SCHEME OF EXAMINATION

&

SYLLABI

for

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

Scheme and Syllabus

for

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

Offered by

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

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

Guru Gobind Singh Indraprastha University
Sector 16C, Dwarka, Delhi – 110 078 [INDIA]
www.ipu.ac.in

Approved by BoS of USICT:31/10/2021, Approved by AC sub-committee: 22/11/2021
Applicable from Batch Admitted in Academic Session 2021-22 Onwards

Approved by BoS of USICT:31/10/2021,
Applicable from Batch Admitted in Academic Session 2021-22 Onwards

Approved by AC sub-committee: 22/11/2021

Vision of the School

Create high-quality engineering professionals

Mission of the School

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

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 analyse complex 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 needs with 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 knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:
    a. 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;
    b. that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;
    c. that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;
    d. which need to be defined (modelled) within appropriate mathematical framework; and
    e. 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 Science
HS: Humanities, social science, management
ES: Engineering Science
MC: Mandatory courses
PC: Programme Core, that is course / paper offered in the discipline of the programme as a compulsory paper.
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. This allows the student to have two minor specializations also.
Note: The papers offered by USICT as open elective shall only be offered in the Dwarka Campus of the University. Students studying at the Dwarka Campus of the University only are eligible for these papers, subject to the rules of the USICT.

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 shall be 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 shall mean the specializations earned through the EAE or OAE route subject to fulfilment of requirements specified in the scheme of study for the concerned minor specialization.

Paper / Course shall be treated as synonyms. A paper is one unit of curriculum taught, in general, in one particular semester, having upto 4 credits (for papers with

Acronyms:
APC: Academic programme committee comprising of all faculty of the school and as defined in the implementation rules.
BoS: Board of Study of the school, USICT.
USICT: University School of Information, Communication and Technology.
L: Number of Lecture hours per week
T/P: Number of Tutorial / 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 OF THE FIRST 4 YEARS (8 SEMESTER) CORRESPONDING TO THE BACHELOR OF TECHNOLOGY PART OF THE BACHELOR OF TECHNOLOGY / MASTER OF TECHNOLOGY PART OF THE DUAL DEGREE PROGRAMMES OFFERED BY USICT AT THE DWARKA CAMPUS OF THE UNIVERSITY. THE CURRENT DOCUMENT DEFINES THE SYLLABUS FOR THE FIRST YEAR ONLY.

Pravin Chandra

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**

First Semester					
Group	Code	Paper	L	P	Credits
Theory Papers					
ES	ICT101	Programming for Problem Solving	3	-	3
ES	ICT103	Electrical Science	3	-	3
ES	ICT105	Engineering Mechanics	3	-	3
HS	HS107	Communication Skills-I	3	-	3
BS	BS109	Engineering Chemistry - I	4	-	4
BS	BS111	Engineering Mathematics - I	3	-	3
BS	BS113	Engineering Physics - I	2	-	2
HS/MC	LLB115*	Indian Constitution			
Practical/Viva Voce					
ES	ICT151	Programming for Problem Solving Lab.	-	2	1
ES	ICT153	Engineering Graphics-I	-	2	1
ES	ICT155	Electrical Science Lab.	-	2	1
BS	BS157	Engineering Chemistry-I Lab	-	2	1
BS	BS159	Engineering Physics - I Lab	-	2	1
Total			24	10	29

***NUES : Comprehensive evaluation by the teacher concerned out of 100.**

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Second Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES		School Specific Engineering Science Paper**			3
HS	HS102	Communication Skills - II	3	-	3
BS	BS104	Engineering Chemistry - II	3	-	3
BS	BS106	Engineering Mathematics - II	4	-	4
BS	BS108	Engineering Physics-II	3	-	3
BS	BS110	Probability and Statistics for Engineers ***	3	2	4
HS/MC	ICT114*	Human Values and Ethics	1	-	1
BS/MC	EMES112	Environmental Studies	4	-	4
Practical/Viva Voce					
ES	ICT152	Engineering Graphics-II Lab.	-	2	1
BS	BS156	Engineering Chemistry - II Lab	-	2	1
BS	BS158	Engineering Physics -II Lab	-	2	1
One paper from the following#:					
ES	ICT154	Workshop Technology		2	1
ES	ICT160	Programming in Python		2	
Total			**24**	**8**	**29**

*NUES: Comprehensive evaluation by the teacher out of 100, no term end examination shall be held.

Either Workshop practice or Programming in Python paper shall be offered to the students by the school. If Workshop Technology paper is offered it shall be considered as a Theory paper otherwise Workshop practice shall be considered as practical paper

** School Specific Engineering Science Paper in this semester shall be one of the papers from the list below or any paper (approved by the Board of Studies of the School) decided by the Academic Programme Committee of the School to be offered in the first year/second semester.

