SCHEME OF EXAMINATION

& SYLLABI

for

Bachelor of Technology / Master of Technology(Dual Degree Programmes)

Scheme and Syllabusfor

a. **Computer Science and Engineering – Major Discipline**
b. **Information Technology– Major Discipline**
c. **Electronics and Communication Engineering– Major Discipline**
d. **Computer Science and Engineering - Artificial Intelligence**
e. **Computer Science and Engineering - Data Science**

1st Year Common Scheme and Syllabus, 2nd year Scheme, and Framework of Scheme for higher semesters (3rd year and 4th year) (w.e.f. AS 2024-25)

Offered by

University School of Information, Communication & Technology

At

GGSIP University, Dwarka Campus

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

Guru Gobind Singh Indraprastha University Sector 16C, Dwarka, Delhi – 110 078 [INDIA]

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Approval History:

1. Scheme and Syllabi of 1st year, Scheme of 2nd year, and framework of scheme of 3rd year and 4th year approved by BoS on 06/08/2024.

2. Scheme and Syllabi of 1st year, Scheme of 2nd year, and framework of scheme of 3rd year and 4th year approved by AC Sub-committee on 13/08/2024.

3. Scheme and Syllabi of 2nd year, and framework of scheme of 3rd and 4th year, and also the regulations for implementation and award of degrees approved by BoS on 28.07.2025.

4. Scheme and Syllabi of 2nd year, and framework of scheme of 3rd and 4th year, and also the regulations for implementation and award of degrees approved by Academic Council Sub-committee on 1.08.2025.

Vision of the School

Create high-quality engineering and computer application professionals

Mission of the School

To serve humanity by creating professionally competent, socially sensitive engineers withhigh ethical values who can work as individuals or in groups in multicultural global environments.

Introduction

This document describes the curriculum of the Bachelor of Technology part of the Dual Degree (Bachelor Technology / Master of Technology) Programmes that are offered at the University School of Information, Communication and Technology in its own campus (not at the affiliated institution of the University). In the event of any difficulty of implementation, and / or interpretation of any clause of the document, the same maybe brought to the notice of Dean of the University School of Information Communication and Technology. The decision of the Dean, University School of Information Communication and Technology shall be final and implemented to resolve the issue. The same shall be put up in the subsequent meeting of the Board of Studies of the University School of Information Communication and Technology for its approval. If the decision of the Board of Studies of the University School of Information Communication and Technology is at variance with the decision taken earlier by the Dean of the School, the decision of the Board shall be effective from the date of the approval by the Board of Studies. In the interim period (between the approval of the Dean, of the School and the Board of Studies approval), the decision already taken by the Dean of the school shall stand.

The marking scheme for all non-NUES papers (theory/practical) to be as:

1. **Teachers Continuous Evaluation: 40 marks**
2. **Term end Theory Examinations: 60 marks**

Programme Outcomes

1. ***Engineering Knowledge*** (**PO01**): Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. ***Problem Analysis*** (**PO02**): Identify, formulate, review research literature, and analysecomplex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. ***Design/Development of Solutions*** (**PO03**): Design solutions for complex engineering problems and design system components or processes that meet the specified needswith appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. ***Conduct Investigations of Complex Problems*** (**PO04**): Use research-based knowledgeand research methods including design of experiments, analysis and interpretation ofdata, and synthesis of the information to provide valid conclusions for complexproblems:
    - that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques;
    - that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;
    - that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;
    - which need to be defined (modelled) within appropriate mathematical framework; and
    - that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.
5. ***Modern Tool Usage*** (**PO05**): Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. ***The Engineer and Society*** (**PO06**): Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. ***Environment and Sustainability*** (**PO07**): Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. ***Ethics*** (**PO08**): Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. ***Individual and Team Work*** (**PO09**): Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. ***Communication*** (**PO10**): Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. ***Project Management and Finance*** (**PO11**): Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. ***Life-long Learning*** (**PO12**): Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Course / Paper Group Codes:
BS: Basic Sciences
ES: Engineering Sciences
VAC: Value Added Course
AEC: Ability Enhancement Course
PC: Programme Core, that is course / paper offered in the discipline of the programme as a compulsorypaper.
PCE: Programme Core Elective, that is elective course / paper offered in the discipline of the programme.
EAE: Emerging Area Elective offered by school.
OAE: Open area elective offered by other school or open / emerging area elective offered by the school/ offered through SWAYAM / NPTEL MOOCs platform.
Note: The details of the papers offered by USIC&T as open elective/emerging area electives shall be notified later on.

Definitions:
Batch: The batch of the student shall mean the year of the first time enrolment of the students in the programme of study in the first semester. Lateral entry students admitted in the 3rd semester / 2nd year shallbe designated as students admitted in the previous batch as they are admitted one year later. A student re-admitted in a programme of study in a lower / later batch shall be considered as the student of the original batch for the purpose calculation of duration of study.

Programme of study shall mean Bachelor of Technology.

Major Specialization shall mean the discipline in which the student is admitted / upgraded or transferred.

Minor Specialization: It is possible to use the electives to provide a limited specialization in some sub-areas of CSE/IT/ECE, which is called Minor specializations. It shall mean the specializations earned through the EAE or OAE route, subject to fulfilment of requirements, as shall be specified in the scheme of study for the concerned minor specialization. The details about the minor specialization offered by USIC&T will be notified later on.

Paper / Course shall be treated as synonyms. A paper is one unit of curriculum taught, in general, in one particular semester, having up to 4 credits.

Acronyms:

CSE: Computer Science and Engineering
IT: Information Technology
ECE: Electronics and Communications Engineering
CSE-AI: Computer Science and Engineering - Artificial Intelligence
CSE-DS: Computer Science and Engineering - Data Science
APC: Academic programme committee comprising of all faculty of the school and as defined in theimplementation rules.
BoS: Board of Study of the school, USICT.
USIC&T: University School of Information, Communicatio &Technology.
L: Number of Lecture hours per week
P: Number of Practical Hours per week
C: Number of credits assigned to a course / paper
COE: Controller of Examinations of the Examinations Division of the University.SGPA/CGPA: Semester/Cumulative Grade Point Average.
NUES: No term end examination shall be held. The evaluation shall be conducted as per the scheme of examinations as described in the scheme of study.

NOTE: THE CURRENT DOCUMENT DEFINES THE SCHEME AND SYLLABUS FOR THE FIRST TWO YEAR, AND FRAMEWORK OF SCHEME OF THIRD YEAR AND FOURTH YEAR. THE SCHEME OF 3rd AND 4th YEAR MAY CHANGE ON FINALIZATION OF THE SCHEME AND SYLLABUS OF 3rd YEAR ONWARDS (INCLUDING IMPLEMENTATION REGULATION AND THE REGULATION FOR THE AWARD OF THE DEGREE)

FIRST YEAR

Common Scheme and Syllabus for

Bachelor of Technology / Master of Technology(Dual Degree Programmes)
In

a. Computer Science and Engineering – Major Discipline
b. Information Technology– Major Discipline
c. Electronics and Communication Engineering– Major Discipline
d. Computer Science and Engineering - Artificial Intelligence
e. Computer Science and Engineering - Data Science

B.Tech/M.Tech Dual Degree

First Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-101	Programming for Problem Solving	4	-	4
ES	ES-103/ ES-105	*Any one of the following: Basics of Electrical Engineering/ Basics of Electronics Engineering	3	-	3
BS	BS-107	Engineering Mathematics – I	4	-	4
BS	BS-109/ BS-111	*Any one of the following: Engineering Chemistry/ Engineering Physics	3	-	3
ES/ AEC	ES-113/ AEC-115	*Any one of the following: Engineering Mechanics/ Communication Skills	3	-	3
VAC	VAC-117	+Indian Constitution	2	-	2
VAC	VAC-119	++Human Values & Ethics	2	-	2
Practical/ Viva Voce					
ES	ES-151	Programming for Problem Solving Lab	-	2	1
ES	ES-153/ ES-155	*Any one of the following corresponding to the theory paper offered: Basics of Electrical Engineering Lab/ Basics of Electronics Engineering Lab	-	2	1
BS	BS-157/ BS-159	*Any one of the following corresponding to the theory paper offered: Engineering Chemistry Lab/Engineering Physics Lab	-	2	1
Total			**21**	**6**	**24**

Group	**Code**	**Paper**	**L**	**P**	**Credits**
VAC		**NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
VAC	VAC-161	***Environment Studies	-	-	0

Note: Orientation/ Student Induction program will be offered to the students, right at the start of the first semester.

* For a particular batch of a programme of study one out of these two papers shall be taught in the first semester while the other shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper in the second semester. The school shall decide which paper to offer in which semester.

+This is an NUES paper.

++This is an NUES paper. Every student is required to complete this paper of at least 2 credits through SWAYAM / NPTEL MOOCs platform, with the approval of the Dean, USIC&T. If the student completes a course with the higher number of credits from SWAYAM / NPTEL MOOCs platform, the credits reflected in the university marksheet shall be only 2 credits. The marksheet of successfully completing the paper/course with at least 40% marks has to be submitted to the school by the end of the 6th semester (3rd year) of studies. The cost of the paper/course including its examination fee is to be borne by the student. The clearance of the paper/course is mandatory for the award of the degree. The result of this subject shall be incorporated in the 6th semester marksheet.

**NUES: Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall undergo training or participate in the activities for the period of 3rd semester to 6thsemester only.

***Non-credit: Every student is required to complete an Environmental Studies paper of at least 2 credits through SWAYAM / NPTEL MOOCs platform with the approval of Dean, USIC&T. This shall be considered as a non-credit paper/course. The marksheet of successfully completing the paper/course with at least 40% marks has to be submitted to the school by the end of the 6th semester (3rd year) of studies. The cost of the paper/course including its examination fee is to be borne by the student. The clearance of the paper/course is mandatory for the award of the degree.

B.Tech/M.Tech Dual Degree

Second Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-102	Data Structures	4	-	4
SEC	SEC-104	Python Programming	4	-	4
ES	ES-106/ ES-108	*Any one of the following: Basics of Electrical Engineering/ Basics of Electronics Engineering	3	-	3
BS	BS-110	Engineering Mathematics – II	4	-	4
BS	BS-112/ BS-114	*Any one of the following: Engineering Physics/ Engineering Chemistry	3	-	3
ES/ AEC	ES-116/ AEC-118	*Any one of the following: Engineering Mechanics/ Communication Skills	3	-	3
Practical/ Viva Voce					
ES	ES-152	Data Structures Lab	-	2	1
SEC	SEC-154	Python Programming Lab	-	2	1
ES	ES-156/ ES-158	*Any one of the following corresponding to the theory paper offered: Basics of Electrical Engineering Lab/ Basics of Electronics Engineering Lab	-	2	1
BS	BS-160/ BS-162	*Any one of the following corresponding to the theory paper offered: Engineering Physics Lab/ Engineering Chemistry Lab	-	2	1
Total			**21**	**8**	**25**

*For a particular batch of a programme of study one out of these two papers shall be taught in the first semester while the other shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper in the second semester. The school shall decide which paper to offer in which semester.

SYLLABUS OF FIRST YEAR

for

a. Computer Science and Engineering – Major Discipline
b. Information Technology – Major Discipline
c. Electronics and Communication Engineering – Major Discipline
d. Computer Science and Engineering - Artificial Intelligence
e. Computer Science and Engineering - Data Science

Offered by

University School of Information, Communication & Technology at the GGSIPU University Campus, Dwarka

Paper Code: ES-101	**Paper: Programming for Problem Solving**	**L**	**P**	**C**
		4	**-**	**4**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

There should be 9 questions in the term end examinations question paper.

The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.

Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions.Each Unit shall have a marks weightage of 15.

The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level ofthe questions to be asked should be at the level of the prescribed textbook.

The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in 'C'.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in 'C'.
3:	To impart knowledge about using arrays, pointers, files, union and structures to develop algorithms and programs in 'C'.
4:	To impart knowledge about how to approach for dividing a problem into sub-problems and solve the problem in 'C'.

Course Outcomes (CO):

CO1:	Ability to develop simple algorithms for arithmetic and logical problems and implement them in 'C'.
CO2:	Ability to implement conditional branching, iteration and recursion and functions in 'C'
CO3:	Ability to use arrays, pointers, union and structures to develop algorithms and programs in 'C'.
CO4:	Ability to decompose a problem into functions and synthesize a complete program using divide and conquer approach in 'C'.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation andexecution of a programme. Algorithms: Representation using flowcharts, pseudocode.

Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types, I/O statements. Interconversion of variables.

Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions.

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays.

Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arraysto functions: idea of call by reference, Recursion.

Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions.

Unit III

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation. Pointers to functions. Pointers and Strings

Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self referential structures, unions, typedef, enumerations.File handling: command line arguments, File modes, basic file operations read, write and append.Scope and life of variables, multi-file programming.

C99 extensions. 'C' Standard Libraries: stdio.h, stdlib.h, assert.h, math.h, time.h, ctype.h, setjmp.h, string.h, stdarg.h, unistd.h

Unit IV

Basic Algorithms: Finding Factorial, Fibonacci series, Searching, Basic Sorting Algorithms- Bubble sort, Insertion sort and Selection sort. Find the square root of a number, array order reversal, reversal of a string, two-way merge sort, stacks, queues, single –link linked list, Binary search tree.

Textbooks:

1. *How to solve it by Computer* by R. G. Dromey, Prentice-Hall India EEE Series, 1982.
2. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Programming Logic & Design* by Tony Gaddis, Pearson, 2nd Ed. 2016.
2. *Programming Logic and Design* by Joyce Farrell, Cengage Learning, 2015.
3. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
4. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
5. *Structure and Interpretation of Computer Programs* by Harold Abelson and Gerald Sussman with Julie Sussman, MIT Press, 1985.
6. *How to Design Programs* by Matthias Felleisen, Robert Bruce Findler, Matthew Flatt, and Shriram Krishnamurthi, MITPress, 2018.
7. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).
8. *ISO/IEC 9899:1999. International Standard for Programming Languages – C (ISO/IEC 9899)* by American NationalStandards Institute, Information Technology Industry Council, 2000 (C99).
9. *INCITS/ISO/IEC 9899-2011.American National Standard for Programming Languages 'C'*by American National Standards Institute, Information Technology Industry Council, 2012 (C11).

Paper Code: ES-103(odd)/ ES-106(even)	**Paper: Basics of Electrical Engineering**	**L**	**P**	**C**
		3	**-**	**3**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Outcomes (CO):

CO1:	Ability to understand and use Kirchpff's Laws to solve resistive circuit problems.
CO2:	Ability to analyse resistive, inductive and capacitive circuits for transient and steady state sinusoidal solutions.
CO3:	Understand the first order filters and magnetic circuits.
CO4:	Understand the design of electrical machines.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**2**

Unit - I

DC Circuits: Passive circuit components, Basic laws of Electrical Engineering, Temperature Resistance Coefficients. voltage and current sources, Series and parallel circuits, power and energy, Kirchhoff's Laws, Nodal & Mesh Analysis, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Time domain analysis of first Order RC & LC circuits.

Unit – II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit - III

D. C. Generators & Motors: Principle of operation of Generators & Motors, Speed Control of shunt motors, Flux control, Rheostatic control, voltage control, Speed control of series motors.
A. C. Generators & Motors: Principle of operation, Revolving Magnetic field, Squirrel cage and phase wound rotor, Starting of Induction motors, Direct on line and Star Delta starters, Synchronous machines.

Unit - IV

Transformers: Construction and principle of operation, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.
Measuring Instruments: Electromagnetism, Different Torques in Indicating instruments, Moving Iron Instruments: Construction & Principle, Attraction and Repulsion type; Moving Coil instruments: Permanent Magnet type; Dynamometer type Instruments

Textbooks:

1. *Electrical Engineering Fundamentals* by Vincent Del Toro, PHI (India), 1989

References:

1. *An Introduction to Electrical Science* by Adrian Waygood, Routledge, 2nd Ed. 2019.
2. *Electrical Circuit Theory and Technology* by John Bird, Elsevier, 2007.
3. *Principles and Applications of Electrical Engineering* by Giorgio Rizzoni, MacGraw-Hill, 2007.
4. *Electrical Engineering* by Allan R. Hambley, Prentice-Hall, 2011.
5. *Hughes Electrical & Electronic Technology* by Edward Hughes revised by Hohn Wiley, Keith Brown and Ian McKenzie Smith, Pearson, 2016.
6. *Electrical and Electronics Technology* by E. Hughes, Pearson, 2010.
7. Basic Electrical Engineering by D.C. Kulshrestha, McGraw-Hill, 2009.
8. Basic Electrical Engineering by D. P. Kothai and I.J. Nagrath, McGraw-Hill, 2010.

Paper Code: ES-105(odd)/ ES-108(even)	**Paper: Basics of Electronics Engineering**	**L**	**P**	**C**
		3	**-**	**3**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations :60 marks

Instruction for paper setter:

There should be 9 questions in the term end examination question paper.

The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.

Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attemptonlyoneofthetwoquestionsintheunit.Individualquestionsmaycontainupto5sub-parts/sub-questions.Each Unit shall have a marks weightage of 15.

The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.

The requirement of(scientific)calculators/log-tables/data– tables may be specified if required.

Course Objectives:

1:	To impart the basic knowledge about semiconductor Physics
2:	To impart the knowledge about pn junction and special diodes
3:	To impart the knowledge about transistors and MOSFET
4:	To impart the knowledge about digital system

Course Outcomes(CO):

CO1:	Ability to understand the fundamentals of semiconductor Physics.
CO2:	Ability to understand pn junction and special diodes .
CO3:	Ability to understand transistors and MOSFET.
CO4:	Ability to understand the digital systems.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale1: low,2: Medium, 3:High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	3	3	1	1	1	-	-	-	-	-	-	2
CO2	3	3	3	3	2	-	-	-	-	-	2	2
CO3	3	3	3	3	3	-	-	-	-	-	2	2
CO4	3	3	3	3	3	1	-	-	-	-	1	2

UNIT I

Review of semiconductor Physics: Energy levels and Energy bands, Electrons and holes in an intrinsic semiconductor, conductivity of a semiconductor, direct and indirect band-gap semiconductors, carrier concentration in an intrinsic semiconductor, donor and acceptor impurities, charge densities in a semiconductor, fermi level in a semiconductor having impurities, Carrier transport: diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations.

Unit II

Diodes: Open circuit pn Junction, energy band diagram, contact potential, Space charge at the junction, pn junction diode under external bias,I-Vcharacteristics,DiodeEquation, Temperature dependence of diode. Breakdown phenomena, diode resistances & capacitances, Diode equivalent circuit. Zener Diode, LED, Photodiode, Solar cell: structure, principle, characteristics.

UNIT - III

Transistors: Bipolar Junction transistor (BJT)-Physical Structure, modes of operation, BJT current components, BJT Configurations and I-V characteristics, large signal current gains, early effect, BJT as switch, BJT as an Amplifier, Eber's moll model of BJT

MOSFET: Structure, operation, current voltage characteristics, enhancement and depletion type MOSFETs, CMOS structure, MOSFET as resistor and inverter.

UNIT–IV

Fundamentals of Digital Systems: Logic gates; Boolean Algebra; Number Systems: decimal, binary, octal hexadecimal numbers and their conversion, signed binary numbers, Binary arithmetic, Binary codes. Minimization of logic functions usingK-map & Quine-McCluskey's algorithm.

Digital Circuits: Half adder, full adder, subtractors, Multiplexer,De-Multiplexer,Decoders,Encoder, decoders/drivers for display devices, S-R Flip-Flop, J-K Flip-Flop, sequential circuits.

TextBooks:

1. Millman's Electronic Devices and Circuits, Third Edition, McGraw Hill Education(India) Pvt. Ltd.
2. M. Morris Mano, Digital Logic and Computer Design. Prentice Hall, 2016

Reference Books:

1. D. P. Leach and Albert Paul Malvino, Digital Principles and Applications. McGraw-Hill Science, Engineering & Mathematics, 2011.
2. Microelectronic Circuits, 7thEdition, Adel S Sedra and Kenneth C Smith, Oxford University Press.
3. B. Streetman and S. Banerjee, Solid State Electronic Devices. Pearson, 2015.

Paper Code: BS-107	Paper: Engineering Mathematics – I	L	P	C
		4	-	4

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

There should be 9 questions in the term end examinations question paper.

The first (1^{st}) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.

Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions.Each Unit shall have a marks weightage of 15.

The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level ofthe questions to be asked should be at the level of the prescribed textbook.

The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand use series, differential and integral methods to solve formulated engineering problems.
2:	To understand use Ordinary Differential Equations to solve formulated engineering problems.
3:	To understand use linear algebra to solve formulated engineering problems.
4:	To understand use vector calculus to solve formulated engineering problems.

Course Outcomes (CO):

CO1:	Ability to use series, differential and integral methods to solve formulated engineering problems.
CO2:	Ability to use Ordinary Differential Equations to solve formulated engineering problems.
CO3:	Ability to use linear algebra to solve formulated engineering problems.
CO4:	Ability to use vector calculus to solve formulated engineering problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Partial derivatives, Chain rule, Differentiation of Implicit functions, Exact differentials.Maxima, Minima and saddle points, Method of Lagrange multipliers. Differentiation underIntegral sign, Jacobians and transformations of coordinates.

