of order 25?

   (f) What is the order of any non identity element of $Z_3 \oplus Z_3 \oplus Z_3$

   (g) If $G = <a>$ and $|G| = 20$ given $K / 20$ and $H = <a^k>$ find $|G:H|$?

   (h) How many subgroups of Z_{20} have?

   (i) How many elements of order 5 and in S_7.

   (j) What is the maximum order of any element in A_{10}.

   (k) Write order of the permutation. (147)

   (l) Define centre of a group.

Part – II

[1]

$$8 \times 2 = 16$$

2. Answer any Eight questions.

(a) $\alpha = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 1 & 3 & 5 & 4 & 6 \end{bmatrix}$ find α^{-1}.

(b) How many odd permutation of order 4 does S_6 have?

(c) Find $u_{(5)} \oplus U_{(8)}$

(d) What is the largest order of any element in $Z_{30} \oplus Z_{20}$

(e) Find smallest subgroup of Z containing 8 and 13

(f) Let $\left\{ \begin{bmatrix} a & b \\ o & d \end{bmatrix} : a, b, d \in R, ad \neq 0 \right\}$

   is H a normal subgroup of $GL(2,R)$?

(g) Determine all abelian group of order 36

(h) Determine all homomorphism from Z_4 to $Z_2 \oplus Z_2$

(i) If $a \in G$ and $|a| = 10$ find $|a^{35}|$.

(j) If G is finite and H is subgroup

   of G prove that $|G:H| = \dfrac{|G|}{|H|}$

Part - III

3. Answer any Eight questions.　　　　$8 \times 3 = 34$

(a) find inverse of $\begin{pmatrix} 4 & 5 \\ 6 & 3 \end{pmatrix}$ in $GL(2, Z_7)$?

(b) Let a, b, c, b e elements of a group solve the equation

   $axb = c$ for x solve $a^{-1}xa = c$ for x?

(c) Show that a group G is abetian iff Inn $G = \{IG\}$

(d) Prove that $U_{(55)} \approx U_{75}$

[2]

(e) Prove that a group of prime order is cyclic?

(f) If $G = \{a + bv_2 : a, b \in Q\}$

$$H = \left\{ \begin{bmatrix} a & 2b \\ b & a \end{bmatrix} : a, b \in Q \right\}$$ show that G and H are

isomorphicunder addition.

(g) Find all abelian group of order 1125?

(h) Show that $\mathbb{Z} / 3\mathbb{Z} \approx Z_3$

(i) List the element of the subgroup

$< 20 > and < 10 > in Z_{30}$

(j) If $G = GL(2, R)$ find $Z_{(G)}$.

Part - IV

Answer all questions. $4 \times 7 = 28$

4.   (a)   The center of group G is a. Subgroup of G prove it?

Or

For any element a and b from a group and any integer

n prove that $(a^{-1}ba)^n = a^{-1}b^n a$

5.   (a)   Every permutation of a finite set can be written as a
cycle or as a product of disjoint cycle.

Or

(b)   (i)   Let G be a group and $a \in G$ prove that

$C_{(a)} = C(a^{-1})$ $[3\frac{1}{2}]$

(ii)   For each 'a' in group G the centralizer of 'a' is
subgroup of G $[3\frac{1}{2}]$

6.   (a)   State and prove lagrange's theorem.

[3]

<div align="center">Or</div>

(b) Every group is isomorphic to a group of permutation

7. (a) Let ϕ be a nomomorphism from a group G to group $\overline{G}$ prove that

    (i) $\phi(e) = \overline{e}$

    (ii) $\phi(a^n) = [\phi(a)]^n$

<div align="center">Or</div>

(b) If K is subgroup of G and N is a normal subgroup of G then $K/(K \cap N) \approx KN/N$

<div align="center">•••</div>

2021

Time : As in Programme

Full Marks : 60

The figures in the right-hand margin indicate marks.