Second Semester Open Elective from the School					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
	Open Elective Papers				
ES	ICT116	Introduction to Manufacturing Process	3	-	3
ES	BS118	Industrial Chemistry	3	-	3
ES	BT120	Introduction to Biotechnology	3	-	3

*** The Teachers' Continuous Evaluation Component shall be 25, Term end theory examinations of 50 marks and term end practical marks shall be of 25 marks maximum. The marks obtained in each component by the student shall be reflected in the marksheet.

SYLLABUS OF FIRST YEAR

for

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

Offered by

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

PaperCode: ICT101	Paper: Programming for Problem Solving	L	T/P	C
PaperID: 164101		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. 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 and execution 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. [10Hrs]

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 arrays to functions: idea of call by reference, Recursion.
Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions. [10Hrs]

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 [10Hrs]

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. [10Hrs]

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, MIT Press, 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 National Standards 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).

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PaperCode: ICT103	Paper: Electrical Science	L	T/P	C
PaperID: 164103		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	To impart knowledge of the basics electrical engineering.
2:	To impart knowledge of the working of RLC circuits.
3:	To impart basic knowledge about filters and magnetic circuits.
4:	To impart basic knowledge about electrical machines.

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, Kirchho '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. [10Hrs]

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. [10Hrs]

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. [10Hrs]

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. [10Hrs]

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.

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5. *Hughes Electical & 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.

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PaperCode: ICT105	Paper: Engineering Mechanics	L		T/P	C
PaperID: 164105		3		-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. 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 method of 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. [10Hrs]

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. [10Hrs]

Unit III

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

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. [10Hrs]

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. [10Hrs]

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.*

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PaperCode: HS107	Paper: Communication Skills - I	L	T/P	C
PaperID: 99107		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 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, [8Hrs]

Unit II

Basic Language Efficiency 2: Writing Skills: Types of Writing, Paragraph writing,Paraphrasing, Summarizing, Précis Writing [8Hrs]

Unit III

Formal Written Communication: Meetings - Agenda and Minutes,Press release, Letter writing, Notice, Memorandum, E-mails [8Hrs]

Unit IV

Appreciating written Texts for comprehension ability:

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

[8Hrs]

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.

PaperCode: BS109	Paper: Engineering Chemistry - I	L	T/P	C
PaperID: 99109		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 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.
5. 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. [12Hrs]

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. [10 Hrs]

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.[8Hrs]

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. [10Hrs]

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.

PaperCode: BS111	Paper: Engineering Mathematics - I	L	T/P	C
PaperID: 99111		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. 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 algebrato solve formulated engineering problems.
4:	To understand use vector calculusto 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 algebrato solve formulated engineering problems.
CO4:	Ability to use vector calculusto 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. [8Hrs]

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 of a 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 Jn(x) and Yn(x). Gamma Function [12Hrs]

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) [10Hrs]

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. [10Hrs]

Textbooks:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th 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), 2019.

Pravin Chandra

PaperCode: BS113	Paper: Engineering Physics - I	L	T/P	C
PaperID: 99113		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	To understand thermodynamic principles.
2:	To understand and model oscillations and waves.
3:	To understand and model interference, diffraction and polarization phenomenon.
4:	To understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO):

CO1:	Ability to apply thermodynamic principles to solution of engineering problems.
CO2:	Ability to understand and model oscillations and waves.
CO3:	Ability to understand and model interference, diffraction and polarization phenomenon.
CO4:	Ability to understand and appreciate relativistic systems and Lasers.

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

Introduction to Thermodynamics: Fundamental Ideas of Thermodynamics, The Continuum Model, The Concept of a "System'", "State", "Equilibrium", "Process'". Equations of state, Heat, Zeroth Law of Thermodynamics, Work, first and second laws of thermodynamics, entropy [8Hrs]

Unit II

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 [8Hrs]

Unit III

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. [12Hrs]

Unit IV

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 [12Hrs]

Textbooks:

*Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw-Hill, 2017.
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.

PaperCode: LLB115	Paper: Indian Constitution	L	T/P	C
PaperID: 99115		2	-	2

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter (Maximum Marks for Term End Examinations: 75):

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.

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. [6Hrs]

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 [6Hrs]

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 [6Hrs]

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 [6Hrs]

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

Pravin Chandra

PaperCode: ICT151	Paper: Programming for Problem Solving Lab.		L	P	C
PaperID: 164151			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

The course objectives and course outcomes are identical to that of ICT101 (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.