Unit II

Ordinary Differential Equations (ODEs): Basic Concepts. Geometric Meaning of $y' = f(x, y)$. Direction Fields, Euler's Method, Separable ODEs. Exact ODEs. Integrating Factors, Linear ODEs. Bernoulli Equation. Population Dynamics, Orthogonal Trajectories. Homogeneous Linear ODEs with Constant Coefficients. Differential Operators. Modeling of Free Oscillations ofa Mass–Spring System, Euler–Cauchy Equations. Wronskian, Nonhomogeneous ODEs, Solution by Variation of Parameters. Power Series Method for solution of ODEs: Legendre's Equation. Legendre Polynomials, Bessel's Equation, Bessels's functions $J_n(x)$ and $Y_n(x)$. Gamma Function

Unit III

Linear Algebra: Matrices and Determinants, Gauss Elimination, Linear Independence. Rank of a Matrix. Vector Space. Solutions of Linear Systems and concept of Existence, Uniqueness, Determinants. Cramer's Rule, Gauss–Jordan Elimination.The Matrix Eigenvalue Problem.

Determining Eigenvalues and Eigenvectors, Symmetric, Skew-Symmetric, and Orthogonal Matrices.Eigenbases. Diagonalization. Quadratic Forms.Cayley – Hamilton Theorem (without proof)

Unit IV

Vector Calculus: Vector and Scalar Functions and Their Fields. Derivatives, Curves. Arc Length. Curvature. Torsion, Gradient of a Scalar Field. Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Line Integrals, Path Independence of Line Integrals, Double Integrals, Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Stokes Theorem. Divergence Theorem of Gauss.

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10^{th} Ed., 2011.
2. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013. (for Unit I)

References:

1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.

2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland),

Paper Code: BS-109 (odd)/ BS-114 (even)	**Paper: Engineering Chemistry**	**L**	**P**	**C**
		3	**-**	**3**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

There should be 9 questions in the term-end examinations question paper.
The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the studentswill be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions.Each Unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge about understanding and modeling atomic structure and chemical bonding.
2:	To impart knowledge about understanding and modeling Thermochemistry and Reaction Kinetics.
3:	To impart knowledge about understanding and modeling organic compound structure and reactions.
4:	To impart knowledge about understanding and modeling Stereochemistry.

Course Outcomes (CO):

CO1:	Ability to understand and model atomic structure and chemical bonding.
CO2:	Ability to understand and model Thermochemistry and Reaction Kinetics.
CO3:	Ability to understand and model organic compound structure and reactions.
CO4:	Ability to understand and model Stereochemistry.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Atomic Structure: Introduction to wave mechanics, the Schrödinger equation as applied to hydrogen atom, origin of quantum numbers, Long form of periodic table on the basis of Electronic configuration s, p, d, f block elements periodic trends, Ionization potential, atomic and ionic radii electron affinity & electro-negativity.
Chemical Bonding: Ionic bond, energy changes, lattice energy Born Haber Cycle, Covalent bond-energy changes, Potential energy curve for H2 molecule, characteristics of covalent compound, co-ordinate bond-Werner's Theory, effective atomic numbers, A hybridization and resonance, Valence Shell Electron Repulsion theory (VSEPR), Discussion of structures of H2O, NH3, BrF3, SiF4, Molecular orbital theory, Linear combination of atomic orbitals (LCAO) method. Structure of simple homo nuclear diatomic molecule like H2, N2, O2, F2.

Unit II

Thermochemistry: Hess's Law, heat of reaction, effect of temperature on heat of reaction at constant pressure (Kirchhoff's Equation) heat to dilution, heat of hydration, heat of neutralization and heat of combustion, Flame temperature. Reaction Kinetics: Significance of rate law and rate equations, order and molecularity, Determinations of order of simple reactions-experimental method, Equilibrium constant and reaction rates -Lindermann, collision and activated complex theories, complex reactions of 1st order characteristics of consecutive, reversible and parallel reactions-Steady state and non-steady state approach.

Unit III

Basic concepts of Organics: Inductive, electromeric, mesomeric and hyperconjugative effects. Stability of reaction intermediates. Electrophiles and nucleophiles, concepts of acids and bases. Arrhenius, Lowry-Bronsted and Lewis theory of acids and bases (HSAB), Carbon acids (active methylene groups), super acids. Bonds weaker than covalent bond: Hydrogen bonding - nature, types, stability and effects. IUPAC Nomenclature.

Unit IV

Stereochemistry: Classification of stereoisomers, diastereomers, Separation of enantiomers. Absolute configuration (R and S), Projection formulae. Stereochemistry of compounds containing two asymmetric C-atoms. Elements of symmetry - center, plane and axis of symmetry, Conformations: Conformations around a C-C bond in acyclic and cyclic compounds.

Textbooks / References:

1. Engineering Chemistry (16th Edition) Jain, Jain, Dhanpat Rai Publishing Company, 2013.2.Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley, 2017

3.Engineering Chemistry by E.R. Nagarajan and S. Ramalingam, Wiley, 2017.

Paper Code: BS-111 (odd)/ BS-112 (even)	**Paper: Engineering Physics**	**L**	**P**	**C**
		3	**-**	**3**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers orshort answer type question of total 15 marks.
Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand and model oscillations and waves.
2:	To understand and model interference, diffraction and polarization phenomenon.
3:	To understand and appreciate relativistic systems and Lasers.
4:	To learn about the band theory of solids and properties and characteristics of diodes.

Course Outcomes (CO):

CO1:	Ability to understand and model oscillations and waves.
CO2:	Ability to understand and model interference, diffraction and polarization phenomenon.
CO3:	Ability to understand and appreciate relativistic systems and Lasers.
CO4:	Understand the band theory of solids and properties and characteristics of diodes.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	2	2	3	3	2	-	-	-	1	1	-	2
CO2	2	2	3	3	2	-	-	-	1	1	-	2
CO3	2	2	3	3	2	-	-	-	1	1	-	2
CO4	2	2	3	3	2	-	-	-	1	1	-	2

Unit I

Waves and Oscillations: Wave motion, simple harmonic motion, wave equation, superposition principle. Introduction to Electromagnetic Theory: Maxwell's equations. work done by the electromagnetic field, Poynting's theorem, Momentum, Angular momentum in electromagnetic fields, Electromagnetic waves: the wave equation, plane electromagnetic waves, energy carried by electromagnetic waves

Unit II

Interference: Interference by division of wave front (Young's double slit experiment, Fresnel's biprism), interference by division of amplitude (thin films, Newton's rings, Michelson's interferometer), Coherence and coherent sources

Diffraction: Fraunhofer and Fresnel diffraction; Fraunhofer diffraction for Single slit, double slit, and N-slit (diffraction grating), Fraunhofer diffraction from a circular aperture, resolving power and dispersive power of a grating, Rayleigh criterion, resolving power of optical instruments

Polarization: Introduction to polarization, Brewster's law, Malu's law, Nicol prism, double refraction, quarter-wave and half- wave plates, optical activity, specific rotation, Laurent half shade polarimeter.

Unit III

Theory of relativity: The Michelson-Morley Experiment and the speed of light; Absolute and Inertial frames of reference, Galilean transformations, the postulates of the special theory of relativity, Lorentz transformations, time dilation, length contraction, velocity addition, mass energy equivalence. Invariance of Maxwell's equations under Lorentz Transformation.
Introduction to Laser Physics: Introduction, coherence, Einstein A and B coefficients, population inversion, basic principle and operation of a laser, the He-Ne laser and the Ruby laser

Unit IV

Band Theory of Solids: Origin of energy bands in solids, motion of electrons in a periodic potential – the Kronig–Penny model (Qualitative). Brillouin zones, effective mass, metals, semi-conductors and insulators and their energy band structures. Extrinsic and Intrinsic semiconductors, doping – Fermi energy for doped and undoped semiconductors, the p-n junction (energy band diagrams with Fermi energy), the unbiased diode, forward and reverse biased diodes – tunnel diodes, zener diode, photo diode

its characteristics, LED

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw-Hill, 2017.
2. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017

References:

1. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Optics* by Ajoy Ghatak, McGraw Hill, 2020.
4. *Solid State Electronic Devices ,by* Streetman and Ben G Prentice Hall India Learning Private Limited; 2006

Paper Code: ES-113 (odd)/ ES-116 (even)	**Paper: Engineering Mechanics**	**L**	**P**	**C**
		3	**-**	**3**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective,single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts
4. / sub-questions. Each Unit shall have a marks weightage of 15.
5. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard /level of the questions to be asked should be at the level of the prescribed textbook.
6. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge to solve problems pertaining to force systems, equilibrium and distributed systems.
2:	To impart knowledge to solve problems of friction and engineering trusses.
3:	To impart knowledge to deal with the problems of kinematics and kinetics of particle
4:	To impart knowledge to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO):

CO1:	Ability to solve problems pertaining to force systems, equilibrium and distributed systems.
CO2:	Ability to solve problems of friction and engineering trusses.
CO3:	Ability to deal with the problems of kinematics and kinetics of particle
CO4:	Ability to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	3	3	3	3	2	-	-	-	1	1	1	2
CO2	3	3	3	3	2	-	-	-	1	1	1	2
CO3	3	3	3	3	2	-	-	-	1	1	1	2
CO4	3	3	3	3	2	-	-	-	1	1	1	2

Unit I

Force System: Introduction, force, principle of transmissibility of force, resultant of a force system, resolution of a force, moment of force about a line, Varigon's theorem, couple, resolution of force into force and a couple, properties of couple and their application to engineering problems.

Equilibrium: Force body diagram, equations of equilibrium and their applications to engineering problems, equilibrium of two force and three force members.

Distributed Forces: Determination of center of gravity, center of mass and centroid by direct integration and by the methodof composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, polar moment of inertial.

Unit II

Structure: Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints, method of section and graphical method.

Friction: Static and Kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, frictional lock, friction in flat pivot and collar bearing, friction in flat belts.

Unit III

Kinematics of Particles: Rectilinear motion, plane curvilinear motion, rectangular coordinates, normal and tangentialcoordinates.

Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work-energy equation, conservation of energy, concept of impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact.

Unit IV

Kinematics of Rigid Bodies: Concept of rigid body, types of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of zero velocity, Velocity and acceleration.

Kinetics of Rigid Bodies: Equation of motion, translatory motion and fixed axis rotation, application of work energy principles to rigid bodies conservation of energy.

Beam: Introduction, types of loading, methods for the reactions of a beam, space diagram, types of end supports, beams subjected to couple.

Textbooks:

1.*Engineering Mechanics* by A.K.Tayal, Umesh Publications.

References:

1. *'Engineering Mechanics' by K. L. Kumar, Tata Mc-Graw Hill*
2. *'Engineering Mechanics' by S. Timoshenko, D. H. Young, J. V. Rao, Tata Mc-Graw Hill*
3. *'Engineering Mechanics-Statics and Dynamics' by Irwing H. Shames, PHI.*
4. *'Engineering Mechanics' by Basudev Bhattacharya, Oxford Higher Education.*

Paper Code: AEC-115 (odd)/ AEC-118(even)	Paper: Communication Skills	L	P	C
		3	-	3

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.

Course Objectives:

1:	To help them understand the structures of language, and build up the vocabulary.
2:	To enhance language proficiency and communication competence.
3:	To understand basic principles of written communication.
4:	To develop the efficiency of using language for Specific Purposes with clarity.
5:	To be able to critically appreciate the written texts and audio-visual inputs effectively.
6:	To develop the theoretical understanding of interpersonal communication effectively.

Course Outcomes (CO):

CO1:	Ability to understand the basic structure of language.
CO2:	Ability to communicate effectively in writing.
CO3:	Ability to present their ideas effectively in professional and demanding situations.
CO4:	Ability to interpret texts and comprehend the extended discourse.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	3	3	-	3

Unit I
Basic Language Efficiency 1: Parts of Speech, Sentence Structure, Subject-Verb Agreement, Vocabulary, Common Errors

Unit II
Basic Language Efficiency 2: Writing Skills: Types of Writing, Paragraph writing, Paraphrasing, Summarizing, Précis Writing

Unit III
Formal Written Communication: Meetings – Agenda and Minutes ,Press release, Letter writing, Notice, Memorandum, E-mails

Unit IV
Appreciating written Texts for comprehension ability:

Steven Spielberg's Speech at Harvard Commencement 2016 (https://www.youtube.com/watch?v=TYtoDunfu00)
Lecture by Johan Rockstrom: Let the Environment Guide our Development
http://www.ted.com/talks/johan_rockstrom_let_the_environment_guide_our_development

Textbooks

1. *High English Grammar and Composition* by Wren, P.C. & Martin H., S.Chand & Company Ltd, New Delhi.
2. *Technical Communication: Principles & Practice* by Meenakshi Raman, New Delhi: Oxford University Press

References:

1. *Be Grammar Ready: The Ultimate Guide to English Grammar* by John Eastwood, New Delhi, Oxford University Press, 2020.
2. *Communication Skills: A Workbook* by Sanjay Kumar & Pushp Lata, New Delhi, Oxford University Press, 2018.
3. *Basic Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2012.
4. *Advanced Technical Communication* by Kavita Tyagi & Padma Mishra, New Delhi, PHI Learning, 2011.

Paper Code: VAC-117	**Paper: Indian Constitution**	**L**	**P**	**C**
		2	**-**	**2**

Marking Scheme:
This is an NUES paper of 100 marks, hence all examinations to be conducted by the concerned teacher.

Course Objectives:

1:	To create awareness among students about the Indian Constitution
2:	To create consciousness among students about democratic principles and enshrined in the Constitution of India

Course Outcomes (CO):

CO1:	To understand institutional mechanism and fundamental values enshrined in the Constitution of India
CO2:	To understand the inter-relation between Centre and State Government
CO3:	To understand Fundamental Rights and Duties
CO4:	To understand the structure and functions of judicial systems in the country.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	-	-	-	-	-	3	-	2	-	-	-	1
CO2	-	-	-	-	-	3	-	2	-	-	-	1
CO3	-	-	-	-	-	3	-	2	-	-	-	1
CO4	-	-	-	-	-	3	-	2	-	-	-	1

Unit I

Introduction to Constitution of India: Definition, Source and Framing of the Constitution of India. Salient Features of the Indian Constitution. Preamble of the Constitution.

Unit II

Fundamental Rights and Duties: Rights To Equality (Article 14-18).Rights to Freedom (Article 19-22).Right against Exploitation (Article 23-24).Rights to Religion and Cultural and Educational Rights of Minorities(Article 25- 30). The Directive Principles of State Policy – Its significance and application. Fundamental Duties – Necessary obligations and its nature, legal status and significance

Unit III

Executives and Judiciary: Office of President, Vice President and Governor: Power and Functions, Parliament, Emergency Provisions-, President Rule; Union Judiciary: Appointment of Judges, Jurisdiction of the Supreme Court, State Judiciary: Power and functions, Writ Jurisdiction

Unit IV

Centre- States Relation: Is Indian Constitution Federal in Nature, Legislative relations between Union and States, Administrative Relations between Union and States, Financial Relations between Union and States

Textbooks:

1. *Constitutional Law of India* by J.N Pandey, Central Law Publication, 2018.
2. *Introduction to the Indian Constitution of India*by D.D. Basu, PHI, New Delhi, 2021
3. *The Constitution of India* by P.M. Bakshi, Universal Law Publishing Co., 2020.

References:

1. *Indian Constitutional Law* by M.P. Jain, Lexis Nexis, 2013
2. *Constitution of India* byV.N. Shukla, Eastern Book Agency, 2014

PaperCode: ES-151	Paper: Programming for Problem Solving Lab.		L	P	C
			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		
Instructions: The course objectives and course outcomes are identical to that of ES-101 (Programming for Problem Solving) as this is the practical component of the corresponding theory paper. The practical list shall be notified by the teacher in the first week of the class commencement.					

PaperCode: ES-153(odd)/ ES-156(even)	Paper: Basics of Electrical Engineering Lab.		L	P	C
			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		
Instructions: The course objectives and course outcomes are identical to that of ES-103(odd)/ES-106(even) (Basics of Electrical Engineering) as this is the practicalcomponent of the corresponding theory paper. The practical list shall be notified by the teacher in the first week of the class commencement.					

PaperCode: ES-155(odd)/ ES-158(even)	Paper: Basics of Electronics Engineering Lab.		L	P	C
			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		
Instructions: The course objectives and course outcomes are identical to that of ES-105(odd)/ ES-108(even) (Basics of Electronics Engineering) as this is the practical component of the corresponding theory paper. The practical list shall be notified by the teacher in the first week of the class commencement.					

PaperCode: BS-157(odd)/ BS-162(even)	Paper: Engineering Chemistry Lab.		L	P	C
			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		
Instructions: The course objectives and course outcomes are identical to that of BS-109(odd)/BS-114(even) (Engineering Chemistry) as this is thepractical component of the corresponding theory paper. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.					

PaperCode: BS-159(odd)/ BS-160(even)	Paper: Engineering Physics Lab.		L	P	C
			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		
Instructions: The course objectives and course outcomes are identical to that of BS-111(odd)/BS-112(even) (Engineering Physics) as this is thepractical component of the corresponding theory paper. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.					

Paper Code: ES-102	**Paper: Data Structures**	**L**	**P**	**C**
		4	**-**	**4**

Prerequisite Paper: ES-101

Marking Scheme :
Teacher's Continuous Evaluation : 40 marks
Term and Theory Examinations : 60 marks

Instructions for paper setter

There should be 9 questions in the term end examinations question paper.

The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.

Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions maycontain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.

The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives :

1.	To introduce basics of Data structures (Arrays, strings, linked list etc.)
2.	To understand the concepts of Stacks, Queues and Trees, related operations and theirimplementation
3.	To understand sets, heaps and graphs
4.	To introduce various Sorting and searching Algorithms

Course Outcomes (CO)

CO 1	To be able to understand difference between structured data and data structure
CO 2	To be able to create common basic data structures and trees
CO 3	To have a knowledge of sets, heaps and graphs
CO 4	To have basic knowledge of sorting and searching algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	2	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	2	2	2	3

UNIT – I

Overview of data structure, Basics of Algorithm Analysis including Running Time Calculations, Abstract Data Types, Arrays, Arrays and Pointers, Multidimensional Array, String processing, General Lists and List ADT, Listmanipulations, Single, double and circular lists. Stacks and Stack ADT, Stack Manipulation, Prefix, infix and postfix expressions, recursion. Queues and Queue ADT, Queue manipulation.

UNIT - II

Sparse Matrix Representation (Array and Link List representation) and arithmetic (addition, subtraction and multiplication), polynomials and polynomial arithmetic.

Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, Expression treesand their usage, binary search trees, AVL Trees, Heaps and their implementation, Priority Queues, B-Trees, B* Tree, B+ Tree

UNIT - III

Sorting concept, order, stability, Selection sorts (straight, heap), insertion sort (Straight Insertion, Shell sort),Exchange Sort (Bubble, quicksort), Merge sort (External Sorting) (Natural merge, balanced merge andpolyphase merge). Searching – List search, sequential search, binary search, hashing methods, collision resolution in hashing.

UNIT - IV

Disjoint sets representation, union find algorithm, Graphs, Graph representation, Graph Traversals and theirimplementations (BFS and DFS). Minimum Spanning Tree algorithms, Shortest Path Algorithms

Textbook(s):

1. Richard Gilberg , Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C, 2nd Edition,Cengage Learning, Oct 2004
2. E. Horowitz, S. Sahni, S. Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Silicon Press(US), 2007.

References:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson, September, 1996
2. Robert Kruse, "Data Structures and Program Design in C", 2nd Edition, Pearson, November, 1990
3. Seymour Lipschutz, "Data Structures with C (Schaum's Outline Series)", McGrawhill, 2017
4. A. M. Tenenbaum, "Data structures using C". Pearson Education, India, 1st Edition 2003.
5. Weiss M.A., "Data structures and algorithm analysis in C++", Pearson Education, 2014.

Paper Code: SEC-104	**Paper: Python Programming**	**L**	**P**	**C**
		4	**-**	**4**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instructions for paper setter

There should be 9 questions in the term end examinations question paper.

The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.

Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions maycontain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.

The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.

Course Objectives:	
1:	The students will learn the Programming in the Python Language
2:	The students will learn usage of language implemented data structures.
3:	The students shall learn usage of simple graphics & image processing, and the object oriented features of the Python Language.
4:	The students will learn about graphical user interfaces in Python.
Course Outcomes (CO):	
CO1:	Ability to write procedural programmes in Python.
CO2:	Ability to write programs using standard data structures.
CO3:	Ability to use object oriented paradigm to write program in Python.
CO4:	Ability to do graphical programming in Python.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	-	1	2	1	3	-	-	-	1	1	1	1
CO2	-	1	2	1	3	-	-	-	1	1	1	1
CO3	-	1	2	1	3	-	-	-	1	1	1	1
CO4	-	1	2	1	3	-	-	-	1	1	1	1

Unit I

The concept of data types:

Variables, Assignments; Immutable Variables; Numerical Types; Arithmetic Operators And Expressions; comments in the program; understanding error messages; Conditions, boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation; Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated); String manipulations: subscript operator, indexing, slicing a string.

Unit II

Lists, tuples, and dictionaries:

Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries; Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments.

Unit III

Simple Graphics and Image Processing:

"turtle" module; simple 2d drawing - colors, shapes; digital images, image file formats, image processing: Simple image manipulations with 'image' module (convert to bw, greyscale, blur, etc).

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects; inheritance, polymorphism, operator overloading (_eq_, _str_, etc); abstract classes; exception handling, try block

Unit IV: Graphical user interfaces:

Event-driven programming paradigm; tkinter module, creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

Textbooks:

1. T.R. Padmanabhan, Programming with Python, Springer, 1st Ed., 2016.
2. Kenneth Lambert, Fundamentals of Python: First Programs, Cengage Learning, 1st Ed., 2012.

PaperCode: BS-110	**Paper: Engineering Mathematics – II**	**L**	**P**	**C**

		4	**-**	**4**

Marking Scheme:
Teachers Continuous Evaluation: 40 marks
Term end Theory Examinations: 60 marks

Instruction for paper setter:

There should be 9 questions in the term end examinations question paper.

The first (1^{st}) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.

Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions.Each Unit shall have a marks weightage of 15.

The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level ofthe questions to be asked should be at the level of the prescribed textbook.

The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand Complex series methods.
2:	To understand Complex analysis
3:	To understand Fourier and Laplace methods
4:	To understand how to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO):

CO1:	Ability to use Complex series methods.
CO2:	Ability to use Complex analysis to solve formulated engineering problems
CO3:	Ability to use Fourier and Laplace methods to solve formulated engineering problems
CO4:	Ability to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Complex Analysis – I : Complex Numbers and Their Geometric Representation, Polar Form of Complex Numbers. Powers andRoots, Derivative. Analytic Function, Cauchy–Riemann Equations. Laplace's Equation, Exponential Function, Trigonometric and Hyperbolic Functions. Euler's Formula, de'Moivre's theorem (without proof), Logarithm. General Power. Principal Value**.**Singularities and Zeros. Infinity,

Line Integral in the Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivatives of Analytic Functions, Taylor and Maclaurin Series.

Unit II

Complex Analysis – II: Laurent Series, Residue Integration Method. Residue Integration of Real Integrals,

Geometry of Analytic Functions: Conformal Mapping, Linear Fractional Transformations (Möbius Transformations), Special Linear Fractional Transformations, Conformal Mapping by Other Functions, Applications: Electrostatic Fields, Use of Conformal Mapping. Modeling, Heat Problems, Fluid Flow. Poisson's Integral Formula for Potentials

Unit III

Laplace Transforms: Definitions and existence (without proof), properties, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals and ODEs, Unit Step Function (Heaviside Function).Second Shifting Theorem (t-Shifting), Short Impulses. Dirac's Delta Function. Partial Fractions, Convolution. Integral Equations, Differentiation and Integration ofTransforms. Solution of ODEs with Variable Coefficients, Solution of Systems of ODEs. Inverse Laplace transform and its properties.

Fourier Analysis: Fourier Series, Arbitrary Period. Even and Odd Functions. Half-Range Expansions, Sturm–Liouville Problems. Fourier Integral, Fourier Cosine and Sine Transforms, Fourier Transform. Usage of fourier analysis for solution of ODEs. Inverse Fourier transform and its properties.

Unit IV

Partial Differential Equations (PDEs): Basic Concepts of PDEs. Modeling: Vibrating String, Wave Equation. Solution by Separating Variables. Use of Fourier Series. D'Alembert's Solution of the Wave Equation. Characteristics. Modeling: Heat Flow from a Body in Space. Heat Equation:Solution by Fourier Series.Steady Two-Dimensional Heat Problems. Dirichlet Problem.

Heat Equation: Modeling Very Long Bars.Solution by Fourier Integrals and Transforms. Modeling: Membrane, Two-Dimensional Wave Equation. Rectangular Membrane. Laplacian in Polar Coordinates. Circular Membrane. Laplace's Equation in Cylindrical and Spherical Coordinates. Potential. Solution of PDEs by Laplace Transforms.

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10^{th} Ed., 2011.

References:

1.*Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.
2.*Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3.*Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4.*Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5.*Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.
6.*Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013.

PaperCode: ES-152	Paper: Data Structures Lab.		L	P	C
			-	2	1
Teachers Continuous Evaluation:	**40 marks**	**Term End Examinations:**	**60 Marks**		

Instructions:
The course objectives and course outcomes are identical to that of ES-102 (Data Structures) as this is thepractical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

PaperCode: SEC-154	Paper: Python Programming Lab.		L	P	C
			-	2	1
Teachers Continuous Evaluation:	**40 marks**	**Term End Examinations:**	**60 Marks**		

Instructions:
The course objectives and course outcomes are identical to that of SEC-104 (Python Programming) as this is thepractical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

2ND YEAR SCHEME AND SYLLABUS

Bachelor of Technology / Master of Technology

(Dual Degree Programmes)
In

a. Computer Science and Engineering – Major Discipline
b. Information Technology – Major Discipline
c. Computer Science and Engineering - Artificial Intelligence
d. Computer Science and Engineering - Data Science

B.Tech/M.Tech Dual Degree

Third Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	PC-201	Computer Organization and Architecture	4	-	4
PC	PC-203	Database Management Systems	3	-	3
PC	PC-205	Object Oriented Programming using Java	4	-	4
PC	PC-207	Design and Analysis of Algorithms	4	-	4
PC	PC-209	Operating Systems	3	-	3
AEC	AEC-211/ AEC-213	*Any one of the following: Principles of Management/ Engineering Economics	2	-	2
Practical/ Viva Voce					
PC	PC-251	Database Management Systems Lab	-	2	1
PC	PC-253	Object Oriented Programming using Java Lab	-	2	1
PC	PC-255	Design and Analysis of Algorithms Lab	-	2	1
PC	PC-257	Operating Systems Lab	-	2	1
PC	PC-259	**Term Paper – I****			**2**
Total			**20**	**8**	**26**

*For a particular batch of a programme of study one out of these two papers shall be taught in the third semester while the other shall be taught in the 4thsemester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 3rdsemester and similarly for the students who study the paper in the fourth semester. The school shall decide which paper to offer in which semester.

**NUES: The paper is an NUES paper. The concerned teacher to evaluate out of 100

B.Tech/M.Tech Dual Degree

Fourth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	PC-202	Theory of Computation	4	-	4
PC	PC-204	Software Engineering	3	-	3
PC	PC-206	Computer Networks	4	-	4
PC	PC-208	Artificial Intelligence & Machine Learning	4	-	4
PC	PC-210	Web Technologies	3	-	3
AEC	AEC-212/ AEC-214	*Any one of the following: Engineering Economics/ Principles of Management	2	-	2
Practical/ Viva Voce					
PC	PC-252	Software Engineering Lab	-	2	1
PC	PC-254	Computer Networks Lab	-	2	1
PC	PC-256	Artificial Intelligence & Machine Learning Lab	-	2	1
PC	PC-258	Web Technologies Lab	-	2	1
PC	PC-260	**Term Paper – II***			**2**
Total			**22**	**8**	**26**

*For a particular batch of a programme of study one out of these two papers shall be taught in the third semester while the other shall be taught in the 4thsemester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 3rdsemester and similarly for the students who study the paper in the fourth semester. The school shall decide which paper to offer in which semester.

Paper Code: PC 201	**Paper: Computer Organization and Architecture**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability to identify various components of computer and their interconnection and identify basic components and design of the CPU and to understand the architecture and organization of computer
CO 2	Ability to understand and compare various Memory devices
CO 3	Ability to compare various types of IO mapping techniques
CO 4	Ability to critique the performance issues of cache memory and virtual memory and I/O organization

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	2	-	-	-	2	2	2	3
CO2	3	3	3	2	3	-	-	-	2	2	2	3
CO3	3	3	2	2	3	-	-	-	2	2	2	3
CO4	3	3	3	2	2	-	-	-	3	2	2	3

UNIT ⊣

Basic functional blocks of a computer and its Representation: Functional units, Basic operational concepts, Bus structures, Performance and metrics, Instructions and instruction sequencing, Hardware–Software Interface, Instruction set architecture, Addressing modes, RISC, CISC, ALU design, Fixed point and floating point operations.

UNIT ⊣ I

CPU Control Unit Design: Execution of a complete instruction, Multiple bus organization, Hardwired control, Micro programmed control, Computer arithmetic, Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, Booth multiplier, carry save multiplier etc. Pipeline- Basic concepts, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations, Performance considerations.

UNIT-III

Memory system design: Basic concepts, Semiconductor RAM – ROM, Speed, Size and cost, Cache memories, Improving cache performance, Virtual memory, Memory management requirements, Associative memories, Secondary storage devices.

UNIT- IV

I/O Organization: Accessing I/O devices, Programmed Input/Output, Interrupts, Direct Memory Access, Buses, Interface circuits, Standard I/O Interfaces (PCI, SCSI, USB), I/O devices and processors.

TEXT BOOKS:

1. J. P. Hayes, *Computer Architecture and Organization*, McGraw-Hill, 2017.
2. W. Stallings, *Computer Organization and Architecture: Designing for Performance*, Pearson Education, 2022.
3. M. M. Mano, *Computer System Architecture*, 3rd ed., 2017

REFERENCE BOOKS:

1. D. A. Patterson and J. L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, Elsevier, 2020.
2. C. Hamacher, Z. Vranesic, and S. Zaky, *Computer Organization and Embedded Systems*, McGraw-Hill, 2022.
3. V. P. Heuring and H. F. Jordan, *Computer Systems Design and Architecture*, 2nd ed., Pearson Education, 2009.

Paper Code: PC 203	**Paper: Database Management Systems**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To introduce basic concepts, architecture and characteristics of database systems, advantages of database systems
CO 2	To introduce relational model concepts and SQL, PL/SQL programming, and develop ability to use SQL as DDL, DML, DCL
CO 3	Ability to design relational database and to understand Normal forms based on functional dependencies
CO 4	Ability to manage transactions, develop understanding for object oriented & distributed databases systems and use them

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	2	-	-	-	3	2	2	3
CO2	3	3	2	2	2	-	-	-	3	2	2	3
CO3	3	3	2	3	3	-	-	-	3	2	2	3
CO4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT – I :

Introduction: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, database languages & interfaces

Data modelling using the entity-relationship model: ER model, notation of ER model, Keys, Relationship types, Relationship sets, Roles, and structural Constraints, Weak Entity types, Enhanced ER concepts **–** Subclasses, Superclasses, Inheritance, Specialization and Generalization, Aggregation.

UNIT - II:

Relational model concepts: Different types of keys**,** relational model constraints-(integrity constraints, Keys constraint, domain constraints, referential integrity constraint), Basics of SQL- DDL, DML, DCL, specifying constraints, indexes in SQL, Views, Transaction control commands (TCL), Stored Procedures, Triggers (with emphasis on mySQL and postgreSQL), Functions - aggregate functions, Built-in functions, Use of group by, having, order by, Join and its types, sub-queries, correlated sub-queries, use of Exist, Any, All, Relational algebra, Relational calculus, Relational database design using ER to relational mapping

Data base design & Normalization: Functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving decomposition, normal forms based on multivalued and join dependencies (4NF& 5NF) & domain key normal form

UNIT – III:

Transactions: Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques: locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, Recovery techniques: recovery concepts, database backup and recovery from catastrophic failures

UNIT – IV:

File Structures and Indexing: Disk Storage, Overview of file organization, Heap Files, Sorted Files, Hashing, Single level indexes, Multi-level indexes, B and B+ tree indexes. Concepts of Object-Oriented Database Management systems & Distributed Database Management Systems

Textbooks:

1. R. Elmsari and S. Navathe, *Fundamentals of database systems*. Pearson Education, 7th Edition, 2018
2. A. Silberschatz, H. F. Korth and S. Sudershan, *Database System Concept*. New York McGraw Hill Education, 7th Edition,2021
3. V. M. Grippa and S. Kumichev, *Learning MySQL*. O'Reilly Media Inc., 2nd Edition, 2021.

References:

1. A. Zhao and J. Gennick, *SQL pocket guide.* Cambridge: O'reilly, 4th Edition, 2021.
2. L. Ferrari and E. Pirozzi, *Learn PostgreSQL*: Build and manage high-performance database solutions using PostgreSQL 12 and 13. Packt Publishing Ltd, 2023.
3. T. M. Connolly and C. Begg, *Database systems: a practical approach to design, implementation and management*. Pearson Education Limited, 6th Edition, 2019.
4. C. Coronel and S. Morris, *Database systems: design, implementation, and management.* Cengage Learning, 13th Edition, 2018.

Paper Code: PC-205	**Paper: Object Oriented Programming using Java**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To understand and gain knowledge of characteristics of java, its compilation, JVM as an emulator, instruction set, control flow, programming and the sandbox model.
CO 2	To learn the fundamentals of java programming, understand the concepts like wrapper classes, inheritance and apply the knowledge of exception handling in writing the program.
CO 3	To learn and implement multithreading in Java. Design the windowed applications and web-based applications using swing packages
CO 4	To implement the Input/ Output handling and file handling. Understand the concepts of JDBC in Java

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	2	3	-	3	2	-	-	2	1
CO2	3	2	3	2	3	-	3	2	-	-	2	1
CO3	3	3	3	2	3	-	3	2	-	-	2	1
CO4	3	2	3	2	3	-	3	2	-	-	2	1

UNIT-I

Need for Object Oriented Programming, Comparison of Programming paradigms, Characteristics of Object-Oriented Programming Languages, Introduction to Object Oriented concepts (classes, objects, encapsulation, inheritance, data hiding, abstraction, polymorphism). Overview and characteristics of Java, Java program Compilation and Execution Process.

Organization of the Java Virtual Machine, JVM as an interpreter and emulator, Instruction Set, class File Format, Verification, Class Area, Java Stack, Heap, Garbage Collection. Security Promises of the JVM, Security Architecture and Security Policy. Class loaders and security aspects, sandbox model.

UNIT - II

Java Fundamentals, Data Types & Literals Variables, Wrapper Classes, Arrays, Arithmetic Operators, Logical Operators, Control of Flow, Classes and Instances, Class Member Modifiers Anonymous Inner Class Interfaces and Abstract Classes, Class inheritance and Polymorphism in Java, Using super and final, Abstract Classes and Interfaces, Extending Interfaces, Dynamic Method Dispatch, Garbage Collection. Packages in Java: Defining a Packages, Java Class Libraries, User Defined packages. Standard Classes in Java: String, StringBuffer, StringTokenizer, Object class, System class, Wrapper Classes, Scanner class.

Exception Handling in Java: fundamentals, exception types, uncaught exceptions, throw and throws keywords, finally, built-in exceptions, user-defined exceptions.

UNIT III

Multithreading in Java: fundamentals, Java thread model, creating threads, using methods of Thread class, thread priority, thread synchronization, Inter-thread communication: wait, notify, notify all.

Swing: Introduction to Swing, Swing Features, Hierarchy Of Java Swing Classes, Swing GUI Components, Packages Used In Swing, Using Swing API, AWT v/s Swing. Event Handling in Swings, Event Listener Interfaces, Adapter and Inner Classes, Working with windows, Graphics Object and Layout managers.

UNIT - IV

Input/Output Handling in Java: Input/Output Stream, Stream Filters, Buffered Streams, Data input and Output Stream, Print Stream, File handling. Overview of JDBC, Object serialization, Remote Method Invocation, Java Native Interfaces, Java Collection Framework

Text Books:

1. Herbert Schidt, "*Java - The complete Reference*", McGraw Hill, 2023.
2. Kathy Sierra, "*Head First Java*", O'Reilly, 2022.

Reference Books:

1. P. Dietel and H. Deitel, "*Java How to Program: Early Objects*", Eleventh edition, Pearson, 2018.
2. T. Lindholm, F. Yellin, G. Bracha, A. Buckley, "*The Java Virtual Machine Specification*, Java SE 8th Edition, Addison-Wesley Professional, 2014.
3. D. Liang, *Introduction to Java Programming, Comprehensive version*, Tenth Edition, Pearson, 2018.

Paper Code: PC 207	**Paper: Design and Analysis of Algorithms**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme :
Teacher's Continuous Evaluation : 40 marks
Term and Theory Examinations : 60 marks

Instructions for paper setter

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives :

1.	To introduce the basic concept of Algorithm analysis, Growth of function and Disjoint sets
2.	To introduce the concept of dynamic programming and greedy programming techniques
3.	To understand graphs, graph traversal and applications of graphs.
4.	To understand String matching and NP complete problems

Course Outcomes (CO)

CO 1	To be able to understand time complexity and disjoint sets.
CO 2	To be able to differentiate between dynamic programming and greedy programming methodologies.
CO 3	To have a knowledge of graphs and applications of graphs.
CO 4	To have basic knowledge of string matching and NP complete problems using few examples of NP complete problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	3	-	-	-	3	2	3	3
CO 2	3	3	3	2	3	-	-	-	3	2	3	3
CO 3	3	3	3	3	3	-	-	-	3	3	3	3
CO 4	3	3	3	3	3	-	-	-	3	3	3	3

UNIT – I

Growth of Functions, Summations, Algorithm Design Paradigms, Divide and Conquer Strategy Strassen's algorithm for matrix multiplication, analysis of Merge sort, Quick Sort and Heap Sort, sorting in Linear Time: Counting sort, Radix Sort, Bucket Sort, Medians and Order Statistics, Disjoint Set operations, Rooted Tree Representations, Linked List representation of disjoint sets, disjoint set forests.

UNIT - II

Matrix Chain Multiplication, LCS, Optimal Binary Search Tree, General Greedy Approach Vs Dynamic Programming approach, Case studies: Knapsack problem, Huffman Coding Problem, Matroids
String Matching: The Naïve String Matching Algorithm, The Rabin Karp Algorithm, String Matching with Finite Automata, The Knuth Morris Pratt Algorithm.

UNIT - III

Representation of Graphs, Breadth First Search, Depth First Search, Topological Sort, Strongly Connected Components, Algorithms of Kruskal's and Prim's, Dijkstra's and Bellman ford algorithm, All pair shortest path, Flyod Warshall Algorithm

UNIT - IV

NP-Complete Problems: Polynomial Time Verification, NP-Completeness, Satisfiability and Reducibility, NP Completeness proof, NP-Complete Problems: The vertex-cover problem, the traveling-salesman problem, the set-covering problem, Hamilton Circuit Problem Backtracking algorithms: Graph coloring, N-Queen problem

Textbook(s):

1.T .H . Cormen, C . E . Leiserson, R .L . Rivest, Clifford Stein "*Introduction to Algorithms*", PHI Learning Pvt. Ltd. (Originally MIT Press); 4th Edition (5 April 2022).

2. A .V. Aho, J . E . Hopcroft, J . D . Ullman "*The Design & Analysis of Computer Algorithms*", Addison Wesley, 2002.

References:

1. E. Horwitz and S. Sahani "*Fundamentals of Computer Algorithms*", Galgotia, 2008.

2.Udi Manber "*Introduction to Algorithms – A Creative Approach*", Addison Wesley, 2022.

3.Anany Levitin, "*Introduction to the Design and Analysis of Algorithms*", Pearson; 3rd Edition, 2011.

4.David Harel, Yishai Feldman, "*Algorithmics: The Spirit of Computing*", 3rd Edition, Addison Wesley Publishers Limited and Pearson Education Limited, 2014.

5.H. B. Dave, "*Design and Analysis of Algorithms*", 2nd Edition, India: Pearson, 2013.

Paper Code: PC 209	**Paper: Operating Systems**	**L**	**T/P**	**C**
Paper ID:		3	0	3

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus.
Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard/level of the questions to be asked should be at the level of the prescribed text book.

Course Outcome (CO):

CO 1	To introduce fundamentals of services provided by and the design of an operating system
CO 2	To introduce Processor scheduling and synchronization techniques
CO 3	To introduce Primary and Secondary memory management techniques
CO 4	To introduce the structure and organization of the file system

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1	2	2	1	-	2	2	3	3
CO2	3	3	2	2	2	-	-	-	2	2	2	3
CO3	3	3	2	3	2	-	-	-	2	2	2	3
CO4	3	3	2	3	2	-	-	-	2	2	2	3

UNIT – I

Computer System Organization, Architecture, Operations, Resource Management, Kernel Data Structures, OS Services, OS Types, OS Booting.

Process Management: Concept Scheduling, Operations, IPC, Client – Server Architecture. Multicore Programming, Multithreading models, Thread Structure, Thread Libraries, Implicit threading, Threading Issues.

UNIT – II

CPU Scheduling: Concepts, Criteria, Algorithms, thread scheduling, multi-processor scheduling.

Process Synchronisation: Critical Section Problem, Race Condition, Synchronisation Hardware, Semaphores, Classical Problems of Synchronisation.

DeadLock: Characterisation, Deadlock Prevention, Deadlock Avoidance, Detection and Recovery.

UNIT – III

Memory Management: Main Memory: contiguous allocation, paging, page table, swapping. Virtual Memory: Demand paging, copy on write, page replacement, frame allocation, thrashing, memory compression, kernel memory allocation.

Storage Management: HDD scheduling, NVM scheduling, error detection and correction, storage device management, swap space management, RAID. I/O hardware, application I/O interface, kernel I/O subsystem, STREAMS.

UNIT - IV

File Handling: Access Methods, Directory Structure, Allocation Methods - Contiguous Allocation, Linked Allocation, Indexed Allocation, Free Space Management.

Device Management: Disk Structure, Disk Scheduling Algorithms, Disk Management, Case study on Window and UNIX operating systems.

Textbook(s):

1. A. Silberschatz, P. B. Galvin, and G. Gagne, *Operating System Concepts*, 10th ed., Wiley, 2018.

References:

1. J. A. Harris, *Schaum's Outline of Operating Systems*, New Delhi, India: McGraw Hill Education, 2020
2. A. McHoes and I. M. Flynn, **Understanding Operating Systems**, 8th ed. Boston, MA: Cengage Learning, 2017
3. W. Stallings, *Operating systems – Internals and design principles,Pearson*, 9th ed. 2021

Paper Code: AEC 211 / AEC214	**Paper: Principles of Management**	**L**	**T/P**	**C**
Paper ID:		**2**	**0**	**2**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To introduce the fundamentals of management and strategic planning while exploring managerial roles, evolution, and business environment analysis.
CO 2	To develop an understanding of business forecasting, effective decision-making, and Management by Objectives, along with insights into various global management styles.
CO 3	To provide insights into organizational structure, leadership, HRM practices, coordination mechanisms, and career development strategies for effective management and workforce growth.
CO 4	To enhance understanding of leadership styles, effective communication, change management, and ethical responsibilities in addressing global, cultural, and organizational challenges.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1	2	2	1	-	2	2	3	3
CO2	3	3	2	2	2	-	-	-	2	2	2	3
CO3	3	3	2	3	2	-	-	-	2	2	2	3
CO4	3	3	2	3	2	-	-	-	2	2	2	3

Unit 1

Introduction to Management: Management – An Emerging Profession, Definition, Nature, Scope, Purpose, and characteristics of Management, Functions, roles, skills of an effective Manager. Evolution of Management Thought : Classical Theory, Scientific Management , Management Process or Administrative Management, Bureaucracy, Behavioural Science Approach, Quantitative Approach, Systems Approach, Contingency Approach, Operational Approach. Planning: Types of Plans, Planning Process, Introduction to Strategic Management, Types of Strategies, Understanding environment of business: Environmental appraisal – Industry Analysis - Porter's Model of competitive advantage, analysis of organisational resources and capabilities.

Unit 2

Forecasting and Premising : Introduction to Forecasting, Essential Components in Business Forecasting, Determinants of Business Forecasts, Benefits of Forecasting, Techniques of Forecasting, Limitations of Forecasting. Decision-making : Introduction, Components of Decision-making, Decision-making Process, Group Decision-making, Creativity Problem-solving. Management by Objectives and Styles of Management : Core Concepts of MBO, Characteristics of Management by Objectives, Process of MBO, Defining the Goal, Action Plan, Final Review, Benefits of Management by Objectives, Limitations of Management by Objectives, Styles of Management, American Style of Management, Japanese Style of Management, Indian Style of Management

Unit 3

Organizing and Directing: Introduction, Organizational Design, Hierarchical Systems , Organization Structure, Types of Organization Structure, Formal and Informal Organization, Factors Determining Span of Management, Centralization and Decentralization, Span of control, Understanding authority and responsibility, Principles of Delegation, Authority, Developing a culture of Innovation and performance.
Staffing and Coordination: Introduction, Human Resource Management, Recent Trends in HRM, Technology in HRM,

Economic Challenges, Workforce Diversity, Concept of Coordination, Need for Coordination, Importance of Coordination, Principles of Coordination, Coordination Process, Types of Coordination, Issues and Systems Approach to Coordination, Techniques of Coordination.

Career Development Strategy: Introduction, Concept and Elements of Career, Overview of Career Development, Significance and Advantages of Career Development, Objectives of Career Development, Types of Career Development Programmes, Different Stages or Cycles of Career Development Process, Career Anchors, Steps in the Career Planning Process.

Unit-4

Leadership styles of Managers: Leadership Concept, Nature, Importance, Attributes of a leader, Role of a leader in demonstrating awareness of legal, personnel, and strategic issues relating to globalization, culture and gender diversity in an organization, Role of leader in conflict resolution and negotiations. Organizational Communication: Communication in Organizations: Introduction, Importance of Communication in the Workplace; Understanding Communication Process, Barriers to Communication, Use of tone, language and styles in Communication, Role of Perception in influencing communication, Role of culture in communication. Change management: Concept of change, change as a natural process, Importance & Causes of change – social, economic, technological, organizational, Developing a climate for learning, Concept of learning organizations, Challenges of Contemporary Business: Role of Ethics, Corporate social responsibility, and environmental issues.

Text Books

1. S. P. Robbins and D. A. DeCenzo, Fundamentals of Management, 9th ed. Pearson Education, 2016.
2. H. Koontz, C. O'Donnell, and H. Weihrich, Essentials of Management, 9th ed. New Delhi: Tata McGraw-Hill, 2012.

Reference Books

1. R. L. Daft, Principles of Management, Cengage Learning, 2009.
2. R. Robbins, Management, 9th ed., Pearson Education, 2008.
3. S. P. Robbins and M. Coulter, Management Fundamentals: Concepts, Applications, & Skill Development, 6th ed., Sage, 2014.

Paper Code: AEC-213 / AEC 212	**Paper: Engineering Economics**	**L**	**T/P**	**C**
Paper ID:		**2**	**0**	**2**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability to understand economic analysis.
CO 2	Ability to understand and use cash flow method.
CO 3	Ability to determine economic life of an asset and replacement method
CO 4	Ability to do depreciation analysis and inflation adjustment

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	1	2	3	-	-	-	3	1
CO2	-	1	-	-	1	2	3	-	-	-	3	1
CO3	-	1	-	-	1	2	3	-	-	-	3	1
CO4	-	1	-	-	1	2	3	-	-	-	3	1

UNIT I

Introduction, Flow in an economy, Law of Supply and Demand, Concept of Engineering Economics, Elements of Cost, Break-Even Analysis, P/V ratio, examples of simple economic analysis, Interest Formulas and Their Applications.

UNIT II

Present Worth Method of Comparison: Introduction, Revenue Dominated Cash Flow Diagram, Cost- Dominated Cash Flow Diagram
Future Worth Method: Introduction, Revenue Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram
Annual Equivalent Method: Introduction, Revenue Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram, Alternate approach.
Rate of Return Method.

UNIT III

Replacement and Maintenance Analysis: Introduction, Types, Determination of economic life of an asset, replacement method.
Depreciation: Introduction and methods of depreciation (Straight line, Declining Balance, Sum of the Years Digit method, Sinking fund method, Service output method). Evaluation of public alternative.

UNIT IV

Inflation Adjustment: Introduction, Procedure to adjust Inflation, Inflation Adjusted Economic Life of Machines. Inventory Control and Methods, Make or buy decision, Project Management: Introduction,
Phases, CPM, Gantt/Time Chart, PERT. Value Analysis / Value Engineering

Textbooks:

1. R. Panneerselvam, Engineering Economics, 2nd ed. New Delhi, India: PHI Learning, 2013.
2. Chan S. Park, Fundamentals of Engineering Economics, 5th ed., Pearson, 2020.

Reference:

1. Leland T. Blank and Anthony J. Tarquin, Engineering Economy, 8th ed., McGraw-Hill, 2019.

2. Anindya Sen, Microeconomics, 2nd ed., Oxford University Press India, 2021.
3. Hal R. Varian, Intermediate Microeconomics: A Modern Approach, 10th ed., W.W. Norton & Company, 2024.
4. Zahid A. Khan, Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, Principles of Engineering Economics with Applications, Cambridge University Press (2018).

PaperCode: PC-251	**Paper: Database Management System Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks** **Term End Examinations:**	**60 Marks**		

Instructions:

The course objectives and course outcomes are identical to that of PC-251(Database Management System Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: PC-253	**Paper: Object Oriented Programming using Java Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks** **Term End Examinations:**	**60 Marks**		

Instructions:

The course objectives and course outcomes are identical to that of PC-253(Object Oriented Programming using Java Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: PC-255	**Paper: Design and Analysis of Algorithms Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks** **Term End Examinations:**	**60 Marks**		

Instructions:

The course objectives and course outcomes are identical to that of PC-255(Design and Analysis of Algorithms Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: PC-257	**Paper: Operating System Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks** **Term End Examinations:**	**60 Marks**		

Instructions:

The course objectives and course outcomes are identical to that of PC-257(Operating System Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

Paper Code: PC-202	**Paper: Theory of Computation**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Instructions for paper setter

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard / Level of the questions to be asked should be at the level of the prescribed text box.
The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives:

1.	To understand Automata (Deterministic and Non-Deterministic) and Language Theory
2.	To understand Context Free Grammar (CFG), Parse Trees and Push Down Automata
3.	To introduce the concepts of Turing Machines and Computability Theory
4.	To understand Complexity Theory (NP-completeness NP-hardness) and Space complexity

Course Outcomes (CO)

CO 1	Ability to understand the design principles of abstract computational models such as Finite Automata, Pushdown Automata, and Turing Machines.
CO 2	Ability to analyze the recognizability (decidability) of grammar (language) with specific characteristics through these abstract models.
CO 3	Ability to analyze the computational complexity of problems to decide what makes some problems computationally hard and others easy?
CO 4	Ability to deliberate the problems that that are solvable by machines and those that are unsolvable

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	2	2	-	-	-	2	1	-	3
CO 2	3	2	3	3	2	-	-	-	2	1	-	3
CO 3	3	3	2	2	2	-	-	-	2	1	-	3
CO 4	3	2	2	3	2	-	-	-	2	1	-	3

Unit-I

Automata and Language Theory: Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Regular Expressions, Equivalence of DFAs, NFAs and Regular Expressions, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Closure properties of Regular grammar, Non-Regular Languages, Pumping Lemma, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

Unit-II

Context Free Languages: Context Free Grammar (CFG), Parse Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Parsing, LL(K) grammar, Simplification of CFGs: Elimination of Useless symbols, epsilon productions, and unit productions from CFGs, Normal forms for CFGs: CNF and Greibach Normal Form (GNF), Push Down Automata (deterministic and non-deterministic) (PDA), Equivalence of CFGs and PDAs, CFG to PDA and PDA to CFG, two stack PDA, Pumping Lemma, Closure properties of CFLs, decision problems for CFLs.

Unit-III

Turing Machines and Computability Theory: Definition, design and extensions of Turing Machine, Equivalence of various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Reducibility and its use in proving undecidability, Rices theorem, Undecidability of Posts correspondence problem., Recursion Theorem and its significance, Classification of languages: Recursive and Recursively Enumerable (r.e.) languages, existence of non-recursively enumerable (non-r.e.) languages, informal proofs demonstrating unsolvability of certain computational

problems.

Unit-IV

Computational Complexity Classes: Definition of class P as the consensus class of tractable problems, Classes NP, co-NP, and their significance, Polynomial-time reductions and their role in complexity theory, NP-completeness and NP-hardness with examples, Cook-Levin Theorem (including proof) and its implications, NP-complete problems in different domains: Graph problems: Clique, Vertex Cover, Independent Set, Hamiltonian Cycle, number problem (partition), set cover, Space Complexity: PSPACE and NPSPACE complexity classes, Savitch's Theorem (with proof) and its impact on space complexity, Probabilistic Computation and the BPP Class, Interactive Proof Systems and the IP Class, Relativized Computation and the concept of oracles.

Textbook(s):

1. M. Sipser, *Introduction to the Theory of Computation*, Cengage Learning, 3rd ed., 2012.
2. J. Hopcroft, R. Motwani, and J. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 3rd ed., Pearson, 2008.

References:

1. P. Linz, *An Introduction to Formal Languages and Automata*, 7th ed., Viva Books, 2022.
2.M. Mozgovoy, *Algorithms, Languages, Automata, and Compilers*, Jones and Bartlett, 2009.
3. D. Cohen, *Introduction to Computer Theory*, 2nd ed., Wiley, New York, 2007.
4. J. C. Martin, *Introduction to Languages and the Theory of Computation*, 4th ed., TMH, 2002.
5. K. L. Mishra and N. Chandrasekharan, *Theory of Computer Science: Automata, Languages and Computation*, PHI, 2006.
6. A. Benoit, Y. Robert, and F. Vivien, *A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis*, CRC Press, 2014.

Paper Code: PC-204	**Paper: Software Engineering**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Instructions for paper setter

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /Level of the questions to be asked should be at the level of the prescribed text box.

Course Objectives:

1.	To introduce the concepts of Software engineering, software processes and its models
2.	To understand Software requirements analysis, SRS document, software metrics and system modelling
3.	To understand fundamentals of Software Design, Software Quality and software maintenance
4.	To understand Software Testing and System Security

Course Outcomes (CO)

CO 1	Ability to understand and apply the core principles and practices of software engineering.
CO 2	Ability to design, develop, and maintain reliable and efficient software systems.
CO 3	Ability to create and implement effective test cases using a variety of software testing methodologies
CO 4	Ability to discover how to analyze and assess the software quality, evolutionary process and security.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	3	-	-	-	2	3	2	3
CO 2	3	3	3	3	3	-	-	-	2	3	3	3
CO 3	3	3	2	2	3	-	-	-	2	3	2	3
CO 4	3	3	2	3	3	-	-	-	2	3	2	3

UNIT - I

Introduction: Software Components, Software Characteristics, Software Crisis, Software processes and its models (waterfall, incremental development, spiral model, re-use-oriented model, prototype),
An Introduction to Non-Traditional Software Development Process: Rational Unified Process, Rapid Application Development. Process activities, Process improvement (CMM Levels), Software Reuse. Agile Development model, plan driven vs agile model of development, agile methods and development techniques (user stories, refactoring, test first development, pair programming, agile project management (SCRUM agile method).

UNIT - II

Requirement Engineering: Functional and non-functional requirements, requirement elicitation, use case development, requirement analysis and validation, requirement review or requirement change, SRS
document. Size Estimation: Software Size, LOC and function point, cost and effort estimation, COCOMO, ISO 9001:2015 Certification, Halstead's Metrics & Software Measurement Techniques, Reliability Metrics & Models, Risk Management & Scheduling Techniques (PERT, Gantt Charts), CASE Tools for Requirement Engineering. System modelling: Interaction models: Use case diagram, sequence diagrams, Structural models: class diagrams, generalization, aggregation, Behavioural models: ER diagrams, Data flow diagrams, data dictionaries.

UNIT - III

Software Design: Architectural views and patterns, Modularity (cohesion and coupling), information hiding, functional independence, function-oriented design, object-oriented design, SOA, SAAS, Design Patterns (Singleton, Factory, Observer), UML Modelling (Class, Sequence, State Diagrams). Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Software Reliability, Software Configuration Management. Software Evolution: Evolution process, legacy system, Software maintenance: Maintenance prediction, Software Maintenance Strategies (Corrective, Adaptive, Perfective, Preventive Maintenance), Re-Engineering, Reverse Engineering, Refactoring.

UNIT –IV

Software Testing: verification, validation, Development testing (unit testing, component testing, system testing, Test Driven Development (TDD), Release Testing (Requirement based testing, scenario testing, performance testing), User testing (alpha, beta and acceptance testing), Regression Testing, Stress Testing, Mutation Testing & Fuzz Testing. System Security: Reliability engineering, reliability requirements (functional and non-functional) and its measurement, safety engineering: safety critical systems, its requirement, security engineering and its requirements, security guidelines.

Textbook(s):

1. I. Sommerville, *Software Engineering*, 10th ed. Pearson, 2018.
2. K. K. Aggarwal and Y. Singh, *Software Engineering*, 4th ed. New Delhi, India: New Age International Publishers, 2022.

References:

[1] P. Jalote, *A Concise Introduction to Software Engineering*. Springer, 2008.
[2] R. S. Pressman, *Software Engineering: A Practitioner's Approach*, 8th ed. McGraw-Hill International Edition, 2010.
[3] C. Kaner, J. Falk, and N. Quoc, *Testing Computer Software*, 2nd ed. New York: Van Nostrand Reinhold, 1993.
[4] G. Aszic, *Specification by Example*. Manning Publications, 2011.
[5] K. Beck, *Test-Driven Development By Example*. Pearson Education.
[6] B. Beizer, *Software System Testing and Quality Assurance*. New York: Van Nostrand Reinhold, 1984.
[7] M. Cohn, *Software Development Using Scrum: Succeeding with Agile*. Pearson Education.

Paper Code: PC 206	**Paper: Computer Networks**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: None

Marking Scheme :
Teacher's Continuous Evaluation : 40 marks
Term and Theory Examinations : 60 marks

Instructions for paper setter

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives :

1.	To introduce fundamentals of Data communication and Computer Networking
2.	To impart Physical layer concepts and data link layer functions
3.	To create awareness about data link control, channel access mechanisms and data link protocols
4.	To understand Networking, addressing, routing protocols and transmission control protocol

Course Outcomes (CO) :

CO 1	Ability to understand the concepts of computer networks, OSI model and TCP/IP model.
CO 2	Ability to understand the Data link layer and Transport Layer concepts.
CO 3	Ability to understand the network layer function, routing protocols and application layer protocols.
CO 4	Ability to understand Network Security, QoS, and Network Management.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	2	-	-	-	3	2	2	3
CO 2	3	3	3	2	2	-	-	-	3	2	2	3
CO 3	3	3	3	2	2	-	-	-	3	2	2	3
CO 4	3	3	3	2	2	-	-	-	3	2	2	3

UNIT I

Overview, Types of computer networks: LAN, MAN, WAN, Wireless and Wired networks, broadcast and point-to-point networks, Network topologies; protocol suites: TCP/IP and OSI, History, Standard.
Physical Layer and Transmission Media: Data and Signals, Digital Transmission, Analog Transmission, Bandwidth utilization, Multiplexing : Frequency Division, Time Division, Wavelength Division, Transmission Media, Switching: Circuit Switching, Message Switching, Packet Switching.

UNIT II

Data-Link Layer (Wired Networks): Introduction, DLC, Multiple Access Protocols, Wired LANS (Ethernet, others)
Data-Link Layer (Wireless Networks): Introduction, IEEE 802.11, Bluetooth, WiMAX, Cellular telephony, Satellite Networks, Mobile IP.
Transport Layer: Protocols: simple, stop-and-wait, GBN, Selective repeat, Bidirectional protocols, Internet Transport Layer protocols, UDP, TCP

UNIT III

Network Layer: Introduction, Addressing : Internet address, subnetting, IPv4, ICMPv4, Unicast Routing, Multicast routing, IPV6, ICMPv6.
Application Layer: Application layer paradigm, Client-server paradigm, Standard Client Server Applications, P2P, Socket Interface programming.

UNIT IV

Multimedia and QoS: Data types, streaming of audio/video, real-time interactive protocols, Quality of Service.
Network Management: Introduction, SNMP, ASN.1

Security: Introduction, Ciphers, Application layer security, transport layer security, network layer security, packet filter firewall, proxy firewall. Programming: Socket programming.

Textbook(s):

1. B. A. Forouzan and F. Mosharraf, "*Computer Networks: A Top-Down Approach*", TMH, 2012.
2. James F. Kurose and Keith W.,"*Computer Networking: A Top-Down Approach*", 7th Edition, Pearson Education, 2017.

References:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw Hill, 2013.
2. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 6th Edition, Pearson Education India 2021.
3. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Elsevier, 2021.
4. Jerry FitzGerald, Alan Dennis and Alexandra Durcikova, "Business Data Communications and Networking", 14th Edition, John Wiley & Sons, 2020.
5. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, India, 2017.

Paper Code: PC 208	Paper: Artificial Intelligence & Machine Learning	L	T/P	C
Paper ID:		4	0	4

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To introduce students to the fundamentals of Artificial Intelligence, focusing on intelligent agents, problem-solving techniques, and search algorithms for effective decision-making.
CO 2	To familiarize students with various machine learning paradigms and emerging learning techniques for data-driven decision making.
CO 3	To equip students with core supervised and unsupervised learning techniques, neural networks, and model evaluation methods for building intelligent systems.
CO 4	To develop understanding of knowledge representation, logical reasoning, and probabilistic inference with applications in AI-driven systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	2	1	2	2	1	-	2	2	3	3
CO2	3	3	2	2	2	-	-	-	2	2	2	3
CO3	3	3	2	3	2	-	-	-	2	2	2	3
CO4	3	3	2	3	2	-	-	-	2	2	2	3

Unit-1

Introduction to Artificial Intelligence: Definition and goals of Artificial Intelligence, History and evolution of AI, Intelligent agents and environments, Problem-solving using AI techniques, Turing test and its significance. Problem Solving and Search Algorithms: Problem formulation and state space representation; Uninformed search algorithms: Breadth-First Search, Depth-First Search, Uniform-Cost Search; Informed search algorithms: A* Search, Best-First Search; Heuristic functions and their properties; Constraint satisfaction problems and backtracking algorithms

Unit-2

Introduction to Machine Learning: Paradigms of Machine Learning- Supervised learning, Unsupervised learning, Semi-supervised learning, Active learning, Self-supervised learning, Transfer learning, Domain adaptation, Zero-shot, One-shot and Few-shot learning; Federated learning.

Unit-3

Supervised learning: Decision trees, linear classifiers and kernels, linear regression; Naïve Bayes, k-Nearest Neighbors; Unsupervised learning: Clustering and dimensionality reduction; Expectation Maximization, Dimensionality Reduction. Introduction to neural networks and deep learning; Feature extraction and selection, PCA, factor analysis, manifold learning; Evaluation metrics for machine learning models.

Unit-4

Knowledge Representation and Reasoning: Propositional and first-order logic; Knowledge representation using semantic networks, frames, and ontologies; Resolution and inference in propositional logic; Bayesian networks and probabilistic reasoning; Common-sense reasoning and expert systems. Applications &Research Topics: Application in the field of web and data mining, text recognition, speech recognition.

Text Books

1. E. Rich, K. Knight, and S. B. Nair, *Artificial Intelligence*, 3rd ed. New York, NY, USA: McGraw-Hill, 2009.

2. S. S. Chandra and H. S. Anand, *Artificial Intelligence: Principles and Applications*, 2nd ed. New Delhi, India: PHI Learning, 2020.
3. K. P. Murphy, *Probabilistic Machine Learning: An Introduction*. Cambridge, MA, USA: MIT Press, 2022.

Reference Books

1. I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
2. S. J. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Hoboken, NJ, USA: Pearson, 2020.
3. A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
4. S. Raschka and V. Mirjalili, *Python Machine Learning: Machine Learning and Deep Learning with Python*, *scikit-learn, and TensorFlow 2*, 3rd ed. Birmingham, UK: Packt Publishing, 2019.

Paper Code: PC 210	**Paper: Web Technologies**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.

1. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
2. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
3. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
4. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To equip students with foundational skills in HTML and CSS for structuring and styling web pages, enabling them to build multi-page websites using best practices.
CO 2	To develop a strong understanding of JavaScript fundamentals, including functions, arrays, and object-oriented programming, enabling students to write dynamic and interactive web applications.
CO 3	To enable students to build full-stack web applications by developing interactive front-end interfaces using React.js and implementing scalable back-end logic with Node.js and its core modules.
CO 4	To provide students with practical knowledge of database integration, authentication techniques, and security measures essential for building secure and reliable web applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	2	1	2	2	1	-	2	2	3	3
CO2	3	3	2	2	2	-	-	-	2	2	2	3
CO3	3	3	2	3	2	-	-	-	2	2	2	3
CO4	3	3	2	3	2	-	-	-	2	2	2	3

Unit -1

HTML and CSS: HTML Vs HTML5, Basics of HTML, HTML Document Structure. Understand indentation and nesting in HTML code. Learn to use HTML tags to structure headings, paragraphs. Creating unordered and ordered lists. HTML Tables, Tables Attributes, Rows and Columns. Inserting Images, creating hyperlinks using anchor tags. Introduction to Forms, The <FORM>, <INPUT> Tag Text input. Create multi-page websites. To Learn HTML best practices. Introduction to cascading style sheets and its use, CSS selectors and properties. Types of CSS: inline, internal and external CSS. CSS specificity and inheritance, the CSS Box Model, CSS positioning and display properties. Font styling, CSS float and clear properties.

Unit-2

JavaScript: Overview and its uses, Basic syntax and data types, Operators and expressions, including arithmetic, comparison, and logical operators, Control structures like if/else statements and loops (The for loop and while loop), Function declaration and expression, Higher-order functions, including: Passing functions as arguments to other functions, Returning functions from other functions. The map, filter, and reduce methods on arrays, Creating and accessing arrays, Adding and removing elements from arrays, The slice method for slicing arrays, the concat method for concatenating arrays, The indexOf and lastIndexOf methods for finding elements inarrays.

Object-oriented programming in JavaScript: Creating objects with object literals, Creating objects with constructor functions and the new keyword, Creating objects with classes and the class keyword, Adding and accessing properties and methods on objects, The this keyword and how it works in object methods, The super keyword for accessing parent class methods and properties. Manipulating objects and arrays using methods and iteration, including: The Object.keys and Object.values methods.

Unit-3

React.JS: front-end development with React, Understand when and how to use React Components, Learn to pass

Props and work with them, write JSX and understand JSX syntax, the React DOM, State Management in React, React Hooks, conditional rendering in React, Understand the difference between class and functional components.
NODE.JS: the components of back-end development, workingwith an MVC framework, Apply concepts like data types, objects, methods, object-oriented programming, and classes in the context of back-end development. Server-Side JavaScript, Using Node on the command line, NPM, JavaScript Build Processes, Event Loop and Emitters File System Interaction, Modules, Native Node drivers.

Unit-4

DataBase: Working and connecting with Database, Persistent connection use RDBMS.
Authentication and Security: the need for authentication and keeping userdetails secure, Encryption and use encryption to keep your database secure, implement Hashing and Salting with bcrypt, Using Sessions and Cookies to persist user log in sessions.Setting up local authentication from scratch. Implementing Passport to authenticate users quickly and effectively. Understand and use environment variables to keep secret keyssecure, use OAuth 2.0 to log in users using Google.

Text Books

1. R. Connolly and R. Hoar, Fundamentals of Web Development, 3rd ed. Boston, MA, USA: Pearson, 2021.
2. T. A. Felke-Morris, Web Development and Design Foundations with HTML5, 10th ed. Hoboken, NJ, USA: Pearson, 2020.
3. A. Harris, HTML5 and CSS3 All-in-One For Dummies, 3rd ed. Hoboken, NJ, USA: Wiley, 2014.
4. D. Flanagan, JavaScript: The Definitive Guide: Master the World's Most-Used Programming Language, 7th ed. Sebastopol, CA, USA: O'Reilly Media, 2020.

Reference Books

1. J. L. Rucker, An Introduction to Web Development: A Conceptual Approach. San Diego, CA, USA: Cognella Academic Publishing, 2020.
2. J. Duckett, HTML and CSS: Design and Build Websites, 1st ed. Hoboken, NJ, USA: Wiley, 2011.
3. B. Frain, Responsive Web Design with HTML5 and CSS, 3rd ed. Birmingham, UK: Packt Publishing, 2020.
4. N. Chauhan, The Complete Front-End Interview Guide: Angular, Node.js, React, Next.js, Vue.js, and TypeScript, Notion Press, 2025.

Paper Code: PC 208	**Paper: Artificial Intelligence & Machine Learning**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To introduce students to the fundamentals of Artificial Intelligence, focusing on intelligent agents, problem-solving techniques, and search algorithms for effective decision-making.
CO 2	To familiarize students with various machine learning paradigms and emerging learning techniques for data-driven decision making.
CO 3	To equip students with core supervised and unsupervised learning techniques, neural networks, and model evaluation methods for building intelligent systems.
CO 4	To develop understanding of knowledge representation, logical reasoning, and probabilistic inference with applications in AI-driven systems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1	2	2	1	-	2	2	3	3
CO2	3	3	2	2	2	-	-	-	2	2	2	3
CO3	3	3	2	3	2	-	-	-	2	2	2	3
CO4	3	3	2	3	2	-	-	-	2	2	2	3

Unit-1

Introduction to Artificial Intelligence: Definition and goals of Artificial Intelligence, History and evolution of AI, Intelligent agents and environments, Problem-solving using AI techniques, Turing test and its significance. Problem Solving and Search Algorithms: Problem formulation and state space representation; Uninformed search algorithms: Breadth-First Search, Depth-First Search, Uniform-Cost Search; Informed search algorithms: A* Search, Best-First Search; Heuristic functions and their properties; Constraint satisfaction problems and backtracking algorithms

Unit-2

Introduction to Machine Learning: Paradigms of Machine Learning- Supervised learning, Unsupervised learning, Semi-supervised learning, Active learning, Self-supervised learning, Transfer learning, Domain adaptation, Zero-shot, One-shot and Few-shot learning; Federated learning.

Unit-3

Supervised learning: Decision trees, linear classifiers and kernels, linear regression; Naïve Bayes, k-Nearest Neighbors; Unsupervised learning: Clustering and dimensionality reduction; Expectation Maximization, Dimensionality Reduction. Introduction to neural networks and deep learning; Feature extraction and selection, PCA, factor analysis, manifold learning; Evaluation metrics for machine learning models.

Unit-4

Knowledge Representation and Reasoning: Propositional and first-order logic; Knowledge representation using semantic networks, frames, and ontologies; Resolution and inference in propositional logic; Bayesian networks and probabilistic reasoning; Common-sense reasoning and expert systems. Applications &Research Topics: Application in the field of web and data mining, text recognition, speech recognition.

Text Books

1. E. Rich, K. Knight, and S. B. Nair, *Artificial Intelligence*, 3rd ed. New York, NY, USA: McGraw-Hill, 2009.
2. S. S. Chandra and H. S. Anand, *Artificial Intelligence: Principles and Applications*, 2nd ed. New Delhi, India: PHI Learning, 2020.
3. K. P. Murphy, *Probabilistic Machine Learning: An Introduction*. Cambridge, MA, USA: MIT Press, 2022.

Reference Books

1. I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
2. S. J. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Hoboken, NJ, USA: Pearson, 2020.
3. A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
4. S. Raschka and V. Mirjalili, *Python Machine Learning: Machine Learning and Deep Learning with Python*, *scikit-learn, and TensorFlow 2*, 3rd ed. Birmingham, UK: Packt Publishing, 2019.

PaperCode: PC-252	**Paper: Software Engineering Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks**	**Term End Examinations:**	**60 Marks**	

Instructions:
The course objectives and course outcomes are identical to that of PC-252(Software Engineering Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: PC-254	**Paper: Computer Networks Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks**	**Term End Examinations:**	**60 Marks**	

Instructions:
The course objectives and course outcomes are identical to that of PC-254(Computer Networks Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: PC-256	**Paper: Artificial Intelligence & Machine Learning Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks**	**Term End Examinations:**	**60 Marks**	

Instructions:
The course objectives and course outcomes are identical to that of PC-256 (Artificial Intelligence & Machine Learning Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

PaperCode: PC-258	**Paper: Web Technologies Lab.**	**L**	**p**	**C**
		-	2	1
Teachers Evaluation:	**Continuous 40 marks**	**Term End Examinations:**	**60 Marks**	

Instructions:
The course objectives and course outcomes are identical to that of PC-258 (Web Technologies Lab) as this is the practical component of the corresponding theory paper.
The practical list shall be notified by the teacher in the first week of the class commencement.

BRIDGE COURSE FOR LATERAL ENTRY STUDENTS

Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have two study two papers / courses, namely (first time offered in the 3rd semester):

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor as NUES, the same shall be transferred to Examination Division of the University.
4. The degree to be awarded to the student only subject to the acquiring qualifying grade/marks in the bridge courses and the minimum credits in the regular courses of the scheme of study as prescribed.
5. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA. The qualifying marks shall be 40 marks in each paper.
6. A separate marksheet will be issued by the Examination Division of the University for the Bridge Course.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

Syllabus of Bridge Course

Paper Code(s): BC-001	**L : 4**
Paper: Bridge Course in Mathematics	**C : 4**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 100 marks 2. This is NUES, non-credit and qualifying Paper. All evaluations to be conducted by the concerned teacher.	
Course Outcomes (CO):	
CO1	Ability to understand the use of limits, differentiation and integration.
CO2	Ability to understand and apply the ordinary differential equations.
CO3	Ability to use matrices to solve linear equations.
CO4	Ability to understand linear independence and dependence of vectors.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Differentiation: Limits, Definition, Formulas, Differentiation Rules, Real life applications of Differentiation Integration: Definition, Indefinite Integral, Integration formulas, Definite Integral and its properties, Real life applications of Integration

Unit II

Ordinary Differential Equations: Definition, Solution of ordinary differential equation, linear differential equation of first order, initial value problem, linear differential equation of higher order with constant coefficients

Unit III

Matrices-I: Definition of Matrix and Determinant, Type of Matrices, Properties of Determinants, Transpose of a matrix, Inverse of a matrix, Solution of system of linear equations using the inverse of a matrix, Rank of a matrix.

Unit IV

Matrices-II: Vectors, Linear independence and dependence of vectors; Eigen values and Eigen vectors or matrix.

Textbooks:

1. *Higher Engineering Mathematics* by B S Grewal, Khanna Publishing.

References:

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley, 10th Ed., 2011.

Paper Code(s): BC-002	**L : 3**
Paper: Bridge Course in Programming in C	**C : 3**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 100 marks 2. This is NUES, non-credit and qualifying Paper. All evaluations to be conducted by the concerned teacher.	
Course Outcomes (CO):	
CO1	Ability to write simple programs in in 'C'.
CO2	Ability to implement conditional branching, iteration and arrays in 'C'
CO3	Ability to implement functions and pointers in 'C'
CO4	Ability to use structures, unions and strings in the programs in 'C'.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme.

Introduction to C language: Basic structure of C programs, C tokens, variables, data types, I/O statements. Inter-conversion of variables.

Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators operator precedence and associativity, evaluation of expressions, type conversions in expressions.

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays.

Unit III

Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.

Pointers: Pointer basics, pointer arithmetic, functions returning pointers, Dynamic memory allocation. Pointers and Strings.

Unit IV

Structures and unions: Structure definition, initialization, accessing structures, structures and functions, self-referential structures, unions, typedef.

Strings: Arrays of characters, variable length character strings, inputting character strings, character library function.

Textbooks:

1. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
2. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
3. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).

SECOND YEAR

Scheme and Syllabus for

Bachelor of Technology / Master of Technology

(Dual Degree Programmes)

In

Electronics and Communication Engineering – Major Discipline

Offered by

University School of Information, Communication & Technology

at

the GGSIPU University Campus, Dwarka

B.Tech/M.Tech Dual Degree

Third Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	PC-201	**Computer Organization & Architecture**	4	-	4
PC	PC-203	Signals and Systems	3	-	3
PC	PC-205	Network Analysis & Synthesis	4	-	4
PC	PC-207	Analog Devices & Circuits	4	-	4
PC	PC-209	Analog Communications	3	-	3
AEC	AEC-211	**Principles of Management**	2	-	2
Practical/ Viva Voce					
PC	PC-251	Signals and Systems Lab	-	2	1
PC	PC-253	Network Analysis & Synthesis Lab	-	2	1
PC	PC-255	Analog Devices & Circuits Lab	-	2	1
PC	PC-257	Analog Communications Lab	-	2	1
PC	PC-259	**Term Paper – I****			**2**
Total			**20**	**8**	**26**

**** NUES**

B.Tech/M.Tech Dual Degree

Fourth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	PC-202	Engineering Electromagnetics	3	-	3
PC	PC-204	Digital Communication	3	-	3
PC	PC-206	**Computer Networks**	4	-	4
PC	PC-208	Linear Integrated Circuits	4	-	4
PC	PC-210	Digital Systems Design	4	-	4
AEC	AEC-212	**Engineering Economics**	2	-	2
Practical/ Viva Voce					
PC	PC-252	Digital Communication Lab	-	2	1
PC	PC-254	Linear Integrated Circuits Lab	-	2	1
PC	PC-256	Digital Systems Design Lab	-	2	1
PC	PC-258	Computer Networks Lab	-	2	1
PC	PC-260	**Term Paper – II****			**2**
Total			**20**	**8**	**26**

**** NUES**

Paper Code: PC 201	**Paper: Computer Organization and Architecture**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:
Teacher's Continuous Evaluation: 40 marks
Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability to identify various components of computer and their interconnection and identify basic components and design of the CPU and to understand the architecture and organization of computer
CO 2	Ability to understand and compare various Memory devices
CO 3	Ability to compare various types of IO mapping techniques
CO 4	Ability to critique the performance issues of cache memory and virtual memory and I/O organization

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	2	-	-	-	2	2	2	3
CO2	3	3	3	2	3	-	-	-	2	2	2	3
CO3	3	3	2	2	3	-	-	-	2	2	2	3
CO4	3	3	3	2	2	-	-	-	3	2	2	3

UNIT ⊣

Basic functional blocks of a computer and its Representation: Functional units, Basic operational concepts, Bus structures, Performance and metrics, Instructions and instruction sequencing, Hardware–Software Interface, Instruction set architecture, Addressing modes, RISC, CISC, ALU design, Fixed point and floating point operations.

UNIT ⊣ I

CPU Control Unit Design: Execution of a complete instruction, Multiple bus organization, Hardwired control, Micro programmed control, Computer arithmetic, Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, Booth multiplier, carry save multiplier etc. Pipeline- Basic concepts, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations, Performance considerations.

UNIT-III

Memory system design: Basic concepts, Semiconductor RAM – ROM, Speed, Size and cost, Cache memories, Improving cache performance, Virtual memory, Memory management requirements, Associative memories, Secondary storage devices.

UNIT- IV

I/O Organization: Accessing I/O devices, Programmed Input/Output, Interrupts, Direct Memory Access, Buses, Interface circuits, Standard I/O Interfaces (PCI, SCSI, USB), I/O devices and processors.

TEXT BOOKS:

1. J. P. Hayes, *Computer Architecture and Organization*, McGraw-Hill, 2017.
2. W. Stallings, *Computer Organization and Architecture: Designing for Performance*, Pearson Education, 2022.
3. M. M. Mano, *Computer System Architecture*, 3rd ed., 2017

REFERENCE BOOKS:

1. D. A. Patterson and J. L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, Elsevier, 2020.
2. C. Hamacher, Z. Vranesic, and S. Zaky, *Computer Organization and Embedded Systems*, McGraw-Hill, 2022.
3. V. P. Heuring and H. F. Jordan, *Computer Systems Design and Architecture*, 2nd ed., Pearson Education, 2009.

Paper Code: PC-203	**Paper: Signals and Systems**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Understand classification and properties of Signals and Systems
CO 2	Ability to use Continuous and Discrete time Fourier methods for analysis of signals and systems
CO 3	Ability to use Laplace and Z- transform methods for analysis of signals and systems
CO 4	Ability to use DFT and FFT for solving problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	1	-	-	-	1	2	3
CO2	3	3	3	3	3	1	-	-	-	1	2	3
CO3	3	3	3	3	3	1	-	-	-	1	2	3
CO4	3	3	3	3	3	1	-	-	-	1	2	3

Unit I

Definition and classification of signals (continuous-time, discrete-time, deterministic, random, energy and power signals), signal transformations (time-shifting, time-scaling, reversal), common signals (step, impulse, ramp, exponential, sinusoidal), operations on signals (addition, multiplication), system properties (linearity, time-invariance, causality, memory, stability), examples of physical systems (mechanical, electrical, computational), system modeling via ODEs and recurrence relations, LTI systems and their role, introduction to sampling and aliasing, reconstruction using hold.

Unit II

Fourier Series: representation of periodic signals, exponential and trigonometric forms, computation of Fourier coefficients, convergence and Dirichlet conditions, Parseval's relation, symmetry and waveform shaping, application to electrical and mechanical waveforms.

Continuous-Time Fourier Transform (CTFT): definition, existence conditions, properties (linearity, time/frequency shifting, scaling, convolution, modulation), frequency response of systems, bandwidth and filtering concepts.

Discrete-Time Fourier Transform (DTFT): definition, properties, interpretation, convolution in DT domain.

Application: solving ODEs and linear recurrence relations using Fourier methods, system behavior prediction.

Unit III

Laplace Transform: definition, ROC, properties, inverse Laplace transform, initial/final value theorems, Laplace-domain circuit analysis, pole-zero diagrams, transfer functions, stability and causality in the s-domain.

Application: analysis of continuous-time systems modeled by linear constant-coefficient ODEs.

Z-Transform: definition, ROC, properties, inverse Z-transform techniques, system transfer function, stability in z-domain, mapping between s- and z-domains.

Application: solving linear difference equations and recurrence relations, analysis of discrete-time systems.

Unit IV

Discrete Fourier Transform (DFT): definition, computation, properties, circular convolution, relation to DTFT, spectral leakage and windowing.

Fast Fourier Transform (FFT): radix-2 FFT algorithms (DIT, DIF), computational advantages, signal analysis applications, spectral estimation.
Applications: analysis of discrete signals and systems, filter design verification, spectral analysis of recurrence-generated sequences, hardware implementation aspects.

Textbooks:

1. *Signals and Systems, Alan V. Oppenheim,* Alan S. Willsky, with S. Hamid Nawab, Pearson Education, Latest Edition.
2. *Signals and Systems,* Simon Haykin and Barry Van Veen, Wiley India, Latest Edition.

References:

1. *Linear Systems and Signals,* B.P. Lathi, Oxford University Press.
2. *Digital Signal Processing*, John G. Proakis and Dimitris G. Manolakis, Pearson Education.
3. *Fundamentals of Signals and Systems,* Michael J. Roberts and Govind Sharma, McGraw Hill.
4. *Discrete-Time Signal Processing,* A.V. Oppenheim and R.W. Schafer, Pearson Education.
5. *Schaum's Outline of Signals and Systems,* Hwei P. Hsu, McGraw Hill.

Paper Code(s): PC-251	**P : 2**
Paper: Signals and Systems Lab	**C : 1**
Prerequisites: None	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of PC-203 as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code(s): PC-205	**L : 4**
Paper: Network Analysis and Synthesis	**C : 4**

Prerequisites: None

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term-End Semester Examinations: 60 Marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes (CO):

CO1	Ability of students to describe the underlying concepts of AC electric networks.
CO2	Ability of students to provide knowledge about complex network as two port networks and solution of electric circuits by applying various network laws and theorems.
CO3	Ability of students to understand the fundamental knowledge about inductive coupled circuits and design the various active and passive filters.
CO4	Ability of students to provide basic understanding to design of attenuators and network synthesis.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	***PO01***	***PO02***	***PO03***	***PO04***	***PO05***	***PO06***	***PO07***	***PO08***	***PO09***	***PO10***	***PO11***	***PO12***
CO1	3	3	3	3	3	1	-	-	-	1	2	3
CO2	3	3	3	3	3	1	-	-	-	1	2	3
CO3	3	3	3	3	3	1	-	-	-	1	2	3
CO4	3	3	3	3	3	1	-	-	-	1	2	3

Unit I

Advanced node and mesh analysis, controlled sources and signal modeling, superposition, Thevenin, Norton, Millman's theorem in AC circuits, source transformation, delta-wye equivalents, maximum power transfer theorem (AC domain), energy concepts in RLC elements, time-domain response of second-order systems, damping ratio, under/overdamping, impulse and step responses.

Unit II

Application of Laplace transform to circuit analysis (without derivation), transfer function and frequency response, pole-zero locations and time/frequency domain behavior, Bode plot construction, resonance in RLC circuits, quality factor (Q), selectivity, Fourier-based interpretation of filters, gain and phase margins, sinusoidal steady-state analysis, impedance and admittance loci.

Unit III

Z, Y, h, ABCD and transmission parameters, cascade and parallel connection, equivalent models of amplifiers and filters, power transfer and matching in two-port networks, port reduction and interconnection, graph theory: incidence, tie-set, and cut-set matrices, Tellegen's theorem, network topology.

Unit IV

Positive real functions, Hurwitz polynomials, driving-point function properties, synthesis of one-port networks using Foster and Cauer forms, LC ladder network design, passive filter approximations (Butterworth, Chebyshev), low-pass prototype scaling, transformation to HP, BP, BS filters, ladder realization with impedance/frequency scaling, passive realization constraints, introduction to active filters and analog computation blocks.

Textbooks:

1. *Network Analysis and Synthesis*, Franklin F. Kuo, Wiley India, Latest Edition.

2. *Engineering Circuit Analysis*, William H. Hayt, Jack E. Kemmerly, Steven M. Durbin, McGraw Hill, Latest Edition.

References:

1. *Network Analysis*, M.E. Van Valkenburg, Pearson Education.
2. *Electric Circuits*, James W. Nilsson and Susan A. Riedel, Pearson Education.
3. *Passive Network Synthesis*, M.E. Van Valkenburg, Wiley India.
4. *Linear Systems and Signals*, B.P. Lathi, Oxford University Press.

Paper Code(s): PC-253	**P : 2**
Paper: Network Analysis and Synthesis Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of PC-205as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code: PC 207	**Paper: Analog Devices & Circuits**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability to understand of operation, characteristics, parameters and applications of p-n junction diode
CO 2	Ability to understand about BJT and FET in terms of structure, operation, configurations and characteristics and able to analyse stability and amplifier circuit using small signal models
CO 3	Ability to understand and analyse cascade amplifiers, coupling schemes in amplifiers and power amplifiers
CO 4	Ability to understand feedback amplifiers and oscillators

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	1	1	-	2	1	-	2
CO2	3	3	3	3	2	1	1	-	2	1	-	2
CO3	3	3	3	3	2	1	1	-	2	1	-	2
CO4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

Diode circuits: half-wave and full-wave rectifiers with capacitor filter, clamping and clipping circuits. Zener diodes as voltage regulator.

Bipolar Junction Transistor: operating point, load line concept, Biasing, Need of biasing, CE Configuration: fixed bias, Emitter Bias/self-bias, Voltage Divider, collector to base bias, Bias stabilization, stability factors, Bias compensation, Thermal runaway, Current Mirror Circuits

UNIT – II

Small signal model of BJT: h parameter model, amplifier analysis using h parameter model, low frequency small signal model of FET, Small Signal analysis of FET amplifier using common source configuration**.**

Cascading amplifier, analysis of cascade amplifiers.

UNIT – III

RC coupled Amplifier and its frequency response, Differential Amplifier: differential and Common mode operation, CMRR.

Power Amplifiers: Classification of output stages (Class A, B, C & AB), Class A Amplifier, Transformer coupled class A amplifier, Push pull amplifiers: Class A and Class B, Harmonic distortion, efficiency, crossover distortion, class AB operation, Class C amplifier.

UNIT – IV

Feedback Amplifiers: classification, Feedback concept, basic feedback topologies, Characteristics of Negative Feedback, Feedback and stability, gain margin, Noise margin,

Sinusoidal Oscillator, Barkhausen criterion, RC phase shift, LC (Colpitt's, Hartley, Clapp), Crystal Oscillator.

Textbook(s):

1. J. Millman, C.C. Halkias and Satyabrata Jit, "Electronic Devices and Circuits", Tata McGraw Hill, 4th ed., 1998
2. R. L. Boylestad and N. Nashlesky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Ed., 2014

References:

1. A. S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits Theory and Applications," 5th Edition , OUP, 2004.

2. B. Kumar and S. B. Jain, "Electronic Devices and Circuits"", Prentice Hall of India, 2007
3. S Salivahanan, and N. Suresh Kumar, "Electronic Devices and Circuits", McGraw Hill Education (India), 2018
4. B.P. Singh and R. Singh, "Electronic Devices and Integrated Circuits", Pearson Education, 2009.
5. J. J. Cathey, "Schaum's Outline of Theory and Problems in Electronic Devices and Circuits", McGraw Hill, 2002.

Paper Code(s): PC-255	**P : 2**
Paper: Analog Devices & Circuits Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of PC-207 as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code: PC 209	**Paper: Analog Communications**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability of students to provide fundamental knowledge of signal and its time & frequency domain representation to understand the principal of signal systems.
CO 2	Ability of students to knowledge about signal modulation and computational skills needed to understand the principal of analog communication system.
CO 3	Ability of students to understand the frequency modulation.
CO 4	Ability of students to provide basic knowledge of AM Transmitter& Receiver and FM Transmitter & Receiver and role of noise in AM and FM.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	1	-	-	-	1	2	3
CO2	3	3	3	3	3	1	-	-	-	1	2	3
CO3	3	3	3	3	3	1	-	-	-	1	2	3
CO4	3	3	3	3	3	1	-	-	-	1	2	3

Unit I

Frequency domain representation of signal: Fourier transform and its properties, condition of existence, Fourier transform of impulse, step, signum, cosine, sine, gate pulse, constant, properties of impulse function. Convolution theorem (time & frequency), correlation (auto & cross), energy & power spectral density.

Unit II

Overview of Analog Communication System: Communication channels Need for modulation, Baseband and Pass band signals.

Amplitude Modulation (AM): Double side band with Carrier (DSB-C), Double side band without Carrier, Single Side Band Modulation, DSB-SC, DSB-C, SSB-SC, Generation of AM, DSB-SC, SSB-SC, VSB-SC & its detection, Vestigial Side Band (VSB), Types of angle modulation.

Unit III

Frequency Modulation (FM): Narrowband FM, Wideband FM, its frequency spectrum, transmission BW, methods of generation (Direct & Indirect), detection of FM (discriminators: balanced, phase shift and PLL detector), pre-emphasis and de-emphasis.

Unit IV

AM Transmitter& Receiver: Tuned radio receiver & super heterodyne, limitation of TRF, IF frequency, image signal rejection, selectivity, sensitivity and fidelity.

FM Transmitter & Receiver: Block diagram of FM transmitter& receiver, AGC, AVC, AFC.

Noise: Classification of noise, Sources of noise, Noise figure and Noise temperature, Noise bandwidth, Noise in AM, FM.

Textbook(s):

1. John G. Proakis, " Basics of Communication Systems", 2nd edition Pearson Education India, (2001).
2. Singh & Sapre, "Communication System", 3rd edition, Tata McGraw Hill, (2012).
3. P. Ramakrishna Rao, "Analog Communication ", Tata McGraw Hill, (2017).
4. P. K. Ghosh, "Principles of Electronic Communications Analog and Digital", CRC Press, (2008).

Reference Books:

1. Simon Haykins, "Communication System", 4th edition, John Wiley and Sons (2001).

2. Hwei P. Hsu, "Analog & Digital Communication (Special Indian Edition)", Tata McGraw Hill (2006)

Paper Code(s): PC-257	**P : 2**
Paper: Analog Communications Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of PC-207 as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code: AEC-212	**Paper: Engineering Economics**	**L**	**T/P**	**C**
Paper ID:		**2**	**0**	**2**

Prerequisite Paper:

Marking Scheme:
1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability to understand economic analysis.
CO 2	Ability to understand and use cash flow method.
CO 3	Ability to determine economic life of an asset and replacement method
CO 4	Ability to do depreciation analysis and inflation adjustment

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	1	2	3	-	-	-	3	1
CO2	-	1	-	-	1	2	3	-	-	-	3	1
CO3	-	1	-	-	1	2	3	-	-	-	3	1
CO4	-	1	-	-	1	2	3	-	-	-	3	1

UNIT I

Introduction, Flow in an economy, Law of Supply and Demand, Concept of Engineering Economics, Elements of Cost, Break-Even Analysis, P/V ratio, examples of simple economic analysis, Interest Formulas and Their Applications.

UNIT II

Present Worth Method of Comparison: Introduction, Revenue Dominated Cash Flow Diagram, Cost- Dominated Cash Flow Diagram
Future Worth Method: Introduction, Revenue Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram
Annual Equivalent Method: Introduction, Revenue Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram, Alternate approach. Rate of Return Method.

UNIT III

Replacement and Maintenance Analysis: Introduction, Types, Determination of economic life of an asset, replacement method.
Depreciation: Introduction and methods of depreciation (Straight line, Declining Balance, Sum of the Years Digit method, Sinking fund method, Service output method). Evaluation of public alternative.

UNIT IV

Inflation Adjustment: Introduction, Procedure to adjust Inflation, Inflation Adjusted Economic Life of Machines. Inventory Control and Methods, Make or buy decision, Project Management: Introduction,
Phases, CPM, Gantt/Time Chart, PERT. Value Analysis / Value Engineering

Textbooks:

1. R. Panneerselvam, Engineering Economics, 2nd ed. New Delhi, India: PHI Learning, 2013.
2. Chan S. Park, Fundamentals of Engineering Economics, 5th ed., Pearson, 2020.

Reference:

1. Leland T. Blank and Anthony J. Tarquin, Engineering Economy, 8th ed., McGraw-Hill, 2019.
2. Anindya Sen, Microeconomics, 2nd ed., Oxford University Press India, 2021.

3. Hal R. Varian, Intermediate Microeconomics: A Modern Approach, 10th ed., W.W. Norton & Company, 2024.
4. Zahid A. Khan, Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, Principles of Engineering Economics with Applications, Cambridge University Press (2018).

Paper Code: PC 202	**Paper: Engineering Electromagnetics**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To understand concept of EM wave and its propagation
CO 2	To understand transmission lines concepts, parameters, application and graphical tool to analyse transmission line problems
CO 3	To analyse rectangular and circular waveguides
CO 4	To understand basic concepts of various types of antennas

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	1	1	-	2	1	-	2
CO2	3	3	3	3	2	1	1	-	2	1	-	2
CO3	3	3	3	3	2	1	1	-	2	1	-	2
CO4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

Vector algebra and vector calculus with significance of del operators- theorems and applications, Maxwell's equations (for static, time varying fields) in integral and differential forms, Continuity equation, boundary conditions for electric and magnetic fields, Programmatic solutions to Maxwell's equations using MATLAB, Poisson's and Laplace's equations

UNIT – II

Electromagnetic waves: wave generation and equations in free space, lossy and lossless dielectrics, conductors- skin depth – Plane wave reflection and refraction – Standing Wave – Applications. Wave propagation in lossless and conducting medium, phase and group velocity, Reflection by a perfect conductor, insulator, Brewster Angle, surface impedance. Guided waves and flow of power: Poynting vector and Poynting theorem, applications, power loss in a conductor.

UNIT – III

Transmission Lines: General solution of transmission lines - Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, meaning of reflection coefficient – wavelength and velocity of propagation, distortion less transmission line, Impedance matching - quarter wave line, single stub matching, double stub matching, Power transfer, Microstrip transmission line, Smith chart.

UNIT - IV

Waveguides: Rectangular waveguide, characteristic of TE and TM waves- cutoff wavelength and phase velocity impossibility of TEM waves in waveguides- dominant mode, Surface currents, Attenuation, impedances. Circular wave guides- solution of field equations in cylindrical coordinates- TE and TM waves in circular guides – wave impedance and characteristic impedance, Microwave cavities: rectangular cavity resonators, circular cavity resonators- Q-factor.

Introduction to antenna: monopole, dipole antenna and microstrip antenna.

Textbook(s):

1. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
2. W.H. Hayt, "Engineering Electromagnetics", Tata McGraw Hill, 2006

References:

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. G. S. Rao, "Electromagnetic Field Theory and Transmission lines" Wiley India.

3. G. S. N. Raju, “Electromagnetic Field Theory and Transmission lines” Pearson, 2006

Paper Code: PC 204	**Paper: Digital Communication**	**L**	**T/P**	**C**
Paper ID:		**3**	**0**	**3**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability of students to provide the basic knowledge of signal sampling to understand the principal of signal system
CO 2	Ability of students to knowledge about signal encoding techniques and computational skills needed to understand the principal of digital communication system
CO 3	Ability of students to provide knowledge of data transmission and probability of error in signal and system
CO 4	Ability of students to provide basic of concept of information theory and role of error correcting codes in digital communication system

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	1	-	-	-	1	2	3
CO2	3	3	3	3	3	1	-	-	-	1	2	3
CO3	3	3	3	3	3	1	-	-	-	1	2	3
CO4	3	3	3	3	3	1	-	-	-	1	2	3

Unit I

Sampling theorem for low pass and band pass signals, Ideal sampling, Natural sampling, Flat top sampling, crosstalk, aliasing, time division multiplexing, PAM, PWM and PPM their generation and detection.

Unit II

Pulse code modulation, Quantization, quantization noise, inter symbol interference, Eye pattern, Delta and adaptive modulation.

Encoding Techniques: On-Off signalling, Polar signaling, RZ signalling, Bipolar signalling, AMI, Manchester code, Differential encoding their advantage and disadvantages.

Unit III

Band Pass Data Transmission: ASK, Binary phase shift keying (BPSK), QPSK, DPSK, coherent and non-coherent BFSK, minimum shift keying, QAM, Concept of M-ary PSK and M-ary FSK. Spectral properties of QPSK and MSK,

Probability of Error: concept of signal space for the computation of probability of error, calculation of error, probability for BPSK, QPSK, QAM and coherent BFSK

Unit IV

Concept of Information Theory: entropy, information rate, channel capacity, Shannon's theorem, Shannon Hartley theorem, BW and signal to noise ratio trade off, sources encoding, extension of zero memory source.

Error Correcting Codes: linear block codes and cyclic codes: encoder and decoder circuits, burst error correcting codes, concept of convolution codes.

Textbook(s):

1. **Taub and Schilling, "Principles of Communication Systems", 4th edition, Tata McGraw Hill, (2017).**
2. Singh & Sapre, "Communication System", 3rd edition, Tata McGraw Hill, (2012).
3. B. Sklar, "Digital Communications Fundamentals and Applications", Prentice Hall P T R, (1988).
4. P. K. Ghosh, "Principles of Electronic Communications Analog and Digital", CRC Press, (2008).

Reference Books:

1. Simon Haykins, "Communication System", 4th edition, John Wiley and Sons (2001).
2. Hwei P. Hsu, "Analog & Digital Communication (Special Indian Edition)", Tata McGraw Hill (2006)

Paper Code(s): PC-252	**P : 2**
Paper: Digital Communications Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of PC-202 as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code: PC 206	**Paper: Computer Networks**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper: None

Marking Scheme :
Teacher's Continuous Evaluation : 40 marks
Term and Theory Examinations : 60 marks

Instructions for paper setter

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 15 marks.
Apart from question one which is compulsory, rest of the paper shall consists of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts/sub-questions. Each unit shall have a marks weightage of 15.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text box.
The requirement of (scientific) calculators/log tables/data-tables may be specified if required**.**

Course Objectives :

1.	To introduce fundamentals of Data communication and Computer Networking
2.	To impart Physical layer concepts and data link layer functions
3.	To create awareness about data link control, channel access mechanisms and data link protocols
4.	To understand Networking, addressing, routing protocols and transmission control protocol

Course Outcomes (CO) :

CO 1	Ability to understand the concepts of computer networks, OSI model and TCP/IP model.
CO 2	Ability to understand the Data link layer and Transport Layer concepts.
CO 3	Ability to understand the network layer function, routing protocols and application layer protocols.
CO 4	Ability to understand Network Security, QoS, and Network Management.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	2	-	-	-	3	2	2	3
CO 2	3	3	3	2	2	-	-	-	3	2	2	3
CO 3	3	3	3	2	2	-	-	-	3	2	2	3
CO 4	3	3	3	2	2	-	-	-	3	2	2	3

UNIT I

Overview, Types of computer networks: LAN, MAN, WAN, Wireless and Wired networks, broadcast and point-to-point networks, Network topologies; protocol suites: TCP/IP and OSI, History, Standard.
Physical Layer and Transmission Media: Data and Signals, Digital Transmission, Analog Transmission, Bandwidth utilization, Multiplexing : Frequency Division, Time Division, Wavelength Division, Transmission Media, Switching: Circuit Switching, Message Switching, Packet Switching.

UNIT II

Data-Link Layer (Wired Networks): Introduction, DLC, Multiple Access Protocols, Wired LANS (Ethernet, others)
Data-Link Layer (Wireless Networks): Introduction, IEEE 802.11, Bluetooth, WiMAX, Cellular telephony, Satellite Networks, Mobile IP.
Transport Layer: Protocols: simple, stop-and-wait, GBN, Selective repeat, Bidirectional protocols, Internet Transport Layer protocols, UDP, TCP

UNIT III

Network Layer: Introduction, Addressing : Internet address, subnetting, IPv4, ICMPv4, Unicast Routing, Multicast routing, IPV6, ICMPv6.
Application Layer: Application layer paradigm, Client-server paradigm, Standard Client Server Applications, P2P, Socket Interface programming.

UNIT IV

Multimedia and QoS: Data types, streaming of audio/video, real-time interactive protocols, Quality of Service.
Network Management: Introduction, SNMP, ASN.1
Security: Introduction, Ciphers, Application layer security, transport layer security, network layer security,

packet filter firewall, proxy firewall. Programming: Socket programming.

Textbook(s):

1. B. A. Forouzan and F. Mosharraf, "*Computer Networks: A Top-Down Approach*", TMH, 2012.
2. James F. Kurose and Keith W.,"*Computer Networking: A Top-Down Approach*", 7th Edition, Pearson Education, 2017.

References:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw Hill, 2013.
2. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 6th Edition, Pearson Education India 2021.
3. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Elsevier, 2021.
4. Jerry FitzGerald, Alan Dennis and Alexandra Durcikova, "Business Data Communications and Networking", 14th Edition, John Wiley & Sons, 2020.
5. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, India, 2017.

Paper Code(s): PC-258	**P : 2**
Paper: Computer Networks Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of PC-206 as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code: PC 208	**Paper: Linear Integrated Circuits**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	Ability to understand and use Op-Amps to design open-loop and closed loop configuration.
CO 2	Ability to analyse frequency response of and Op-Amp circuit.
CO 3	Ability to use Op-Amp in linear and non-linear applications.
CO 4	Ability to design Oscillators and Active Filters

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	1	1	-	2	1	-	2
CO2	3	3	3	3	2	1	1	-	2	1	-	2
CO3	3	3	3	3	2	1	1	-	2	1	-	2
CO4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT - I

The Operational Amplifiers: Block diagram representation of OP-AMP; Evolution of IC and types, Power supply for Op-Amp; The Ideal Op-Amp: schematic, characteristics, equivalent circuit, Ideal voltage transfer curve, typical IC 741 characteristics

Open Loop Op-Amp configurations: The differential amplifier, inverting amplifier, non-inverting amplifier Closed loop Op-Amp configurations: inverting and non-inverting amplifiers, voltage followers, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, Inverting and Non-Inverting op-amp.

UNIT - II

The Practical Op-Amp: Input offset voltage, input bias current, input offset current, Total output offset voltage, thermal drift, error voltage, Supply voltage rejection ration (SVRR), CMRR, Slew rate, causes of slew rates and its effects in application.

Linear applications of Op-Amps: Summing, scaling and averaging amplifier (inverting, non-inverting & differential configuration), voltage to current & current to voltage converters, Integrator, Differentiator,

UNIT - III

Oscillators: Principles & Types; Phase shift, Wein-bridge & quadrature. Square wave, triangular wave and saw tooth wave generators, voltage-controlled oscillator. Active Filters.

UNIT - IV

Specialized IC- The 555 Timer: functional diagram, Monostable and Astable multivibrators; PLL: Basic PLL principle, monolithic 565 PLL; Voltage Regulators, Three terminal IC voltage regulators (LM 317)

Textbook(s):

1. R. A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.
2. D. R. Choudhary & S. B Jain, "Linear Integrated Circuit", 2nd ed. New age publication.2018.

Paper Code(s): PC-254	**P : 2**
Paper: Linear Integrated Circuits Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **1.** The course objectives and course outcomes are identical to that of PC-208 as this is the practical component of the theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code: PC 210	**Paper: Digital Systems Design**	**L**	**T/P**	**C**
Paper ID:		**4**	**0**	**4**

Prerequisite Paper:

Marking Scheme:

1. Teacher's Continuous Evaluation: 40 marks
2. Term and Theory Examinations: 60 marks

Guidelines for Paper Setter(s):

1. There should be 9 questions in the term end examinations question paper.
2. The first question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
3. Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
4. The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To understand principles of Boolean Algebra and minimization of logic functions.
CO 2	To design and implement Combinational and Sequential logic circuits.
CO 3	To understand Analog to Digital conversion and Digital to Analog conversion.
CO 4	To understand Digital logic families, PLDs, PLA, PAL and FPGA.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	1	1	-	2	1	-	2
CO2	3	3	3	3	2	1	1	-	2	1	-	2
CO3	3	3	3	3	2	1	1	-	2	1	-	2
CO4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT - I

Fundamentals of Digital Systems: Analog and Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Examples of IC gates, Boolean Algebra.

Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, Don't care conditions, XOR and XNOR simplification of K-maps, minimization of logic functions using Quine-McCluskey's algorithm.

UNIT – II

Combinational Digital Circuits: Multiplexer, De-Multiplexer, Decoders, Encoder, Binary Adders and Subtractors, Binary multiplier, Digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices.

Sequential circuits and systems: S-R, J- K, T and D flip flops, race around condition, Level and Edge triggering mechanism, Master-slave flip flop, Excitation and characteristics tables of flip-flops, realization of flip-flops using other flip-flops, shift registers, applications of shift registers, Ripple (Asynchronous) counters, Synchronous counters, design of counters, special counter IC's: Ring counter and Johnson counter.

UNIT - III

Mealy and Moore machine, state diagram, state table, Design of sequence detector.

A/D and D/A Converters: D/A converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, Sample and hold circuit, Analog to Digital converters: quantization and encoding, A/D converter: Parallel A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, specifications of A/D converters, example of A/D converter ICs.

UNIT - IV

Logic families: Characteristics of Digital ICs, Digital logic families: TTL, ECL and CMOS logic.

Semiconductor memories and Programmable logic devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM). ROM as a PLD, Programmable logic array (PLA), Programmable array logic (PAL), Field Programmable Gate Array (FPGA).

Textbook(s):

1. Donald P. Leach, A. P. Malvino, and Gautam Saha, "Digital principles and applications", TMH, 2011.
2. R. J. Tocci, "Digital Systems", PHI, 2000.

References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. I. J. Nagrath, "Electronics, Analog & Digital", PHI, 1999.
3. J. M. Yarbrough, "Digital Logic-Application and Design", PWS Publishing.
4. B. S. Nai, " Digital Electronics and Logic Design", PHI.
5. Balabanian and Carlson, "Digital Logic Design Principles", Wiley Pub.
6. Morris Mano, "Digital logic and Computer design", Pearson Education India, 2016.

Paper Code(s): PC-256	**P : 2**
Paper: Digital Systems Design Lab	**C : 1**
Prerequisites:	
Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term-End Semester Examinations: 60 Marks	
Instructions: **3.** The course objectives and course outcomes are identical to that of PC-208 as this is the practical component of the theory paper. **4.** The practical list shall be notified by the teacher in the first week of the class commencement.	

Paper Code: AEC 214	**Paper: Principles of Management**	**L**	**T/P**	**C**
Paper ID:		**2**	**0**	**2**

Prerequisite Paper:

Marking Scheme:
NUES: Evaluation out of 100 marks by concerned teacher as Teacher's Continuous Evaluation

Guidelines for Paper Setter(s):

There should be 9 questions in the term end examinations question paper.
The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type questions of total 20 marks.
Apart from question one which is compulsory, rest of the paper shall consist of four units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to five sub-parts/sub-questions. Each unit shall have a marks weightage of 10.
The questions are to be framed keeping in view the learning objectives of course/paper. The standard /level of the questions to be asked should be at the level of the prescribed text book.
The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcome (CO):

CO 1	To introduce the fundamentals of management and strategic planning while exploring managerial roles, evolution, and business environment analysis.
CO 2	To develop an understanding of business forecasting, effective decision-making, and Management by Objectives, along with insights into various global management styles.
CO 3	To provide insights into organizational structure, leadership, HRM practices, coordination mechanisms, and career development strategies for effective management and workforce growth.
CO 4	To enhance understanding of leadership styles, effective communication, change management, and ethical responsibilities in addressing global, cultural, and organizational challenges.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1	2	2	1	-	2	2	3	3
CO2	3	3	2	2	2	-	-	-	2	2	2	3
CO3	3	3	2	3	2	-	-	-	2	2	2	3
CO4	3	3	2	3	2	-	-	-	2	2	2	3

Unit 1

Introduction to Management: Management – An Emerging Profession, Definition, Nature, Scope, Purpose, and characteristics of Management, Functions, roles, skills of an effective Manager. Evolution of Management Thought : Classical Theory, Scientific Management , Management Process or Administrative Management, Bureaucracy, Behavioural Science Approach, Quantitative Approach, Systems Approach, Contingency Approach, Operational Approach. Planning: Types of Plans, Planning Process, Introduction to Strategic Management, Types of Strategies, Understanding environment of business: Environmental appraisal – Industry Analysis - Porter's Model of competitive advantage, analysis of organisational resources and capabilities.

Unit 2

Forecasting and Premising : Introduction to Forecasting, Essential Components in Business Forecasting, Determinants of Business Forecasts, Benefits of Forecasting, Techniques of Forecasting, Limitations of Forecasting. Decision-making : Introduction, Components of Decision-making, Decision-making Process, Group Decision-making, Creativity Problem-solving. Management by Objectives and Styles of Management : Core Concepts of MBO, Characteristics of Management by Objectives, Process of MBO, Defining the Goal, Action Plan, Final Review, Benefits of Management by Objectives, Limitations of Management by Objectives, Styles of Management, American Style of Management, Japanese Style of Management, Indian Style of Management

Unit 3

Organizing and Directing: Introduction, Organizational Design, Hierarchical Systems , Organization Structure, Types of Organization Structure, Formal and Informal Organization, Factors Determining Span of Management, Centralization and Decentralization, Span of control, Understanding authority and responsibility, Principles of Delegation, Authority, Developing a culture of Innovation and performance.

Staffing and Coordination: Introduction, Human Resource Management, Recent Trends in HRM, Technology in HRM, Economic Challenges, Workforce Diversity, Concept of Coordination, Need for Coordination, Importance of Coordination, Principles of Coordination, Coordination Process, Types of Coordination, Issues and Systems Approach to Coordination, Techniques of Coordination.

Career Development Strategy: Introduction, Concept and Elements of Career, Overview of Career Development, Significance and Advantages of Career Development, Objectives of Career Development, Types of Career Development Programmes, Different Stages or Cycles of Career Development Process, Career Anchors, Steps in the Career Planning Process.

Unit-4

Leadership styles of Managers: Leadership Concept, Nature, Importance, Attributes of a leader, Role of a leader in demonstrating awareness of legal, personnel, and strategic issues relating to globalization, culture and gender diversity in an organization, Role of leader in conflict resolution and negotiations. Organizational Communication: Communication in Organizations: Introduction, Importance of Communication in the Workplace; Understanding Communication Process, Barriers to Communication, Use of tone, language and styles in Communication, Role of Perception in influencing communication, Role of culture in communication. Change management: Concept of change, change as a natural process, Importance & Causes of change – social, economic, technological, organizational, Developing a climate for learning, Concept of learning organizations, Challenges of Contemporary Business: Role of Ethics, Corporate social responsibility, and environmental issues.

Text Books

1. S. P. Robbins and D. A. DeCenzo, Fundamentals of Management, 9th ed. Pearson Education, 2016.
2. H. Koontz, C. O'Donnell, and H. Weihrich, Essentials of Management, 9th ed. New Delhi: Tata McGraw-Hill, 2012.

Reference Books

1. R. L. Daft, Principles of Management, Cengage Learning, 2009.
2. R. Robbins, Management, 9th ed., Pearson Education, 2008.
3. S. P. Robbins and M. Coulter, Management Fundamentals: Concepts, Applications, & Skill Development, 6th ed., Sage, 2014.

Framework of the Scheme

(3rd Year and 4th Year)

for

Bachelor of Technology / Master of Technology

(Dual Degree Programmes)

In

a. **Computer Science and Engineering – Major Discipline**
b. **Information Technology – Major Discipline**
c. **Electronics and Communication Engineering – Major Discipline**

Note: The minor specializations are offered through the following routes:

a. Program Core Electives (PCE): Groups of 5 courses / papers are offered for specific minor specialization groups.
b. Emerging Area Elective (EAE) or Open Area Elective Group (OAE): Groups of 5 courses / papers are offered for specific minor specialization groups. These specialization groups are offered by USICT as detailed in this document. Or, they may be offered by other schools of the University at the Dwarka campus of the University. These groups, if offered by other schools shall be called Open elective groups / minor specializations. The open elective groups must be offered as per the framework specified in this document.

B.Tech/M.Tech Dual Degree

Fifth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC		PC1	3	-	3
PC		PC2	3	-	3
PCE		Core area Elective – 1	4	-	4
EAE		#Elective in Emerging Areas 1 (students to choose one #group)	4	-	4
OAE		Elective from other school or emerging area/ open elective offered by the school - 1	4	-	4
VAC		Any one VAC	2	-	2
Practical/ Viva Voce					
PC	PC-355*	Summer Training (after 4th semester) Report	-	-	2
PC	PC-357*	Term Paper – III*	-	-	2
PC		PC Lab 1		2	1
PC		PC Lab 2		2	1
Total			**20**	**4**	**26**

* NUES

Students may choose from one group for a minor specialization (that is one group of papers for programme core elective (PCE) based minor specialization and the other for emerging area elective (AEA) based specializations. Such courses/papers (even in subsequent semesters), if they have a practical component, then the course shall be divided into two separate components. A theory component paper with a unique paper code with 3 credits and a practical component paper with another unique paper code with 1 credit. However, if there is no practical component, then the course / paper shall be a pure theory paper with 4 credits. Minor specialization is awarded only if all 20 credits are awarded / earned from the group of minor specialization specified.

B.Tech/M.Tech Dual Degree

Sixth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Core area Elective – 2	4	-	4
PCE		Core area Elective – 3	4	-	4
EAE		Elective in Emerging Areas - 2 (students to choose one group)	4	-	4
EAE		Elective in Emerging Areas – 3 (students to choose one group)	4	-	4
OAE		Elective from other school or emerging area/ open elective offered by the school - 2	4	-	4
OAE		Elective from other school or emerging area/ open elective offered by the school - 3	4	-	4
Practical/ Viva Voce					
VAC	VAC-314	** NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
Total			**24**		**26**

**** NUES**

Note: The route for the award of the degree has to be chosen by the student at the end of the 6th semester or the 3rd year. That is**,** the students shall be allowed to choose from one of the following three routes, for the award of the degree:

a. **Regular route:** The students taking this route shall continue with the study of the courses / papers in the 7th semester of 24 credits and a project or internship in the 8th semester. This route may lead to the award of two minor specializations.

b. **Internship route:** The students taking this route shall be required to undergo Internship at an organization. The organization shall offer an Internship to the student. The Internship offer shall be through the Training and Placement officer of the school, only. Students shall not be allowed to accept an Internship through any route. The students shall be required to submit an internship report in both the 7th and 8th semester. The reports shall contain the journal kept by the student summarizing weekly work done, countersigned by the mentor allocated by the Internship mentor at the Organization. There shall an internal teacher also allocated to the student as a mentor for the Internship progress guidance and evaluation.

c. **Research route:** The students taking this route be required to join research internship under mentorship of an academician at an organization. The topic of work of the student and the mentor (including the organization) shall be approved by the APC of the school. The student is required to publish at least one conference paper in a reputed conference / journal (meaning thereby, that its proceeding (if it is a conference) or the paper shall be indexed in Web of Science and/or Scopus) before the submission of the 8th semester dissertation. The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more.

B.Tech/M.Tech Dual Degree

Seventh Semester (Regular Route)					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Core area Elective – 7 / MOOC[2]	4	-	4
PCE		Core area Elective – 8 / MOOC[2]	4	-	4
OAE		Elective from other school or emerging area/ open elective offered by the school –4 / MOOC[2]	4	-	4
OAE		Elective from other school or emerging area/ open elective offered by the school – 5 / MOOC[2]	4	-	4
Practical/ Viva Voce					
PC	PC-403	Minor Project[1]	-	-	8
PC	PC-401	Summer Training (after 6th Semester) Report*	-	-	2
Total			**18**		**26**

* NUES

[1] Mandatory Paper, this paper must be passed by the student for award of the degree. The student shall be allocated a supervisor / guide for project work at the end of 6th semester by the School, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the back-ground study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by the concerned supervisor while the term end examinations of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Dean of the school can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the school. However, the APC of the school may allow change of route from the "Regular Route" to "Internship Route" in the eighth semester, but students changing their route to "Internship Route", in the eight semester shall not be eligible for the award of the Honours degree.

[2] The student is allowed to do the elective through MOOCs (Massive Open Online Courses) offered through SWAYAM / NPTEL platform. For this purpose, the student must apply to the school for doing the elective course through MOOC. Only with the approval of the DEAN, USICT, the student may attend the course. All cost for attending and examinations have to be borne by the student. Such courses shall be of 4 or more credits (but shall be accounted for as 4 credits only). The marksheet of the MOOC shall have to be submitted to the school for onward transmission to the Examinations division of the University to include in the records of examinations and count the credits accrued (as 4 credits) together with the marks. These marks shall be reflected in the marksheet of the 7th semester. The student has to seek permission for the MOOC course / paper option by the end of the 6th semester. The marksheet issued by the MOOCs authority have to be submitted by the student within 12 weeks of completion of classes of the 7th semester. Failure to do so, shall imply the student is **absent** in the allowed paper through MOOCs.

Seventh Semester (Internship Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PCE / Internship	[1] PCE - 405	Internship Report – I #	-	-	16
	[1] PCE - 407	Internship – I Viva Voce	-	-	6
	[1] PCE - 409	Internship – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
AEC	PC - 401	* Summer Training (after 6th Sem) Report	-	-	2
Total			**-**	**-**	**26**

Students are allowed to do internship in this semester, if following this route for the award of the degree. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed. An internal mentor shall also be assigned by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Internship Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) and / or Honours.

* NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks.

** NUES: Evaluation by a committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.
Internship Viva Voce: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the mentor (internal and/or external). And, 60 marks by a bench of the internal mentor and the external examiner deputed by examinations division (COE), for a total of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Seventh Semester (Research Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]PCE-411	Research Work Report – I #	-	-	16
	[1]PCE-413	Research Work – I Viva Voce	-	-	6
	[1]PCE-415	Research Work – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
AEC	PC-401	* Summer Training (after 6th Sem) Report	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do academic research in this semester, if following this route for the award of the degree. The students allowed to proceed for this route shall be required to submit a report (ICT461). The report has to be countersigned by the mentor concerned. Marks out of 40 have to awarded by the mentor (on a performa to be provided by the school) and submitted confidentially to the school (this may be done through email). The same has to be countersigned by the mentor at the organization where internship is completed. The format of the report shall be specified by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Research Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) minor specialization(s) and / or Honours.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks.

*NUES: Evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

B.Tech/M.Tech Dual Degree

Eighth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Regular Route					
PC / Project	[1]PC-402	Major Project – Report	-	-	16
	[1]PC-404	Major Project Viva Voce	-	-	8
	[1]PC-406	Major Project Progress Evaluation*	-	-	2
Internship Route					
PC / Internship	[1]PC-408	Internship Report – II	-	-	16
	[1]PC-410	Internship Viva Voce	-	-	8
	[1]PC-412	Internship Progress Evaluation*	-	-	2
Research Route					
PC / Research	[1]PC-414	Thesis**	-	-	16
	[1]PC-416	Internship Viva Voce	-	-	8
	[1]PC-418	Internship Progress Evaluation*	-	-	2
Total			**-**	**-**	**26**

Note: The student continues with the degree route as completed in the seventh semester. However, the APC of the school may allow changes within the scope of this document.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

** Submission of the thesis is to be allowed only if a paper has been accepted / published in a Scopus /Web of Science indexed conference / journal.

In the absence of the supervisor, the Dean of the School can assign the responsibility of the supervisor to any faculty of the school.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Framework of the Scheme

(3rd Year and 4th Year)

for

Bachelor of Technology / Master of Technology

(Dual Degree Programmes)

In

a. **Computer Science and Engineering - Artificial Intelligence**
b. **Computer Science and Engineering - Data Science**

B.Tech/M.Tech Dual Degree

Fifth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC		Core Paper**	4	-	4
PC		Core Paper**	4	-	4
PC		Core Paper**	4	-	4
PC		Core Paper**	4	-	4
OAE		Core Paper**	4	-	4
VAC		Any one VAC	2	-	2
Practical/ Viva Voce					
PC	PC-355	Summer Training (after 4th semester) Report	-	-	2
PC	PC-357*	Term Paper – III*	-	-	2
Total			**22**	**4**	**26**

*** NUES**

** The credits may be apportioned into Theory (3 credits) and Practicals (1 credit) in the final detailed 3rd and 4th year scheme

B.Tech/M.Tech Dual Degree

Sixth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC		Core Paper**	4	-	4
PC		Core Paper**	4	-	4
PC		Core Paper**	4	-	4
PC		Core Paper**	4	-	4
OAE/EAE		Open Area Elective / Emerging Area Elective**	4	-	4
OAE/EAE		Open Area Elective / Emerging Area Elective**	4	-	4
Practical/ Viva Voce					
VAC	VAC-314	** NSS/NCC/Cultural Clubs/Technical Society/ Technical Club/Institution's Innovation Council	-	-	2
Total			**24**	**4**	**26**

**** NUES**

** The credits may be apportioned into Theory (3 credits) and Practicals (1 credit) in the final detailed 3rd and 4th year scheme

Note: The route for the award of the degree has to be chosen by the student at the end of the 6th semester or the 3rd year. That is**,** the students shall be allowed to choose from one of the following three routes, for the award of the degree:

a. **Regular route:** The students taking this route shall continue with the study of the courses / papers in the 7th semester of 24 credits and a project or internship in the 8th semester. This route may lead to the award of two minor specializations.

b. **Internship route:** The students taking this route shall be required to undergo Internship at an organization. The organization shall offer an Internship to the student. The Internship offer shall be through the Training and Placement officer of the school, only. Students shall not be allowed to accept an Internship through any route. The students shall be required to submit an internship report in both the 7th and 8th semester. The reports shall contain the journal kept by the student summarizing weekly work done, countersigned by the mentor allocated by the Internship mentor at the Organization. There shall an internal teacher also allocated to the student as a mentor for the Internship progress guidance and evaluation.

c. **Research route:** The students taking this route be required to join research internship under mentorship of an academician at an organization. The topic of work of the student and the mentor (including the organization) shall be approved by the APC of the school. The student is required to publish at least one conference paper in a reputed conference / journal (meaning thereby, that its proceeding (if it is a conference) or the paper shall be indexed in Web of Science and/or Scopus) before the submission of the 8th semester dissertation. The research route is to be allowed only to students who have no "fail" paper till 6th semester, that is, all papers upto and including 6th semester have been passed by the student and after 6th semester the student has a CGPA of 7.5 or more.

B.Tech/M.Tech Dual Degree

Seventh Semester (Regular Route)					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Core Area Elective ** / MOOCs[2]	4	-	4
PCE		Open Area Elective ** / MOOCs[2]	4	-	4
OAE/EAE		Open Area Elective ** / MOOCs[2]	4	-	4
OAE/EAE		Open Area Elective ** / MOOCs[2]	4	-	4
Practical/ Viva Voce					
PC	PC-403	Minor Project[1]	-	-	8
PC	PC-401	Summer Training (after 6th Semester) Report*	-	-	2
Total			**18**		**26**

[1] Mandatory Paper, this paper must be passed by the student for award of the degree. The student shall be allocated a supervisor / guide for project work at the end of 6th semester by the School, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the back-ground study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by the concerned supervisor while the term end examinations of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Dean of the school can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the school. However, the APC of the school may allow change of route from the "Regular Route" to "Internship Route" in the eighth semester, but students changing their route to "Internship Route", in the eight semester shall not be eligible for the award of the Honours degree.

[2] The student is allowed to do the elective through MOOCs (Massive Open Online Courses) offered through SWAYAM / NPTEL platform. For this purpose, the student must apply to the school for doing the elective course through MOOC. Only with the approval of the DEAN, USICT, the student may attend the course. All cost for attending and examinations have to be borne by the student. Such courses shall be of 4 or more credits (but shall be accounted for as 4 credits only). The marksheet of the MOOC shall have to be submitted to the school for onward transmission to the Examinations division of the University to include in the records of examinations and count the credits accrued (as 4 credits) together with the marks. These marks shall be reflected in the marksheet of the 7th semester. The student has to seek permission for the MOOC course / paper option by the end of the 6th semester. The marksheet issued by the MOOCs authority have to be submitted by the student within 12 weeks of completion of classes of the 7th semester. Failure to do so, shall imply the student is absent in the allowed paper through MOOCs.

*** NUES**

** The credits may be apportioned into Theory (3 credits) and Practicals (1 credit) in the final detailed 3rd and 4th year scheme

Seventh Semester (Internship Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PCE / Internship	[1] PCE - 405	Internship Report – I #	-	-	16
	[1] PCE - 407	Internship – I Viva Voce	-	-	6
	[1] PCE - 409	Internship – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
AEC	PC - 401	* Summer Training (after 6th Sem) Report	-	-	2
Total			**-**	**-**	**26**

Students are allowed to do internship in this semester, if following this route for the award of the degree. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed. An internal mentor shall also be assigned by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Internship Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) and / or Honours.

* NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks.

** NUES: Evaluation by a committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.
Internship Viva Voce: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the mentor (internal and/or external). And, 60 marks by a bench of the internal mentor and the external examiner deputed by examinations division (COE), for a total of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Seventh Semester (Research Route)#					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
PC / Internship	[1]PCE-411	Research Work Report – I #	-	-	16
	[1]PCE-413	Research Work – I Viva Voce	-	-	6
	[1]PCE-415	Research Work – I Progress Evaluation**	-	-	2
Practical/ Viva Voce					
AEC	PC-401	* Summer Training (after 6th Sem) Report	-	-	2
Total			**-**	**-**	**22**

Students are allowed to do academic research in this semester, if following this route for the award of the degree. The students allowed to proceed for this route shall be required to submit a report (ICT461). The report has to be countersigned by the mentor concerned. Marks out of 40 have to awarded by the mentor (on a performa to be provided by the school) and submitted confidentially to the school (this may be done through email). The same has to be countersigned by the mentor at the organization where internship is completed. The format of the report shall be specified by the school. The student shall continue on this route for completion of the requirements of the degree in the final semester. However, the APC of the school may allow change of route to the "Regular Route" in the eighth semester, but students changing their route from "Research Route" to "Regular Route", in the eight semester, shall not be eligible for award of minor specialization(s) minor specialization(s) and / or Honours.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks.

*NUES: Evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100 marks. This exam may be conducted online as the students may be placed outside the city for internship and may not be able to attend in the physical mode.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

B.Tech/M.Tech Dual Degree

Eighth Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Regular Route					
PC / Project	[1]PC-402	Major Project – Report	-	-	16
	[1]PC-404	Major Project Viva Voce	-	-	8
	[1]PC-406	Major Project Progress Evaluation*	-	-	2
Internship Route					
PC / Internship	[1]PC-408	Internship Report – II	-	-	16
	[1]PC-410	Internship Viva Voce	-	-	8
	[1]PC-412	Internship Progress Evaluation*	-	-	2
Research Route					
PC / Research	[1]PC-414	Thesis**	-	-	16
	[1]PC-416	Internship Viva Voce	-	-	8
	[1]PC-418	Internship Progress Evaluation*	-	-	2
Total			**-**	**-**	**26**

Note: The student continues with the degree route as completed in the seventh semester. However, the APC of the school may allow changes within the scope of this document.

*NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

** Submission of the thesis is to be allowed only if a paper has been accepted / published in a Scopus /Web of Science indexed conference / journal.

In the absence of the supervisor, the Dean of the School can assign the responsibility of the supervisor to any faculty of the school.

[1]The credits for these papers are mandatorily required to be earned by the student for the award of the degree through this route.

Regulation for Implementation - I

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) **in Computer Science and Engineering / Information Technology / Electronics and Communications Engineering** programme, offered at University School of Information Communication and Technology. This program shall not be offered at affiliated institutions of the University. This regulation is to be read together with the rest of this document.

A. Guidelines for Electives

Electives are papers/courses that the student is allowed to choose from a specified list of papers. The electives shall be offered in two sections, namely:

1. The program core elective section
2. The emerging area elective section

Within each section of the electives, the student has to study a set/group of 5 papers. Some of the papers of the elective groups may be combined into minor specializations groups and shall be enumerated in this document. No minor specialization outside the list specified shall be allowed. A subset of the electives in the list of electives shall be chosen by the Academic Programme Committee (APC) of the school to be offered to students depending on the availability of faculty and other academic resources and only from this subset an elective shall be allowed to be studied by a group of students if and only if at least one third of the discipline intake of that particular admission year desire to study a particular paper / course.

The elective papers shall be allowed to be taken / studied by the students, by the APC of the School, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

B. Credits per Academic Year

The credits offered to a student in a particular academic year of study shall be 44 credits.

C. Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have two study two papers / courses, namely:

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C and Data Structures	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor as NUES, the same shall be transferred to Examination Division of the University.
4. The degree to be awarded to the student only subject to the acquiring qualifying grade/marks in the bridge courses and the minimum credits in the regular courses of the scheme of study as prescribed.
5. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA. The qualifying marks shall be 40 marks in each paper.
6. A separate marksheet will be issued by the Examination Division of the University for the Bridge Course.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

D. Promotion to the Master of Technology part of the degree

Only after qualifying for the award of the degree of Bachelor of Technology, the student may be allowed to proceed for the Master in Technology part of the Bachelor / Master of Technology (Dual Degree). The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.

E. Scheme and Syllabus of the Master of Technology part of the Dual Degree Programme

The scheme and syllabi of the Master of Technology part of the Bachelor / Master of Technology (Dual Degree) shall be notified separately. This document pertains to the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme only.

F. Members of APC

Teachers of other Schools, as and when deputed by their school, for teaching the students enrolled in programmes offered by the University School of Information, Communication and Technology (USICT) shall be a part of the Academic Programme Committee of the school. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of USICT. Similarly, the guest faculty, the visiting faculty and the contract / Ad Hoc faculty as and when deputed to teach students of USICT shall form a part of APC of USICT.

G. Medium of Instructions

The medium of instructions and examinations shall be English.

H. Power to Remove Difficulty

In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

Regulation for Implementation - II

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Computer Science and Engineering – Artificial Intelligence / Computer Science and Engineering – Data Science** programme, offered at University School of Information Communication and Technology. This program shall not be offered at affiliated institutions of the University. This regulation is to be read together with the rest of this document.

A. Guidelines for Electives

Electives are papers/courses that the student is allowed to choose from a specified list of papers. The electives shall be offered in two sections, namely:

1. The program core elective section
2. The emerging area elective section

A subset of the electives in the list of electives shall be chosen by the Academic Programme Committee (APC) of the school to be offered to students depending on the availability of faculty and other academic resources and only from this subset an elective shall be allowed to be studied by a group of students if and only if at least one third of the discipline intake of that particular admission year desire to study a particular paper / course.

The elective papers shall be allowed to be taken / studied by the students, by the APC of the School, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

B. Credits per Academic Year

The credits offered to a student in a particular academic year of study shall be 44 credits.

C. Provision for Lateral Entry of Students

Lateral entry of students shall be allowed as per University rules, regulations and policy. These students shall be admitted in the second year of the degree programme. Such students shall study the papers / courses offered from the second year onwards only. Only the credits earned for the papers of second to fourth year of the programme of study shall be considered for the award of the degree to the lateral entry students. In addition to these papers/course of second to fourth year of study, these students have two study two papers / courses, namely:

Paper Code	Paper Name	L/P
BC-001	Bridge Course in Mathematics	4
BC-002	Bridge Course in Programming in C and Data Structures	4

Implementation Rules for Bridge Courses:

1. The Class incharges for the third semester of the batch (appointed by the Dean, USICT) shall act as the mentor of the lateral entry students for these courses.
2. These papers have to be qualified by the students. The students shall study the bridge course in self-study mode under the mentorship of the mentors.
3. For these papers examination shall be conducted by the concerned subject teacher / mentor as NUES, the same shall be transferred to Examination Division of the University.
4. The degree to be awarded to the student only subject to the acquiring qualifying grade/marks in the bridge courses and the minimum credits in the regular courses of the scheme of study as prescribed.
5. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA. The qualifying marks shall be 40 marks in each paper.
6. A separate marksheet will be issued by the Examination Division of the University for the Bridge Course.
7. Students shall study the paper in the self study mode. A Mentor shall be allocated by the academic programme committee of the School to groups of lateral entry students. Mentors shall interact with the students to clarify, guide, assignments (given by the mentor) and evaluation of the course.

D. Promotion to the Master of Technology part of the degree

Only after qualifying for the award of the degree of Bachelor of Technology, the student may be allowed to proceed for the Master in Technology part of the Bachelor / Master of Technology (Dual Degree). The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.

E. Scheme and Syllabus of the Master of Technology part of the Dual Degree Programme

The scheme and syllabi of the Master of Technology part of the Bachelor / Master of Technology (Dual Degree) shall be notified separately. This document pertains to the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme only.

F. Members of APC

Teachers of other Schools, as and when deputed by their school, for teaching the students enrolled in programmes offered by the University School of Information, Communication and Technology (USICT) shall be a part of the Academic Programme Committee of the school. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of USICT. Similarly, the guest faculty, the visiting faculty and the contract / Ad Hoc faculty as and when deputed to teach students of USICT shall form a part of APC of USICT.

G. Medium of Instructions

The medium of instructions and examinations shall be English.

H. Power to Remove Difficulty

In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

Regulation for Award of the Degree - I

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Computer Science and Engineering / Information Technology / Electronics and Communications Engineering** (as major discipline) , offered at University School of Information Communication and Technology. This regulation is to be read together with the rest of this document.

1. (a) The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.
   (b) Pass marks in every paper shall be 40.
   (c) Grading System shall be as per Ordinance 11 of the University.

2. **Minimum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme.

3. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme). No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum exit time/year shall be the same as for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. **Maximum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 7 years (N+3 years). After completion of N+3 years of study, no extension shall be given to the student for completing the requirements of the degree and the admission of the student shall stand cancelled. That is, if the student does not complete the requirements for the award of the degree in this period, the admission of the student shall be cancelled. That is, if a batch of regular students is admitted in the 1st semester / 1st year, in the Academic session 2025-26, then the batch period of study finishes in the Academic Session 2032-33. The maximum period of study for a lateral entry student shall end together with the regular batch. That is, if a lateral entry student is admitted in the Academic Session 2026-27, in the 3rd semester /2nd year, his/her last allowed year of study shall be Academic Session 2032-33.

5. After the 6th semester, and before the commencement of the 7th semester, the student has to choose from one of the following routes for the award of the degree:
   a. Regular Route
   b. Internship Route
   c. Research Route

   Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours, can only take this route for the award of the degree.

6. (a) To earn an Honours degree, the student may enrol for 20 credits or more (over and above the 205 credits offered in the classroom) through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point / clause 8a, The acquisition of the credits should be completed before the 15th of the July of the admission year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated for this purpose.

   (b) Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the School about the same before the commencement of the 5th semester. The school shall inform the list of such students to the Examination Division of the University within 4 weeks of the commencement of the 5th semester for the batch of students.

   (c) The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the School. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the school for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the school, then transferred to the Examinations division, shall be notified by the examinations division of the University, and a separate marksheet shall be issued by the Examinations divisions.

   (d) The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as

additional courses / papers for the student.

(e) If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

(f) The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

(g) The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. See Clause 8 also.

(h) No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(i) No Honours shall be conferred if the student fails in any of the mandatory paper offered to the student.

(j) No Honours shall be conferred if the student has taken the any of the interim degrees (as specified in the Table of the Clause 7.)

(k) The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5. In addition, the student should be eligible for the award of the degree after the immediate completion of the 4th year of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(l) Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours can only take this route for the award of the degree.

7. **Exit After Completion of an Academic Year**:

A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The student may re-join later with the provisio that the maximum time allowed is same as clause 4 above. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Certificate in Computer Science and Engineering / Information Technology / Electronics and Communications Engineering	Has earned at least 45 credits in the 1st year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper of 1st year on re-joining in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Diploma in Computer Science and Engineering / Information Technology / Electronics and Communications Engineering	Has earned at least 92 credits upto and including the 2nd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining in the third year to complete the requirement for the award of the degree. (Interim Degree)
3rd Year	Advanced Diploma in Computer Science and Engineering / Information Technology / Electronics and Communications Engineering	Has earned at least 139 credits upto and including the 3rd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining in the fourth year to complete the requirement for the award of the degree. (Interim Degree)
4th Year	See Clause 8	Has earned at least 186 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

Similarly, for Lateral Students admitted in the second year/third semester, the interim awards shall be as follows (the condition of time allowed for re-joining remains as per clause 4 above , applicable to lateral entry students), and shall be as follows:

Completion of	Be Awarded	Condition to be Satisfied	Remarks
2nd Year	Diploma in Computer Science and Engineering / Information Technology / Electronics and Communications Engineering	Has earned at least 47 credits in the 2nd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining in the third year to complete the requirement for the award of the degree. (Interim Degree)
3rd Year	Advanced Diploma in Computer Science and Engineering / Information Technology / Electronics and Communications Engineering	Has earned at least 94 credits upto and including the 3rd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining in the fourth year to complete the requirement for the award of the degree. (Interim Degree)
4th Year	See Clause 8	Has earned at least 141 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Thus, the **minimum credit** for the award of the final degree is 186 (for regular students) and 142 (for lateral entry students). The student has to acquire at least 186 credits for regular students (141 for lateral entry students), other than the credits for Honours (if any), to be considered for the award of the final degree

And, the **maximum credit** for the award of the final degree is 205 (for regular students) and 156 (for lateral entry students).

The student has to study and appear in examinations for at least 205 credits for regular students (156 for lateral entry students), other than the credits for Honours (if any).

8. The following degree route can be taken by a student:
   a. Regular Route
      i. Degree with two minor specializations:
         1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student.
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline> with minor specializations in <First Minor Specialization Group Name> and <First Minor Specialization Group Name >**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in < major discipline> with minor specializations in <First Minor Specialization Group Name> and <Second Minor Specialization Group Name > (Honours)**";

      ii. ***Degree with one minor specializations:***
         1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
         2. Has earned 20 credits from one minor specialization group.
         3. Has cleared all mandatory papers to be passed, offered to the student..
         4. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline> with minor specialization in <Minor Specialization Group Name>**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in < major discipline> with minor specialization in < Minor Specialization Group Name> (Honours)**";

      iii. **Degree with no minor specialization:**
         1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
         2. Has cleared all mandatory papers to be passed, offered to the student..
         3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline>**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in < major discipline> (Honours)**";

b. **Internship Route**
    1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
    2. Has cleared all mandatory papers to be passed, offered to the student..
    3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline> with Internship**"

c. **Research Route**
    1. The student acquires at least 187 credits (142 credits for lateral entry) credits (as per the scheme of examinations for this route).
    2. Has cleared all mandatory papers to be passed, offered to the student..
    3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline> with Research**"

9. In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

10. This regulation has to be read together with the rest of this document.

Regulation for Award of the Degree - II

This regulation shall apply only to the Bachelor of Technology part of the Bachelor of Technology / Master of Technology (dual Degree Programme) in **Computer Science and Engineering – Artificial Intelligence / Computer Science and Engineering – Data Science** (as major discipline) , offered at University School of Information Communication and Technology. This regulation is to be read together with the rest of this document.

1. (a) The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.
   (b) Pass marks in every paper shall be 40.
   (c) Grading System shall be as per Ordinance 11 of the University.

2. **Minimum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme.

3. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme). No exemption certificate shall be issued in any case.
   A specific lateral entry students' minimum exit time/year shall be the same as for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. **Maximum duration** of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 7 years (N+3 years). After completion of N+3 years of study, no extension shall be given to the student for completing the requirements of the degree and the admission of the student shall stand cancelled. That is, if the student does not complete the requirements for the award of the degree in this period, the admission of the student shall be cancelled. That is, if a batch of regular students is admitted in the 1st semester / 1st year, in the Academic session 2025-26, then the batch period of study finishes in the Academic Session 2032-33. The maximum period of study for a lateral entry student shall end together with the regular batch. That is, if a lateral entry student is admitted in the Academic Session 2026-27, in the 3rd semester /2nd year, his/her last allowed year of study shall be Academic Session 2032-33.

5. After the 6th semester, and before the commencement of the 7th semester, the student has to choose from one of the following routes for the award of the degree:
   a. Regular Route
   b. Internship Route
   c. Research Route

   Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours, can only take this route for the award of the degree.

6. (a) To earn an Honours degree, the student may enrol for 20 credits or more (over and above the 205 credits offered in the classroom) through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point / clause 8a, The acquisition of the credits should be completed before the 15th of the July of the admission year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated for this purpose.
   (b) Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the School about the same before the commencement of the 5th semester. The school shall inform the list of such students to the Examination Division of the University within 4 weeks of the commencement of the 5th semester for the batch of students.

   (c) The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the School. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the school for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the school, then transferred to the Examinations division, shall be notified by the examinations division of the University, and a separate marksheet shall be issued by the Examinations divisions.

(d) The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

(e) If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

(f) The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

(g) The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. See Clause 8 also.

(h) No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(i) No Honours shall be conferred if the student fails in any of the mandatory paper offered to the student.

(j) No Honours shall be conferred if the student has taken the any of the interim degrees (as specified in the Table of the Clause 7.)

(k) The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5. In addition, the student should be eligible for the award of the degree after the immediate completion of the 4th year of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

(l) Three routes for award of the final degree are defined in Clause 8 below. Only for the **Regular Route for the Award of the Degree**, the Honours degree may be awarded subject to fulfilment of all conditions specified in this regulation. Thus, the students that opt for the Honours can only take this route for the award of the degree.

7. **Exit After Completion of an Academic Year**:

A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The student may re-join later with the provisio that the maximum time allowed is same as clause 4 above. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Certificate in Computer Science and Engineering	Has earned at least 45 credits in the 1st year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper of 1st year on re-joining in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Diploma in Computer Science and Engineering	Has earned at least 92 credits upto and including the 2nd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining in the third year to complete the requirement for the award of the degree. (Interim Degree)
3rd Year	Advanced Diploma in Computer Science and Engineering – Artificial Intelligence / Computer Science and Engineering – Data Science	Has earned at least 139 credits upto and including the 3rd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining in the fourth year to complete the requirement for the award of the degree. (Interim Degree)
4th Year	See Clause 8	Has earned at least 186 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

Similarly, for Lateral Students admitted in the second year/third semester, the interim awards shall be as follows (the condition of time allowed for re-joining remains as per clause 4 above , applicable to lateral entry students), and shall be as follows:

Completion of	Be Awarded	Condition to be Satisfied	Remarks
2nd Year	Diploma in Computer Science and Engineering	Has earned at least 47 credits in the 2nd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining in the third year to complete the requirement for the award of the degree. (Interim Degree)
3rd Year	Advanced Diploma in Computer Science and Engineering – Artificial Intelligence / Computer Science and Engineering – Data Science	Has earned at least 94 credits upto and including the 3rd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining in the fourth year to complete the requirement for the award of the degree. (Interim Degree)
4th Year	See Clause 8	Has earned at least 141 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

The re-joining is to be allowed if and only if sufficient numbers of years of study are still remaining as per clause 4, for completion of the requirement of the award of the final degree (after 4th year of study as per scheme and syllabi specified in this document).

Thus, the **minimum credit** for the award of the final degree is 186 (for regular students) and 142 (for lateral entry students). The student has to acquire at least 186 credits for regular students (141 for lateral entry students), other than the credits for Honours (if any), to be considered for the award of the final degree

And, the **maximum credit** for the award of the final degree is 205 (for regular students) and 156 (for lateral entry students).

The student has to study and appear in examinations for at least 205 credits for regular students (156 for lateral entry students), other than the credits for Honours (if any).

8. The following degree route can be taken by a student:

a. Regular Route

1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
2. Has cleared all mandatory papers to be passed, offered to the student.
3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline>**; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in < major discipline> (Honours)**";

ii. ***Degree with one minor specializations:***

1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
2. Has cleared all mandatory papers to be passed, offered to the student..
3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline>**; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in < major discipline> (Honours)**";

iii. **Degree with no minor specialization:**

1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
2. Has cleared all mandatory papers to be passed, offered to the student..
3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline>**"; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 6 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "**Bachelor of Technology in < major discipline> (Honours)**";

b. **Internship Route**

1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
2. Has cleared all mandatory papers to be passed, offered to the student..
3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline> with Internship**"

c. **Research Route**

1. The student acquires at least 187 credits (142 credits for lateral entry) (as per the scheme of examinations for this route).
2. Has cleared all mandatory papers to be passed, offered to the student..
3. The degree nomenclature of the degree shall be as: "**Bachelor of Technology in < major discipline> with Research**"

9. In case of difference of opinion in the interpretation of any statement or clause of this regulation or the scheme and syllabus, the decision of the Dean of the University School of Information, Communication and Technology, shall be final.

10. This regulation has to be read together with the rest of this document.