Answer ALL questions.

PART - I

1. Answer all questions. $\qquad$ $1 \times 8 = 8$

   (a) Find solution of $U_{x=0}$

   (b) Write one dimensional wave equation.

   (c) Classify the $P-D-E$ $u_{x_x} + x^2 u_{y_y} = 0$ as elliptic, parabolic or hyperbolic.

   (d) Write heat equation of the dimensional.

   (e) Write Euler Tricomi's Equation.

   (f) Write complete Intgral of $P = Q$ is
   $$(Z = ax + by,\ Z = ax + c,\ Z = ax - by,\ None)$$

   (g) Is $U_{xx} + xu_{yy} = \cot y$ is 2nd order quasi linear P-D-E (yes/No)

   (h) Write condition when P-D-E is parabolic.

Part - II

2. Answer any Eight questions. $\qquad$ $1.5 \times 8 = 12$

   (a) Write Characteristic equations in non parametric form.

   (b) Solve $u_{xy} = 0$

   (c) Define complete solution of a P-D-E

[1]

(d) Eliminate the arbitory functions from the equation

$$z = yf(x) + x g(y)$$

(e) Write second canonical form of hyperbolic P-D-E

(f) Write general form of homogeneous wave equation given boundary condition (assumption)

(g) Eliminate a, b from the P-D-E

$$2z = (ax + y)^2 + b$$

(h) Write D' inbent one dimensional wave equation.

(i) Write euler Equation.

(i) Write canonical form of parabolic equations

Part - III

3. Answer any Eight questions. $2 \times 8 = 16$

(a) Find general solution of $\dfrac{\partial u}{\partial x} = 6\dfrac{\partial u}{\partial t} + u$ by using separation of variable method.

(b) $\dfrac{\partial^2 u}{\partial t^2} - \dfrac{\partial^2 u}{\partial x^2} = xt, \quad -\infty < x < \infty, \ t > 0$

$$u(x,0) = \dfrac{\partial u}{\partial t}(x,0) = 0, \quad -\infty < x < \infty \quad \text{find value of}$$

$u(2,3)$

(c) $x'' + \lambda x = 0$ be eigen value problem when boundary condition is $x(0) = x(L) = 0$ then find eigen function λx?

(d) Write general solution of one dimensional wave Equation with given boundary conditon $u(0,t) = u(L,t) = 0$

(e) Write a mathematical model representiong (assumption) vibration of finite string with free end

[2]

(f) In steady state conditions derivethe solution of one dimensional heat flow equation.

(g) Suppose the string has intial conditions $u(x,0)=e^x$, $u_t(x,0)=0$ write D' alember's solution.

(h) solve $\left(D^2-D'^2\right)z=0$

(i) Find solution of the intial boundary value problem

$u_{tt}=u_{xx}$ $0<x<\infty$, $t>0$

$u(x,0)=us\left(\dfrac{\pi x}{4}\right)$, $0\leq x<\infty$

$u_t(x_{10})=0$, $0\leq x<\infty$, $u(x,0)=0$, $t\geq 0$

(j) Determine the solution of intial boundary value problem for $x>2t$ of

$u_{tt}=4u_{x_x}$ $x?>0$, $t>0$

$u(x,0)=|\sin x|$, $x>0$

$ut(x_{10})=0$, $x\geq0$, $u(x,0)=0, t\geq0$

Part - IV

Answer all questions. $4 \times 6 = 24$

4. (a) Determine the integral surface of the equation

$x\left(y^2+u\right)4_x-y\left(x^2+u\right)u_y=\left(x^2-y^2\right)u$

with condition $x+y=0$, $u=1$

Or

Use separation of variables $u(x,y)=f(x)+g(y)$ solve the equation $U_x^2+U_y^2=1$

5. (a) Find general solution of the equation

$U_{xx}+2u_{xy}+5u_{yy}+u_x=0$

Or

[3]

(b) Determine the general solution of the problem

$$4u_{xx} + 5u_{xy} + u_{yy} + u_x + u_y = 2$$

6. (a) Find solution of wave equation

$$\frac{\partial^2 u}{\partial t^2} = C^2 \frac{\partial^2 u}{\partial x^2}$$ corresponding to the triangular intial deflection.

$$f(x) = \begin{cases} \dfrac{2kx}{l} & \text{for } 0 < x < L/2 \\ \dfrac{2K}{L}(L-x) & \text{for } \dfrac{L}{2} < x < L. \end{cases}$$

Or

(b) Determine the solution of the problem

$$u_{tt} = C^2 u_{xx}, \quad 0 < x < L, t > 0$$

$$u(x,0) = \sin\left(\frac{\lambda x}{L}\right), \quad 0 \le x \le L$$

$$u_t(x,0) = 0, \quad u(0,t) = 0, u(L,t) = 0, \quad t \ge 0$$

7. (a) Find general solution of the system $\dfrac{dx}{dt} = 4x - y$ and

$$\frac{dy}{dt} = 2x + y$$

Or

(b) Find general solution of the system

$$\frac{dx}{dt} + 2x - 3y = t$$

$$\frac{dy}{dt} - 3x + 2y = e^{2t}$$

•••

[4]

2021

Time :As in Programme

Full Marks : 60

The figures in the right-hand margin indicate marks.

*Answer **all** questions.*

SECTION-A

1. Answer all the questions :   1x8

    a) Interference obey's principle of conservation of ....

    b) Bending of light rays at the corner of an obstacle or slit is known as ....

    c) Write the dimensionof Joule's constant.

    d) Lyman series belongs to .... region.

    e) Write the wave function which represents a free particle moving along the X-axis.

    f) The prabability density $\psi^*(x,t)\Psi(x,t)$ is always ....

    g) Halt lite = ... x mean life.

    h) What is rest mass of photon ?

SECTION-B

2. Answer any eight questions of the following   1.5x8

    a) Define packing fraction.

    b) What is the role of the magnetic field in cyclotron ?

    c) Write Heisenberg's uncertainty principle.

                                                        (Turn Over)

d) Write the normalization condition of a wave function.

e) Write Galilean transformation equations.

f) State de-Broglie's hypothesis.

g) How much amount of energy will be liberated from a mass of one gram ?

h) Find the angular momentum of an electron revolving around the nucleus in second orbit.

i) Explain coherent source.

j) State Brewster's Law.

SECTION-C

3. Answer any eight questions of the following

2x8

a) Newton rings are observed in reflected eight of wavelength 6000A°. The diameter of 10th dark ring is 0.5cm. Find the radius of curvature.

b) Explain double refraction.

c) State planck's quantum theory of radiation.

d) Explain particle nature of electromagnetic radiation.

e) State Bohr's correspondence principle.

f) State ehrenfest's theorem.

g) Explain probability current density.

h) Define Mass defect and write its relation with binding energy.

i) Find the compton wavelength of neutron.

j) Explain relativistie mass-energy relation.

SECTION-D

Answer all the questions   6x4

4) With necessary theory describe the formation of secondary rainbow.

OR

Discuss Fraunhoffer's diffraction at single slit. Find the position of maxima and minima.

5. Describe the construction, working and theory of Davisson Germer experiment.

OR

With basic postulates describe the Bohr's theory of Hydrogen atom.

6. Derive an expression for time dependent schrodinger's equation in one dimension.

OR

Derive an expression for time independent schrodinger's wave equation in one dimention particle in a box.

7. With neat diagram describe the principle, construction and working of Cyclotron.

OR

With neat diagram descrbe the Michelson Morley experiment and its consequence.

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2021

Time :As in Programme

Full Marks : 80

The figures in the right-hand margin indicate marks.

Answer all questions.

1. Answer any three of the following.　　　　　(3x12)

    (a)　What is vertical Communication? Discuss the important functions of Vertical. communication in an organisation?

    (b)　What is Indian English? Throw light on some of the areas where Indianisation of English is widely marked in India?

    (c)　What is Active Listening? Enlist the different Verbal and Non- Verbal responses one should display to show that he/she is actively listening.

    (d)　Describe the different steps of developing an essay??

    (e)　What do you mean by Alternative texts of language learning? Give some tips for learning English through Alternative texts.

    (f)　Write short notes on the following.

    　　a. Sexism

    　　b. Jargon

    　　c. skimming

2. **Do as directed**

(a) He is studying hard for the last two weeks. (Corre T
sentence)

(b) We should do some advance planning for the mee
(Rewrite the sentence by eliminating the redun
words)

(c) Vitamins and minerals nourish our body. (Rewrite
sentence using the noun form of the underlined wor

(d) love makes the world go round. (Turn the sentence
cleft sentence)

(e) Give a single word for the expression, "one who is prese
everywhere"

(f) Give a gender-neutral word for 'Mankind'.

(g) Write the antonym of "Condemn'.

(h) Write the synonym of Adversity'

(i) Finally on August 15 1947 India became free (Punctuate
the sentence)

3. Fill in the blanks using the following words.   (1x5)

After all for example in addition in the meantime so

The difficulty of getting people to pay attention to the problem
of rising sea level is that it often has to compete with, _____
news of rising food prices or an increase in violent crime.
_____, you are unlikely to worry about flooding in the future
if, _____, you can't afford to eat or you're about to be
shot. _____ most of us don't live anywhere near the sea.
_____ why should we worry about it.

Write a precis of the following passage by reducing it to one-third of its length.   1x10

The effects of plastic bags on the environment are really quite devastating because there is no disposal method that will really help eliminate the problem. While reusing them is the first step, most people don't do it, because most of them are not durable enough to survive multiple use.

The biggest problem with them is that once they have been soiled, they end up in the trash, which then ends up in the landfill or is burned. Either solution is very poor for the environment. Burning emits toxic gases that harm the atmosphere while landfills hold them indefinitely as part of the plastic waste problem throughout the globe.

One of the greatest problems is that an estimated 300 million plastic bags end up in the Atlantic Ocean alone. These bags are very dangerous for sea life, especially those of the mammal variety. Any hunting mammal can easily mistake the size, shape and texture of the plastic bag for a meal and find its airway cut off. Needless deaths from plastic bags are increasing every year.

The environmental balance of the waterways is being thrown off by the rate of plastic bags finding their way into the mouths and intestinal tracts of sea mammals. As one species begins to die off at an abnormal rate, every other living organism in the waterways is impacted.

The indefinite period of time that it takes for the average plastic bag to break down can be literally hundreds of years. Every bag that ends up in the woodlands of the country threatens the natural progression of wildlife. Because the breakdown rate is so slow, the chances that the bag will harmlessly go away are

extremely slim. Throughout the world plastic bag
responsible for suffocation and deaths of woodland anim
well as inhibiting soil nutrients.

While it's a noble thought to place the plastic bags in
recycling bin every week, studies have proven that there
very few recycling plants that actually recycle them. M
municipalities either burn them or send them off to the land
after sorting. This is because it can be expensive to recyc
this type of plastic. It doesn't melt down easily and is often n
fit to be reused in its original form.

The premise of recycling these bags is nice. Yet funding fo
the upgrading of the recycling units just has not happened and
thus less than one per cent of all bags are sent to recycling
plants worldwide. Most are left to become a pollution problem
in one way or another.

There are always alternatives to plastic bags and the search
for more altenatives continues. Paper bags are a possible option
but they also take their toll on the environment. The use of
trees to increase the production of paper products will also
have a negative environmental effect.