Pranin Chandra

PaperCode: ICT153	Paper: Engineering Graphics-I	L	P	C
PaperID: 164153		-	2	1

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

Course Objectives:

1:	The students will learn the introduction of Engineering graphics, various equipment used, various scales, dimensions and BIS codes used while making drawings for various streams of engineering disciplines.
2:	The students will learn theory of projections and projection of points.
3:	The students will learn projection of lines and projection of planes.
4:	The students will learn the projection of solid and development of surfaces

Course Outcomes (CO):

CO1:	To understand the theory of projections and projection of points.
CO2:	Ability to do line projections.
CO3:	Ability to do plane projections.
CO4:	Ability to do solid projections and development of surfaces

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	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I
Introduction: Engineering Graphics/Technical Drawing, Introduction to drawing equipments and use of instruments, Conventions in drawing practice. Types of lines and their uses, BIS codes for lines, technical lettering as per BIS codes, Introduction to dimensioning, Types, Concepts of scale drawing, Types of scales
Theory of Projections: Theory of projections, Perspective, Orthographic, System of orthographic projection: in reference to quadrants, Projection of Points, Projection in different quadrants, Projection of point on auxiliary planes. Distance between two points, Illustration through simple problems.

Unit II
Projection of Lines: Line Parallel to both H.P. and V.P., Parallel to one and inclined to other, Other typical cases: three view projection of straight lines, true length and angle orientation of straight line: rotation method, Trapezoidal method and auxiliary plane method, traces of line.

Unit III
Projection of Planes: Projection of Planes Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, Plane oblique to reference planes, traces of planes.
Planes Other than the Reference Planes: Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points and lines lying in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.

Unit IV
Projection of Solids: Projection of solids in first or third quadrant, Axis parallel to one and perpendicular to other, Axis parallel to one inclined to other, Axis inclined to both the principal plane, Axis perpendicular to profile plane and parallel to both H.P. and V.P., Visible and invisible details in the projection, Use of rotation and auxiliary plane method.
Development of Surface: Purpose of development, Parallel line, radial line and triangulation method, Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, Development of surface.

Note: The sheets to be created shall be notified by the concerned teacher in the first week of teaching.

Textbooks:
1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:
1. *Engineering Drawing*by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing*by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.

PaperCode: ICT155	Paper: Electrical Science Lab.		L	P	C
PaperID: 164155			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

The course objectives and course outcomes are identical to that of ICT103 (Electrical Science) 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: BS157	Paper: Engineering Chemistry - I Lab.		L	P	C
PaperID: 99157			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of BA109 (Engineering Chemistry - I) as this is the practical component of the corresponding theory paper.
2. 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: BS159	Paper: Engineering Physics - I Lab.		L	P	C
PaperID: 99159			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:

1. The course objectives and course outcomes are identical to that of BA113 (Engineering Physics - I) as this is the practical component of the corresponding theory paper.
2. 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.

Pranin Chandra

PaperCode: HS102	Paper: Communication Skills - II	L	T/P	C
PaperID: 99102		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 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.

Course Objectives:

1:	To develop the theoretical framework of communication to understand the professional interaction.
2:	To develop confidence in all aspects of communication whether verbal or non-verbal.
3:	To be able to create error-free and well-formatted formal documents for professional records.
4:	To be able to overcome the barriers to effective communication.
5:	To inculcate the capacity to organize ideas and systematically present them through various media.
6:	To be able to critically appreciate the written texts and audio-visual inputs effectively.

Course Outcomes (CO):

CO1:	Ability to understand basic concepts regarding communication and develop a clear understanding of the flow of thoughts.
CO2:	Ability to apply verbal and non-verbal communication skills in real-life situations.
CO3:	Ability to write and document the information in the appropriate formats.
CO4:	Ability to effectively communicate in interpersonal and intercultural situations without being misunderstood.

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

Communication as Process: Concept of Communication, Communication as a Process, Formal, Informal and Intercultural communication, Barriers to Effective Communication and remedies, Characteristics of Effective Communication [8Hrs]

Unit II

Communication Efficiency: Concept of Non-verbal Communication, Elements of Non-verbal Communication - Gestures, Postures, Facial-expressions, Gaze, Eye contact, and Space, Presentation skills - Interviews, Group Discussion, Making presentations with Audio-visual aids, Electronic Communication - Internet and Social media. [8Hrs]

Unit III

Technical Documents: Definition, Types, Structure, Significant Features of: Resume Writing, Report Writing, Proposal Writing, Dissertation, and Research Papers [8Hrs]

Unit IV

Communication in Society and Workplace:

Text 1 - Gender-inclusive Language

Background, Purpose, and Guidelines
United Nations Gender-inclusive Language
https://www.un.org/en/gender-inclusive-language/index.shtml

Text 2 - Cultural Diversity in India

India: Unity in Cultural Diversity Introduction (P. xii - xviii)
https://dsel.education.gov.in/sites/default/files/book_unity_in_diversity.pdf

Text 3 - The Matrix (1999)

Genre: Movie (Science Fiction)
Dir. The Wachowski Brothers

[8Hrs]

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.

Pranin Chandra

PaperCode: BS104	Paper: Engineering Chemistry - II	L	T/P	C
PaperID: 99104		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	To understand methods to make pure water and use fuels.
2:	To understand the use of techniques used to characterize engineering materials.
3:	To understand the properties and industrial applications of polymers.
4:	To understand the basics of nano-technology and bio chemistry

Course Outcomes (CO):

CO1:	Ability to make pure water and use fuels and perform energy conversion calculations
CO2:	Ability to use techniques used to characterize engineering materials.
CO3:	Understand the properties and industrial applications of polymers.
CO4:	Understand the basics of nano-technology and bio chemistry

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

Water treatment: Introduction, Hardness of water, Disadvantages of hard water, Water-softening-Lime-Soda process, Ion-exchanger polished water, Boiled-feed water, boiler problems-scale, sludge priming and foaming, caustic embrittlement and corrosion.

Fuels: Classification of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, Bomb calorimeter, Calorific value of gaseous fuel, Theoretical calculation of calorific value of a fuel, Wood, Coal, Analysis of coal, Natural Gas, Producer gas, water gas, Non-Conventional sources of energy. [10Hrs]

Unit II

Spectroscopic Techniques: Basic principles of spectroscopic methods. The use The use of various spectroscopic techniques for the determination of structure of simple compounds. XRD, SEM and TEM. [10Hrs]

Unit III

Polymers: Basic concepts & Terminology, such as monomers, Polymers, functionality, Thermoplastics, Thermosets, Linear, Branched, cross linked polymers etc. Different definitions of molecular weight's viz. Mw, Mn, Mv and then determinations, Industrial applications of polymers. General methods of synthesis of organics and their applications. [10Hrs]

Unit IV

Nano Technology: Introduction, Properties, Synthesis and characterization of Nanomaterials, Material self-assembly, Nanoscale materials and their applications.

Biochemistry: Molecular basis of life, study of macro molecules: Carbohydrates, Proteins, Lipids, Nucleic acid. Metabolism, basic concepts and design, Glycolysis citric acid cycle oxidative phosphorylation pentose phosphate pathway.. [10Hrs]

Textbooks/References:

1. *Engineering Chemistry (16th Edition) by Jain, Jain, Dhanpat Rai Publishing Company, 2013.*
2. *Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley, 2017.*
3. *Engineering Chemistry* byE.R. Nagarajan and S. Ramalingam, Wiley, 2017.

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4. *Biochemistry* by Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto 9th Edition 2019. W H Freeman & Co.

PaperCode: BS106	Paper: Engineering Mathematics - II	L	T/P	C
PaperID: 99106		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. 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 and Roots, 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. [10Hrs]

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 [10Hrs]

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 of Transforms. 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.
[10Hrs]

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. [10Hrs]

Textbooks:

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

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PaperCode: BS108	Paper: Engineering Physics - II	L	T/P	C
PaperID: 99108		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	To learn about the quantum nature of reality.
2:	To learn about quantum statistics and its significance.
3:	To learn about the band theory of solids and properties and characteristics of diodes.
4:	To understand the basics of physical basis of biology.

Course Outcomes (CO):

CO1:	Understand and appreciate the quantum nature of reality.
CO2:	Understand quantum statistics and its significance.
CO3:	Understand the band theory of solids and properties and characteristics of diodes.
CO4:	To have an understanding of the physical basis of Biology.

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

Quantum Mechanics: Introduction: Wave particle duality, de Broglie waves, the experiment of Davisson and Germer, electron diffraction, physical interpretation of the wave function, properties, the wave packet, group and phase velocity, the uncertainty principle . The Schrödinger wave equation (1D), Eigen values and Eigen functions, expectation values, simple Eigen value problems - solutions of the Schrödinger's equations for the free particle, the infinite well, the finite well, tunneling effect, the scanning electron microscope, the quantum simple harmonic oscillator (qualitative), zero point energy. [12Hrs]

Unit II

Quantum Statistics: The need for statistics , statistical distributions: Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac statistics, their comparisons, Fermions and Bosons, