**PUNJABI UNIVERSITY, PATIALA**

**OUTLINES OF TESTS,**

**SYLLABI AND COURSES OF READING**

**FOR**

**B.Sc. (HONOURS IN MATHEMATICS) Part - I**

**1st and 2nd SEMESTER**

**2020-2021, 2021-2022 & 2022-2023**

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**PUNJABI UNIVERSITY, PATIALA**

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 **( Semester- I)**

**BMH 101: Calculus-I**

 L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

 **Section-A**

**Differential Calculus:** ∈ - *δ* definition of the limit of a function. Basic properties of limits. Continuous functions and classification of discontinuities. Differentiability. Applications of Derivatives. Asymptotes. Test for concavity. Points of inflexion. Tracing of Curves.

(Scope as in Chapters 1,2,3 of Calculus and Analytic Geometry by Thomas and Finney, Ninth Edition)

**Integral Calculus:** Integration of functions. Riemann sum and definite integrals. Properties, Area and the Mean value theorem, The fundamental theorem of Calculus.

(Scope as in Chapters 4 of Calculus and Analytic Geometry by Thomas and Finney, Ninth Edition)

 **Section-B**

**Integral Calculus :** Integration by parts, Partial fractions and trigonometric substitutions. Applications of integrals. Areas between curves. Finding volumes by slicing. Volumes of solids of Revolution-Disks and Washers. Cylindrical Shells. Lengths of plane curves. Areas of surfaces of revolution.

(Scope as in Chapters 5 of Calculus and Analytic Geometry by Thomas and Finney, Ninth Edition)

**Infinite Series :** Limits of sequence of numbers. Theorems for calculating limits of sequences, Bounded and Monotonic sequences, Cauchy’s convergence criterion. Infinite Series, Series of non-negative terms. Comparison tests. Cauchy’s Integral test. Ratio tests. Alternating series. Absolute and conditional convergence. Leibnitz Theorem, Convergence of Taylor Series, Error Estimates. Applications of Power Series.

(Scope as in Chapters 8 of Calculus and Analytic Geometry by Thomas and Finney, Ninth Edition.

**Suggested Readings**

1.George B. Thomas and Ross L. Finney: Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998.

2. Liefhold, Louis: Calculus and Analytic Geometry, 2nd Edition, New York, Harper & Row 1972.

3.Lipmen Bers: Calculus, IBH Mumbai 1974.

**BHM 102: Coordinate Geometry**

 L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

**Section-A**

**General Equation of Second Degree:** conic section, centre of conic section, principal axes and eccentricity of a conic, axis, latus rectum, vertex and focus of a parabola, tracing of cones.

**Polar Equation of a conic:** tracing of the conic, chord joining two points, tangents, normals, polar, director circle and asymptotes.

**Introduction of Oblique Axes:** distance between two points, equation of a line, angle between two lines, length of perpendicular, angle between the pair of lines.

**Section-B**

**Oblique axes:** oblique axes from rectangular axes, invariants equation of circle, parabola, ellipse, hyperbola.

**Cone:** general second degree equation of a cone, its intersection with a plane and with a line, enveloping cone, right circular cone, the cone $ax^{2}+by^{2}+cz^{2}=0$

**Cylinder:** enveloping cylinder, right circular cylinder .

**References**

* + - 1. P.K Jain and Khalil Ahmed: A text book of Analytical Geometry ,New Age International Publishers, Third Edition, 2014.
			2. Shanti Narayan and P.K Mittal: Analytical Solid Geometry, 17th Revised Edition, S.Chand and Co., New Delhi, 2006.

 **CS- 103: Introduction to Information Technology**

L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

**SECTION-A**

Historical Evolution of Computer: Characterization of Computers, types of Computers, the Computer generations. Basic Anatomy of Computers: memory unit, input-output unit, arithmetic logic unit, control unit, central processing unit, RAM, ROM, PROM, EPROM. Input-Output Devices: punched hole devices, magnetic media devices, printers, keyboard, scanners, OCR, OMR. Number System: non-positional and positional number systems, base conversion, fractional numbers, various operations on binary numbers: addition, subtraction, multiplication and division. Secondary Storage: sequential vs random storage, floppy, hard disk, optical disk.

**SECTION-B**

Computer Code: BCD, EBCDIC, ASCII, Grey Code

Computer Software: Introduction, types of software: application and systems software.

 Computer Languages: Machine Language, assembly language, high level language, 4GL, assembler, compiler and interpreter.Networking: Basics, types of networks (LAN, WAN, MAN), topologies, communication media, Operating System, Definition, functions and types of operating system, E-commerce: meaning, advantages and application of e-commerce.

**REFERENCES**

1. V Rajaraman, "Fundamentals of Computers", PHI, N. Delhi, 1996.
2. N Subramanium, "Introduction to Computers", Volume-I.
3. Dr. Rajesh Trehan, "A Complete Book on IT", Cyber Tech.

**CS-104 A: Computer Programming using 'C'**

L T P University Exam: 40

4 0 0 Internal Assessment: 10

Time Allowed: 3 hours Total: 50

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

**SECTION-A**

Programming process: Problem definition, program design, coding, compilation and debugging. Identifiers and keywords, data types, input and output, type conversion, operators and expressions: Arithmetic, unary, logical and relational operators, assignment operator, conditional operator, library functions. Control statements: branching, looping, using for, while and do-while statements, nested control structures, switch, break and continue statement. Functions: definition, call prototype and passing arguments to a function, recursion versus iteration. User defined and library functions. Storage classes: automatic, external and static variables.

**SECTION-B**

Arrays: Definition, accessing elements, initialization, passing to functions, multi dimensional arrays, strings, Structure: variables, accessing members, nested structures.Pointers: address and differencing operators, declaration, assignment, passing pointer to functions, pointer arrays, pointer and arrays, pointer to structures, Files: reading, writing text and binary files. text vs binary files.

**TEXT BOOKS**

1. Byron Gottfried, "Programming with C. (Second edition), Schaum's outline series" Tata McGraw Hill Publishing Co.

**REFERENCE BOOKS**

2. Ram Kumar and Rakesh Aggarwal: Programming in Ansi C, Tata McGraw Hill Publishing Co. Ltd. (2nd ed.).

3. B.W. Karrighan and D.M. Richie, "The C programming language", 2nd edition, (2003) PHI.

1. H.H. Tan & T.B. Dorazio, "C Programming for engineers & Computer Science", McGraw Hill (international edition).

**CS-104 B: Software Lab-I (C- Programming)**

L T P University Exam: 30

0 0 4 Internal Assessment: 20

Time Allowed: 3 hours Total: 50

Programs to be developed based upon various constructs in the C language

**SC 105: Mathematical Foundation of Statistics**

L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

**SECTION-A**

Notion of Probability: Random experiment, sample space, axiom of probability, elementary properties of probability, equally likely outcome problems. Random Variables : Concept, cumulative distributive function, discrete and continuous random variables, expectations, mean, variance, moment generating functions. Discrete random variable: Bernoulli random variable, binomial random variable, generic random variable, Poisson random variable. Continuous random variables: Uniform random variable, exponential random variable, Gamma random variable, normal random variable.

**SECTION-B**

Conditional probability and conditional expectations, Bayes theorem, independence, computing expectation by conditioning; some applications- a list model, a random graph, Paly's urn model. Bivariate random variable: Joint distributions and conditional distributions, the correlation coefficient. Function of random variable: Sum of random variables. The laws of large numbers and the Central Limit Theorem, the approximation of distributions. Uncertainity, information and entropy, conditional entropy, solution of certain logical problems by calculating information.

**REFERENCES**

1.S.M. Ross, *Introdution to Probability Models (*Sixth edition) Academic Press, 1997

2. I. Blake, *An Introduction to Applied Probability,* John Wiley and Sons, 1979.

3. J. Pitman, *Probability,* Narosa, 1993.

**phHn?;H;hH (nkBoI) rfDs ;w?;No**

**2020^21, 2021^22 ns/ 2022^23 ;?PB bJh**

**;w?;No gfjbk**

**PBI 106:- PUNJABI-I/ Mudhla Gyan**

e[b nze L 100 ftP/ ftu'A gk; j'D bJh nze L 40

nzdo{wh w[bKeD L 25 nze nzdo{Bh w[bKeD ftu'A gk; j'D bJh nze L 12

pkjoh gohfynk L 75 nze pkjoh gohfynk ftu'A gk; j'D bJh nze L 28

;wKL3 xzN/ (nfXnkgB L5 ghohnv gqsh jcsk)

**f;b/p; ns/ gkm g[;seK**

Gkr^TL (1) **ekft Ne;kb** (wZXekbhB ekft gzB/ 1^34), (;zgkdeLfsqb'e f;zx nkBzd ns/ nB{g ftoe, gzikph :{Bhtof;Nh, gfNnkbk)

 (2) **eEk ejkDh** (;zgkde Loxpho f;zx ns/ dopkok f;zx, gzikph :{Bhtof;Nh, gfNnkbk)

Gkr^nL (1) **g?oQk ouBk**^ ;wkie, tksktoD iK ;fGnkuko Bkb ;pzXs.

 (2) **ftnkeoD**

 (i) ;to ;EgBk d/ nkXko, gzikph ;toK dk torheoB s/ nkXko, tos'A ns/

T[ukoB d/ fB:w

(ii) ftnziBL;EkgBk d/ nkXko, gzikph ftnziB X[BhnK, torheoB d/ nkXko, tos'A ns/ T[ukoB ftXh s/ ;EkB

 (iii) gzikph ftu ;[o, pb ns Bkf;esk dk T[ukoB ns/ fB:w

Gkr^J ;ko/ f;b/p; s/ nkXkos ;zy/g T[ZsoK tkb/ gqPB.

**nze ^tzv ns/ g/go ;?ANo bJh jdkfJsK**

1H f;b/p; d/ ;ko/ GkrK ftu'A gqPB g[ZS/ ikDr/.

2H g/go B{z fszBH GkrK T,n,ns/ J ft/Zu tzfvnk ikt/rk.

3H fe;/ eftsk dk ftPk iK ;ko (fszB ftZu'A fJZe) 10 nze

4H gq;zr ;fjs ftnkfynk (fszB ftZu'A fJZe) 07 nze

5H fe;/ ejkDh dk ftPk$;ko iK gkso ;zpzXh ikDekoh (fszB ftZu'A fJZe) 10 nze

6H ;wkfie tksktoD iK ;fGnkuko Bkb ;zpzXh g?oQk ouBk (fszB ftZu'A fJZe) 08 nze

7H ftnkeoD ;zpzXh toDBkswe gqPB (fszB ftZu'A fJZe) 10 nze

8H Gkr J T[go'es f;b/p; ;zpzXh ;zy/g T[ZsoK tkb/ 15 gqPB g[ZS/ ikD.ftfdnkoEhnK B/ ;ko/

 gqPBKdk T[Zso d/Dk j't/rk. jo/e gqPB d/ 2 nze j'Dr/. **15x2=30 nze**

**;jkfJe gkm ;wZroh**

1H I;ftzdo f;zx, BthA gzikph eftskL gSkD fuzBQ, u/sBk gqekPB, b[fXnkDk,

2H vkH okfuzdo gkb f;zx pokV, nkX[fBe gzikph eftsk g[Bo fuzsB , b'erhs gqekPB, uzvhrVQH

3Hy'I gfsqek, (rbg ftP/P nze), gzikph :{Bhtof;Nh, gfNnkbkH

4HvkH pbd/t f;zx Xkbhtkb, gzikph ejkDh dk fJfsjk;, gzikph nekdwh, fdZbhH

5H vkH I'frzdo f;zx g[nko, GkPk ftfrnkBL ;zebg s/ fdPktK , gzikph GkPK nekdwh, ibzXoH

6H vkH I'frzdo f;zx g[nko ns/ j'o, gzikph GkPk dk ftnkeoBe Gkr I,II,III, gzikph GkPk nekdwh,ibzXoH

**Mudhla Gyan\* as per University Guidelines. Syllabus is available on University website**

**(Semester-II)**

**BMH- 201: Calculus-II**

L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of

the Section A and B and compulsory question of Section C

**Section-A**

**Vector Analysis :** Vectors in the plane Cartesian Co-ordinates and vectors in spaces. Dot and cross products. Lines and planes in space, Cylinders and Quadric surfaces. Cylindrical and Spherical co-ordinates. Vector valued functions and space curves. Modelling Projectile Motion. Arc length and Unit Tangent vector curvature, Torsion and the TNB Frame. Functions of several variables. Limits and continuity. Partial derivatives. Differentiability. The chain rule, Directional derivatives, Gradient vectors and tangent planes. Extreme values and saddle points. Lagrange multipliers

