Code : 102102/105102

B.Tech 1st Semester Special Exam., 2020

(New Course)

MATHEMATICS—I

(Calculus and Linear Algebra)

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

(iv) Question No. 1 is compulsory.

1. Choose the correct answer of the following (any *seven*) : 2×7=14

(a) If

$$Y = \int_0^\infty \frac{x^a}{a^x}\,dx,\ a>1$$

then the value of Y is

(i) $\frac{\Gamma(a)}{(\log_e a)^a}$ *(ii)* $\frac{\Gamma(a+1)}{(\log_e a)^a}$

(iii) $\frac{\Gamma(a+1)}{(\log_e a)^{a+1}}$ *(iv)* $\frac{\Gamma(a)}{(\log_e a)^{a+1}}$

(b) The area bounded by the axis of x, and the curve and ordinates $y = c\cosh\frac{x}{c}$ from $x=0$ to $x=a$ is

(i) $c\cosh\frac{a}{c}$

(ii) $c^2\sinh\frac{a}{c}$

(iii) $c\sinh\frac{a}{c}$

(iv) None of the above

(c) Consider the following functions :

1. $y = x\sin\frac{1}{x}$, $x\neq 0$; and $y=0$ if $x=0$
2. $y = x^2\sin\frac{1}{x}$, $x\neq 0$; and $y=0$ if $x=0$
3. $y = x^2\cos\frac{1}{x}$, $x\neq 0$; and $y=0$ if $x=0$
4. $y = x\cos\frac{1}{x}$, $x\neq 0$; and $y=0$ if $x=0$

The functions, differentiable at $x=0$, are

(i) 1 and 2

(ii) 2 and 3

(iii) 3 and 4

(iv) 1 and 4

(d) For a positive term series $\sum a_n$, the ratio test states that

(i) the series converges, if

$$\lim_{n\to\infty}\frac{a_{n+1}}{a_n} > 1$$

(ii) the series converges, if

$$\lim_{n\to\infty}\frac{a_{n+1}}{a_n} < 1$$

(iii) the series converges, if

$$\lim_{n\to\infty}\frac{a_{n+1}}{a_n} = 1$$

(iv) None of the above

(e) If

$$\lim_{x\to 0}\frac{\sin 2x + a\sin x}{x^3} = b$$

where b is finite, then the values of a and b respectively will be

(i) (−2, −1)

(ii) (2, 1)

(iii) (−2, 1)

(iv) (2, −1)

(f) The expansion of $\tan x$ in powers of x by Maclaurin's theorem is valid in the interval

(i) $(-\infty, \infty)$

(ii) $\left(-\frac{3\pi}{2}, \frac{3\pi}{2}\right)$

(iii) $(-\pi, \pi)$

(iv) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

(g) The value of

$$\lim_{(x,\,y)\to(1,\,0)}\left(1+\frac{x}{y}\right)^y$$

is

(i) 1

(ii) e^{-k}

(iii) e^k

(iv) Does not exist

(h) The gradient of the function $f(x, y, z) = \sin(xyz)$, at $(1, -1, \pi)$, is

(i) $\pi(\hat{i} - \hat{j} + \hat{k})$

(ii) $\pi(\hat{i} + \hat{j} + \hat{k})$

(iii) $(\hat{i} + \hat{j} + \hat{k})$

(iv) $(\pi\hat{i} - \pi\hat{j} + \hat{k})$

(i) If $\det(A) = 7$, where

$$A = \begin{bmatrix} a & b & c \\ 1 & 1 & g \\ g & \omega & 1 \end{bmatrix}$$

then $\det(2A)^{-1}$ is equal to

(i) $\frac{1}{14}$

(ii) $\frac{1}{49}$

(iii) $\frac{1}{56}$

(iv) $\frac{7}{2}$

(j) If $3x+2y+z=0$, $x+4y+z=0$ and $2x+y+4z=0$ be a system of equations, then

(i) it is inconsistent

(ii) it has only the trivial solution (0, 0, 0)

(iii) it can be reduced to a single equation and so a solution does not exist

(iv) the determinant of the matrix of coefficients is zero

2. *(a)* Evaluate

$$\int_0^\infty \log\left(x+\frac{1}{x}\right)\frac{dx}{1+x^2}$$ 7

(b) Find the volume of the solid generated by rotating completely about the x-axis where the area enclosed between $y^2 = x^3 + 5x$ and the line $x=2$ and $x=4$ about its major axis. 7

3. *(a)* Find the maximum value of the function

$$f(x) = \frac{x}{1+x\tan x}$$ 5

(b) It is given that Rolle's theorem holds for the function $f(x) = x^3 + bx^2 + cx$, $1\le x\le 2$ at the point $x=\frac{4}{3}$. Find the values of b and c. 9

4. *(a)* Discuss the convergence of the sequence whose n-th term is

$$a_n = \frac{(-1)^n}{n} + 1$$ 7

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$$A = \begin{bmatrix} a & b & c \\ 1 & 1 & g \\ g & \omega & 1 \end{bmatrix}$$

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4. (a) Discuss the convergence of the sequence whose n-th term is

$$a_n = \frac{(-1)^n}{n} + 1$$ 7

(b) Test the convergence of the following series : 7

$$x^2 + \frac{2^2x^4}{3.4} + \frac{2^2 4^2 x^6}{3.4.5.6} + \frac{2^2 4^2 6^2 x^8}{3.4.5.6.7.8} \cdots$$

5. (a) Find the Fourier series expansion of the function $f(x) = x^2, -2 \le x \le 2$. Hence deduce that

$$\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots$$ 7

(b) Find the Fourier cosine series and Fourier sine series of the following function in given interval : 7

$$f(x) = \begin{cases} x, & 0 < x < 2 \\ 2, & 2 \le x < 4 \end{cases}$$

6. (a) Discuss continuity of the following function at the point (0, 0) : 7

$$f(x, y) = \begin{cases} \frac{x^2y^2}{(x^3+y^3)}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$$

(b) Find the maximum value of xyz under the constraints $x^2 + z^2 = 1$ and $y - x = 0$. 7

7. (a) Find the value of

$$\lim_{x\to\infty}\left(\frac{x+4}{x+2}\right)^{x+3}$$ 4

(b) Find the equation of the tangent plane to the surface $x^2 - 3y^2 - z^2 = 2$, at the point (3, 1, 2). 10

8. Find the eigenvalues and eigenvectors of the following matrix : 14

$$\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$

9. (a) Verify Cayley-Hamilton theorem for the matrix

$$\begin{bmatrix} 0 & 0 & 1 \\ 3 & 1 & 0 \\ -2 & 1 & 4 \end{bmatrix}$$

(b) Determine the range of the following linear transformation. Also find the rank of T, where it exists. $T : V_2 \to V_3$ defined by

$$T(x_1, x_2) = (x_1, x_1 + x_2, x_2)$$ 7

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Code : 100103/100203

B.Tech 2nd Semester Special Exam., 2020

(New Course)

CHEMISTRY

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are NINE questions in this paper.

(iii) Attempt FIVE questions in all.

(iv) Question No. 1 is compulsory.

1. Answer any *seven* questions in brief : 2×7=14

(a) Arrange the following in increasing order of stability :

N_2, N_2^+, N_2^-, N_2^{2-}

(b) Transition metal ions like Cu^+ and Ag^+ are colourless. Why?

(c) Which of Cr^+ or Cu^+ is expected to be coloured?

(d) ^{13}C is NMR active, but ^{12}C is not. Why?

(e) What is the direction of a reaction when $\Delta G = 0$?

(f) Why is work not a state function?

(g) Write the relationship between parts per million (ppm) and Clarke's degree [°Cl].

(h) What is critical temperature of a gas?

(i) Arrange the following ligands in order of increasing field strength :

CN^-, CO, H_2O, NH_3

(j) Arrange the following in order of their increasing reactivity in nucleophilic substitution reaction :

CH_3F, CH_3I, CH_3Br, CH_3Cl

2. (a) At what temperature will water boil when the applied pressure is 528 mm of Hg? (Latent heat of vaporisation of water = 545·5 cal/g) 4

(b) At NTP, 2·8 L of O_2 were mixed with 19·6 L of H_2. Calculate the increase in entropy (assume ideal gas behaviour). 4

(c) The equilibrium constants for the reaction $H_2(g) + S(s) \rightleftharpoons H_2S(g)$ are 18·5 at 925 K and 9·25 at 1000 K. Calculate standard enthalpy of the reaction. Also calculate ΔG° and ΔS° at 925 K. 6

3. (a) The uncertainties in the position and velocity of a particle are 9.5×10^{-10} m and 5.5×10^{-20} ms^{-1}, respectively. Calculate the mass of the particle. ($h = 6.626 \times 10^{-34}$ J-s) 4

(b) Calculate the kinetic energy of a moving electron which has a wavelength of 4·8 pm. [Mass of electron = 9.11×10^{-31} kg) 5

(c) Discuss the failures of classical mechanics to explain properties of particles at atomic and sub-atomic levels. 5

4. (a) Draw the MO energy-level diagram for O_2 and based on the diagram, and explain the magnetic property observed in O_2, O_2^+ and O_2^-. 8

(b) Explain geometrical isomerism and optical isomerism for transition metal complex with an example for each. 6

5. (a) The internuclear distance of NaCl is 2.36×10^{-10} m. Calculate the reduced mass and moment of inertia of NaCl. (Atomic mass of Cl = 35×10^{-3} kg mol^{-1} and Na = 23×10^{-3} kg mol^{-1}) 4

(b) Calculate the force constant for CO, if it absorbs at 2.143×10^5 m^{-1}. (Atomic mass of C = 12×10^{-3} kg mol^{-1} and O = 16×10^{-3} kg mol^{-1}) 4

(c) How many ^1H NMR signals are there in –

(i) CH_3–CH_3;

(ii) CH_3–CH_2–CH_3;

(iii) CH_3–CH_2–Cl;

(iv) CH_3–CHCl–CH_3;

(v) $C_6H_5CH_3$;

(vi) $C_6H_5CH_2CH_3$? 6

6. (a) 2 mols of NH_3 at 300 K occupy a volume of 5×10^{-3} m^3. Calculate the pressure using van der Waals equation [$a = 0.417$ N m^4 mol^{-2} and $b = 0.037 \times 10^{-3}$ m^3 mol^{-1}]. Compare the above result with the pressure calculated using ideal gas equation. 5

(b) Write short notes on the following : 9

(i) Magnetic resonance imaging

(ii) Fingerprint region in infrared spectroscopy

(iii) Different types of electronic excitations

7. (a) Consider the following half-cell reactions :

$PbO_2(s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e \rightarrow PbSO_4(s) + 2H_2O$, $E^\circ = 1.70$ V

$PbSO_4(s) + 2e \rightarrow Pb(s) + SO_4^{2-}(aq)$, $E^\circ = -0.31$ V

Write the cell (in proper cell notation) and the cell reaction. Calculate the value of E° for the cell and the EMF generated if $[H^+] = 0.1$ *M* and $[SO_4^{2-}] = 2$ *M*. 7

(b) A water sample had the following constituents per litre :

$CaCO_3$ = 81 mg, $MgHCO_3$ = 75 mg, $CaSO_4$ = 136 mg, $MgSO_4$ = 120 mg, NaCl = 4·7 mg

Calculate the quantity of temporary and permanent hardness in the water sample. Calculate the quantity of lime (78% purity) and soda (92% purity) required for softening of 1·5 million litres of the above water sample. 7

8. (a) Describe two methods used for resolving racemic mixtures into optically active compounds. 4

(b) Write the possible optical isomers of tartaric acid and indicate the point of symmetry or plane of symmetry (if any) in the isomers. 5

(c) Differentiate between (i) enantiomers and diastereomers and (ii) racemic mixture and *meso* compounds. 5

9. (a) How do you decide whether the reaction $CH_3Br + OH^- \rightleftharpoons CH_3OH + Br^-$ proceeds by S_N1 or S_N2 reaction? Give justification in favour of your answer. 4

Code : 100106/100206

B.Tech 2nd Semester Special Exam., 2020

(New Course)

ENGLISH

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are NINE questions in this paper.

(iii) Attempt FIVE questions in all.

(iv) Question No. 1 is compulsory.

1. Answer the following (any *seven*) :

(a) Give one word of the following : ½×4=2

(i) Relating to sound

(ii) Related to handwriting

(iii) Fit to be eaten

(iv) Mercy killing

(b) Form a new word by adding a suffix to it : ½×4=2

(i) child

(ii) work → workout

(iii) taste

(iv) idol

(c) Write antonyms of the following : ½×4=2

(i) Particular

(ii) Ordinary

(iii) Systematic

(iv) Humble

(d) Write synonyms of the following : ½×4=2

(i) Deplete

(ii) Diversity

(iii) Enormous

(iv) Fraud

(e) Write the meanings of the following Foreign expressions : 1×2=2

(i) Modus operandi

(ii) Status quo

(f) Write the meanings of the following : 1×2=2

(i) At the drop of a hat

(ii) Devil's advocate

(g) Change the following sentences as directed : ½×4=2

(i) Did I meet him in his office? (Assertive)

(ii) He had gone to market before it started raining. (Interrogative)

(iii) Rahul goes for morning walk everyday. (Negative)

(iv) Has he lived in Allahabad? (Affirmative)

(h) Use suitable form of verbs to fill in the blanks : ½×4=2

(i) The man with all his belongings ____ (live, lives) on my street.

(ii) Annie ____ (doesn't, don't) know the answer.

(iii) Rahul and his brothers ____ (is, are) at school.

(iv) Either my shoes or your coat ____ (is, are) always on the floor.

(i) Write the meanings of the following homophones : 1×2=2

(i) Hangar / Hanger (ii) Ascent / Assent

(j) Write four sentences on 'My Ideal Teacher'. ½×4=2

2. Write an essay in about *250* words on any *one* of the following : 14

(a) Success and failure

(b) Life in a Hostel

3. Write a letter of resignation from the membership of a health club. Invent the necessary details. 14

4. Write notes on any *two* of the following : 14

(a) Chronemics

(b) Body language in presentation

(c) Spiral communication

(d) Kinesics

5. What are the causes of inter-personal barriers? How do poor listening skills affect the inter-personal barriers? 14

6. What is technical style of report writing? What principles of written communication are relevant for report writing? 14

7. Prepare a curriculum vitae for recruitment in an IT company. 14

8. What is the significance of paralinguistics in presentation? 14

9. Write about 'Stress Management' in not more than *150* words. 14

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Code : 100104/100204

B.Tech 2nd Semester Special Exam., 2020

(New Course)

PROGRAMMING FOR PROBLEM SOLVING

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are NINE questions in this paper.

(iii) Attempt FIVE questions in all.

(iv) Question No. 1 is compulsory.

1. Choose the correct alternative (any *seven*) : 2×7=14

(a) A variable name in C should be a/an

(i) reserve word

(ii) keyword

(iii) identifier

(iv) All of the above

(b) Why do we write (int*) before malloc?

int *p=(int*)malloc(sizeof(int));

(i) It is for the syntax correctness

(ii) It is for the type casting

(iii) It is to inform malloc() function about data-type expected

(iv) None of the above

(c) Which header file is used for reading and writing to a file?

(i) #include<iostream.h>

(ii) #include<fstream.h>

(iii) #include<file.h>

(iv) All of the above

(d) Which of the following functions displays the keyboard character for pressed key?

(i) getch()

(ii) getche()

(iii) Both (i) and (ii)

(iv) None of the above

(e) What does the following declaration mean?

int (*ptr) [10];

(i) *ptr* is array of pointers to 10 integers

(ii) *ptr* is a pointer to an array of 10 integers

(iii) *ptr* is an array of 10 integers

(iv) *ptr* is a pointer to array

(f) Automatic variables are initialized to

(i) zero

(ii) junk value

(iii) None of the above

(iv) Both of the above

(g) Which of the following symbols is the type-specifier?

(i) &

(ii) *

(iii) #

(iv) %

(h) The && and || operators

(i) compare two numeric values

(ii) compare two numeric values short-hand operators

(iii) compare two Boolean values

(iv) None of the above

(i) Identify the correct sequence of steps to run a program.

(i) Link, load, code, compile and execute

(ii) Code, compile, link, execute and load

(iii) Code, compile, link, load and execute

(iv) Compile, code, link, load and execute

(j) An external variable is the one

(i) which resides in the memory till the end of the program

(ii) which is globally accessible by all the functions

(iii) which is declared outside the body of the function

(iv) All of the above

2. (a) Discuss about some methods or methodologies used for problem solving. 5

(b) How programming utilizes different components of computer system? 5

(c) What is algorithm? Give an example algorithm for any problem. 4

3. (a) What is the difference between compilation and execution of a program? 4

(b) What is the effect of warning and syntax error on program execution? What we get as an output of compilation step? 6

(c) What are varibales? List the 'data types' which can be associated to a variable in C language. 4

4. (a) What is the role of 'header files' in C language? List any four with their usage. 6

(b) Draw a flowchart to find the average of 10 numbers of an array. 4

(c) Write the syntax for conditional operator in C. Also write the syntax for some conditional statements used in C. 4

5. (a) List the looping constructs used in C. What are the roles of 'break' and 'continue' statements in loops? Show with examples. 7

(b) Given a list of 11 numbers. Write a C program to find the median of that list. 7

6. (a) What are functions? How are they useful? Comment on two categories in which various functions can be categorized. 6

(b) Write a C program to generate Fibonacci series using function. 5

(c) List three different ways to read a string from the prompt. 3

7. (a) What are the ways of parameter passing in functions? Explain each. 6

(b) Write a C program to find the largest number from an array using pointer. 5

(c) What are the structures in C? How are they different from Union? 3

8. (a) What is dynamic memory allocation? How is this achieved in C? Explain. 6

(b) Write a C program to copy the content of one file into other. 6

(c) How is merge sort different from other sorting algorithms? 2

Code : 100105

B.Tech 1st Semester Exam., 2019
(New Course)

WORKSHOP MANUFACTURING PRACTICES

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are NINE questions in this paper.

(iii) Attempt FIVE questions in all.

(iv) Question No. 1 is compulsory.

1. Choose the correct answer of the following (any *seven*) : 2×7=14

(a) A zinc diffusion process is called
- (i) galvanizing
- (ii) anodizing
- (iii) parkerizing
- (iv) sherardizing

(b) The type of file used for a woodwork is
- (i) single-cut file
- (ii) double-cut file
- (iii) rasp-cut file
- (iv) Any one of the above

(c) A taper provided on the pattern for its easy and clean withdrawal from the mould is known as
- (i) machining allowance
- (ii) draft allowance
- (iii) shrinkage allowance
- (iv) distortion allowance

(d) In arc welding, the electric arc is produced between the work and the electrode by
- (i) voltage
- (ii) flow of current
- (iii) contact resistance
- (iv) All of the above

(e) In a centrifugal casting method
- (i) core is made of sand
- (ii) core is made of ferrous metal
- (iii) core is made of non-ferrous metal
- (iv) no core is used

(f) The draft or taper allowance on casting is generally
- (i) 1 to 2 mm/m
- (ii) 2 to 5 mm/m
- (iii) 5 to 10 mm/m
- (iv) 10 to 15 mm/m

(g) Which of the following welding processes uses non-consumable electrodes?
- (i) TIG welding
- (ii) MIG welding
- (iii) Manual arc welding
- (iv) Submerged arc welding

(h) In a bilateral system of tolerance, the tolerance is allowed on
- (i) one side of the actual size
- (ii) one side of the nominal size
- (iii) both sides of the actual size
- (iv) both sides of the nominal size

(i) The temperature at which the new grains are formed in the metal is called
- (i) lower critical temperature
- (ii) upper critical temperature
- (iii) eutectic temperature
- (iv) recrystallization temperature

(j) In sheet metal blanking, shear is provided on punches and dies so that
- (i) press load is reduced
- (ii) good cut edge is obtained
- (iii) warping of sheet is minimized
- (iv) cut blanks are straight

2. (a) Draw a neat sketch of metal jack plane and name its parts. 7

(b) Write the specific use of (i) spokeshave and (ii) router plane. 7

3. (a) List out the different types of files. Write the use of any three types of files with sketches. 7

(b) Describe the working of spring hammer with neat sketch. 7

4. (a) What is tap? Explain the different types of tap that are used in fitting with neat sketch. 7

(b) List out the forging operations. Explain any four forging operations with a suitable diagram. 7

5. (a) List any four materials used for pattern making. 2

(b) Explain any four properties of moulding sand. 8

(c) What is meant by sand binder? Name the types of sand binders. 4

6. (a) Write four advantages of hot working process. Explain the principle of hot rolling. 6

(b) Explain the following hot working processes : 8
- (i) Extrusion
- (ii) Drawing

7. (a) Explain any four operations performed on lathe machine with neat sketch. 8

(b) Write a short note on sine bar. 6

8. (a) Write the specific application of any three measuring tools in carpentry. List out the different holding tools used in carpentry. 6

(b) Explain the following handsaws used in carpentry with neat sketch : 8
- (i) Rip saw
- (ii) Bow saw
- (iii) Dovetail saw
- (iv) Keyhole saw

9. *(a)* What is the minimum flange length in sheet metal bend? 6

(b) Draw and explain four types of seam in sheet metal operation. 8

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