Reusable plastic bags are being introduced into regions that
want to outlaw the plastic bags altogether. These are stronger
and more durable and can be used for three to five trips to the
market. Of course, the reusable cloth bag is fast becoming a
favourite among environment supporters. These bags are
currently recommended for use to help protect environmental
concerns.

Or

B. Giving a suitable title make a note of the following passage.

What actually is a robot? When different persons have different concepts of robots, the only way of deciding what really is a robot is to look for a definition of the term robot. The dictionary meaning of a robot is that it is an automatic apparatus or device that performs functions ordinarily ascribed to human beings or operates with what appears to be almost-human intelligence. It is interesting to observe that this meaning does not give a human shape to the robot. In order to dramatise the fact that the robot does the work of a human being, a human shape is given to the robot in science-fiction stories and movies. The human shape is irrelevant as far as the functions of the robot are concerned.

The Robot Institute of America, which is an association of several robot manufacturers defines, "An industrial robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialised devices through variable programmed motions for the performance of a variety of tasks."

The key word in this definition is 'reprogrammable'. This means that a robot is capable of being reprogrammed. This feature is the one that distinguishes it from a fixed automation. A fixed automation is designed to do one, and only one, specific task. If the specifications of the tasks change even slightly, the fixed automation becomes incapable of performing the task it was designed to perform according to one fixed specification. However, a robot can be reprogrammed to perform even when the specifications are changed drastically. The original program is simply erased and the new program takes care of the changed tasks.

The characteristic that a robot can be reprogrammed to handle a variety of tasks makes the robot a flexible device because of the flexibility offered by robots, manufacturing systems which use robots are called Flexible Manufacturing Systems (FMS).

Karel Capek was responsible for introducing the word robot. Sir Isaac Asimov is the one who coined the word robotics. Acording to Asimov, robotics is the science of dealing with robots. Hence robotics involves a scientific study of robots. The study includes design, selection of materials of proper quality for the components, fabrication, study of various motors required for moving the components, design of electronic circuits, computers and computer programming, and control of robots. Since robots and robotics are still in the developing stages, a considerable amount of research is required and is being pursued. Robotics involves various disciplines-mechanical engineering, material science, electronics, computer science, computer engineering, and control systems, to name just a few. Depending on the area in which robots are to be used, robotics includes disciplines such as biology, medical science, psychology, agriculture, mining, outer space engineering etc.

Basically, there are two types of robots: fixed and mobile. A fixed robot is attached to a stationary platform. A fixed robot is analogous to a human standing or sitting in one fixed location while doing his work with his hands. A mobile robot moves from place to place. Mobility is given to robots by providing wheels or legs or other crawling mechanisms. A mobile robot can be given a human shape, but the actual shape has nothing to do with the functions of the robot. Wheeled locomotion is good for smooth terains. For rugged terain, legged locomotion is preferable. A mobile robot should have at least three wheels or legs for stability.

5.a. You bought a 1.5-ton, LG Air Conditioner from Patra Electronics, Bhubaneswar about a month ago. Now you find that the AC makes a lot of noise and the cooling is also not effective. Write a letter of complaint to the manager, Patra Electronics, Bhubaneswar asking him to get the device replaced.   1x10

<p align="center">Or</p>

You saw an advertisement in The Hindu on 24/9/21 for the post of Marketing Manager at Maruti Udyog, New Delhi. Draft a job application along with complete biodata to The Marketing Head, Maruti Udyog, New Delhi for this.

b.   The main road leading to your locality has been seriously damaged for which frequent accidents occur at night, especially during the rainy season. As a responsible citizen, write a letter to the Editor, The Times of India drawing attention of the Municipal Commissioner to this.   1x10

<p align="center">Or</p>

Recently your college organised a Covid-19 awareness camp. Write a report on it to be published in a local daily.

© vitamins and minerals need
fore nourishment oure body.

$$2 \left(\frac{F}{h} \right) = \text{mankind} \\ \left(\frac{F}{h} \right) = \text{Diversity}$$