(Scope as in chapters 10, 11 and 12 of Calculus and Analytic Geometry by Thomas and Finney, Ninth Edition)

**Section-B**

**Multiple Integrals:**. Double integrals. Double integrals in Polar Form. Triple integrals in Rectangular co-ordinates. Triple integrals in Cylindrical and Spherical co-ordinates. Integration in Vector fields : Line and Surface integrals. Green's, Stoke's and Gauss Divergence theorems with proofs, and their applications.

(Scope as in Chapters 13 and 14 of Calculus and Analytic Geometry by Thomas and Finney, Ninth Edition).

**Suggested Readings**

1. George B. Thomas and Ross L. Finney: Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998.

 2. Liefhold, Louis: Calculus and Analytic Geometry, 2nd Edition, New York, Harper & Row 1972.

1. Lipmen Bers: Calculus, IBH Mumbai 1974.

**BMH-202: Ordinary Differential Equations**

L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the

 Section A and B and compulsory question of Section C

**Section-A**

**Ordinary differential equations:** Basic definitions: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines.

First order differential equations: Linear, non-linear differential equations, Variables separable, homogeneous, non-homogeneous exact equations and integration factors, equations reducible to first order, Clairaut’s equation and Geometrical interpretation of first order differential equation, applications.

Successive approximations, Lipschitz condition, Statements of Existence and Uniqueness of solution of first order differential equations.

**Section-B**

**Second order Differential Equations**: Linear equations with constant coefficients, Wronskian, Standard Methods for solution, Nonhomogeneous, linear with constant coefficients. Method of Variation of Parameter, Linear Independence, Linear dependence. Second order linear equation with variable coefficient.

Euler equation, regular singular points, ordinary points, series soultion. Method of Frobenius, Applications, Legendre’s, Hermite’s and Bessel’s equation.

**Suggested Reading**

1. W.E.Boyce and P.C.Diprima : Elementary Differential Equations and Boundary value problems, John Wiley, 1986.
2. Coddington, E.A. : An Introduction to Ordinary Differential Equations. Prenctice-Hall (India),1961, (Chapters I-V).
3. E.L.Ince : Theory of Ordinary Differential Equations. Dover ,1956.
4. E. D. Rainville: Elementary Differential Equations, Bedient Publisher Prentice

Hall, 1997.

 **CS-203: Computer Systems Architecture**

L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the

 Section A and B and compulsory question of Section C.

**Section A**

Basic computer architecture, functional organization, Register organization, arithmetic and logic unit, central processing unit, Instruction formats, Addressing modes, Data transfer and manipulation, Interrupts, RISC/CISC architecture. Boolean algebra, Basic Gates, Combinational logic design: half-adder, full adder, parallel adder. Sequential circuits: concept, flip-flops (D, RS, JK, JK-Master-Slave, T), Counters (Ripple, Asynchronous Synchronous, Decade, Mod-5).

**Section B**

Register Transfer Language, Arithmetic, Logic and Shift micro-operations, Arithmetic Logic Shift unit, Memory organization: memory hierarchy, Memory types: cache, associative and other types. I/O organization: Peripheral devices, I/O interface, Modes of data transfer: Programmed I/O, Interrupt initiated I/O, DMA,I/O processor.

**Text Books**

1. M.M. Mano, “Computer System Architecture”, Third Edition, Prentice Hall of India, 2002.

2.A.S. Tannenbaum, “Structured Computer Organisation”, Prentice- Hall of India, 1999.

3.William Stallings, “Computer Organisation and Architecture”, 6th edition, Pearson Education, 2000.

**CS-204 A: Object Oriented Programming with "C++"**

L T P University Exam: 40

4 0 0 Internal Assessment: 10

Time Allowed: 3 hours Total: 50

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the

 Section A and B and compulsory question of Section C.

#  SECTION A

Evolution of OOP: Procedure Oriented Programming, OOP Paradigm, Advantages and disadvantages of OOP over its predecessor paradigms.

Characteristics of Object Oriented Programming: Abstraction, Encapsulation, Data hiding, Inheritance, Polymorphism, Code Extensibility and Reusability, User defined Data Types.

Introduction to C++: Identifier, Keywords, Constants, Operators: Arithmetic, relational, logical, conditional and assignment. Size of operator. Type conversion, Variable declaration, expressions, statements, manipulators. Input and output statements, stream I/O, Conditional and Iterative statements. Storage Classes: Automatic, Static, Extern, Register. Arrays, Arrays as Character Strings.

Pointers: Pointer Operations, Pointer Arithmetic, Pointers and Arrays, Pointer to functions. Functions: Prototyping, Definition and Call, Scope Rules. Parameter Passing: by value, by address and by reference, Functions returning references, recursion, Default Arguments, Const arguments.

**SECTION B**

Pre-processor: #define, #error, #include, #if, #else, #endif, #ifdef, #ifdef, #undef

Classes and Objects: Class Declaration and Class Definition, Defining member functions, making functions inline, Nesting of member functions, Members access control. this pointer. Objects: Object as function arguments, array of objects, Const member functions. Static data members and Static member functions.Friend functions and Friend classes.

Constructors: properties, types of constructors (Default, parameterized and copy), Dynamic constructors, multiple constructors in classes. Destructors: Properties, Virtual destructors. Destroying objects. Rules for constructors and destructors.

Array of objects. Dynamic memory allocation using new and delete operators, Nested and container classes. Scopes: Local, Global.

Inheritance: Defining derived classes, inheriting private members, single inheritance, types of derivation, constructors in derived class.

Polymorphism : Operator overloading and Function overloading.

**TEXT BOOKS**

1. Herbert Schildt, “The Complete Reference C++”, Tata McGraw-Hill, 2001.
2. Deitel and Deitel, “C++ How to Program”, Pearson Education, 2001

**REFERENCE READINGS**

1. Robert Lafore, “Object Oriented Programming in C++”, Galgotia Publications, 1994.
2. Bjarne Strautrup, “The C++ Programming Language”, Addition- Wesley Publication Co., 2001.
3. E. Balagurusamy, “ Object Oriented Programming with C++”, Tata McGraw-Hill, 2001

**CS-204 B -Software Lab-II (C++)**

L T P University Exam: 30

0 0 4 Internal Assessment: 20

Time Allowed: 3 hours Total: 50

Programs to be developed based upon various constructs in the C++

**SC-205: LINEAR PROGRAMMING**

L T P University Exam: 70

4 1 0 Internal Assessment: 30

Time Allowed: 3 hours Total: 100

**INSTRUCTIONS FOR THE PAPER-SETTER**

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having ten short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 10 marks and and Section C will be of 30 marks.

**INSTRUCTIONS FOR THE CANDIDATES**

Candidates are required to attempt five questions in all selecting two questions from each of the

 Section A and B and compulsory question of Section C

**SECTION A**

Mathematical Programming Problems, Linear programming problems (LPPs); Examples, Mathematical formulation, Graphical solution, Solution by Simplex method, Artificial variables, Big-M method and Two phase method. Duality in linear programming; Concept, Mathematical formulation, fundamental properties of duality, duality and simplex method and dual simplex method.

**SECTION B**

Sensitivity Analysis : Discrete changes in the cost vector, requirement vector and Co-efficient matrix (Numerical Problems Only). Transportation problem ; initial basic feasible solution and Optimal solutions using MODI method (for balanced cases only) Assignment problem; Formulation of Assignment Problems, solution of balanced and unbalanced assignment problems, maximization case in assignment problem.

**TEXT BOOKS**

1. Kanti Swarup, P.K. Gupta and Manmohan : ‘Operations Research’, Sultan Chand
and Sons, New Delhi.

 **RECOMMENDED READING**

1. Kasana, H.S. and Kumar K.D. : Introductory Operations Research, SIE 2003

**phHn?;H;hH (nkBoI) ;w?;No**

**2020^21,2021^22 ns/ 2022^23 ;?PB bJh**

**;w?;No d{ik**

**PBI 206:- Punjabi-II/ Mudhla Gyan**

e[b nze L 100 ftP/ ftu'A gk; j'D bJh nze L 40

nzdo{wh w[bKeD L 25 nze nzdo{Bh w[bKeD ftu'A gk; j'D bJh nze L 12

pkjoh gohfynk L 75 nze pkjoh gohfynk ftu'A gk; j'D bJh nze L 28

;wKL3 xzN/ (nfXnkgB L5 ghohnv gqsh jcsk)

**f;b/p; ns/ gkm g[;seK**

Gkr^TL (1) **ekft Ne;kb** (nkX[fBe ekft, 35^70), (;zgkdeLfsqb'e f;zx nkBzd ns/ nB{g ftoe, gzikph :{Bhtof;Nh, gfNnkbk)

(2) **fJeKrh :ksok** (;zgkde Loxpho f;zx ns/ ;shP e[wko towk,gzikph :{Bhtof;Nh, gfNnkbk)

Gkr^nL (1) jo/e ftP/ Bkb ;pzXs seBheh Ppdkpbh (nzro/ih s'A gzikph nB[tkd s/ tkeK

ftu tos'A

 (2) **ftnkeoD**

 (i) PpdL gfoGkPk ns/ torheoB, fwPos ns/ ;z:[es gzikph Ppd dh pDso, tX/so, nr/so, fgS/so

(ii) Ppd ouBkL ;zebg, o{g noE ns/ Po/Dh d/ gZy s'A gzikph Ppd^o{gK dk ;o{g ns/ fBowkD ftXh.

(iii) Ppd Po/DhnK (BKt, gVBKt, ftP/PD, fefonk, fefonk ftP/PD, ;pzXe, :'ie)

Gkr^J ;ko/ f;b/p; s/ nkXkos ;zy/g T[ZsoK tkb/ gqPB.

**nze ^tzv ns/ g/go ;?ANo bJh jdkfJsK**

1H f;b/p; d/ ;ko/ GkrK ftu'A gqPB g[ZS/ ikDr/.

2H g/go B{z fszBH GkrK T,n,ns/ J ft/Zu tzfvnk ikt/rk.

3H fe;/ eftsk dk ftPk iK ;ko (fszB ftZu'A fJZe) 10 nze

4H gq;zr ;fjs ftnkfynk (fszB ftZu'A fJZe) 07 nze

5H fe;/ fJeKrh dk ftPk$;ko iK gkso ;zpzXh ikDekoh (fszB ftZu'A fJZe) 10 nze

6H ftP/ Bkb ;zpzfXs seBheh Ppdktbh dk gzikph o{g iK nB[tkd (nZm ftZu'A uko) 4x2=08 nze

 ns/ tkeK ftZu tos'A

7H ftnkeoD ;zpzXh toDBkswe gqPB (fszB ftZu'A fJZe) 10 nze

8H T[go'es f;b/p; ;zpzXh ;zy/g T[ZsoK tkb/ 15 gqPB g[ZS/ ikD. ftfdnkoEhnK B/ ;ko/

gqPBK dk T[Zso d/Dk j't/rk.jo/e gqPB d/ 2 nze j'Dr/. **15x2=30 nze**

**;jkfJe gkm ;wZroh**

1H I;ftzdo f;zx, BthA gzikph eftskL gSkD fuzBQ, u/sBk gqekPB, b[fXnkDk,

2H vkH okfizdo gkb f;zx pokV, nkX[fBe gzikph eftsk g[Bo fuzsB , b'erhs gqekPB, uzvhrVQH

3H y'i gfsqek, (BkNe ftP/P nze), gzikph :{Bhtof;Nh, gfNnkbkH

4H o'PB bkb nkj{ik, fJeKrh ebk, gzikp ;N/N N?e;N p[e p'ov uzvhrVQH

5H ;shP e[wko towk, gzikph BkNe dk fJfsjk;, gzikph nekdwh, fdZbhH

6H vkH I'frzdo f;zx g[nko ns/ j'o, gzikph GkPk dk ftnkeoBe Gkr I,II,III, gzikph GkPk nekdwh,ibzXoH

**Mudhla Gyan\* as per University Guidelines. Syllabus is available on University website.**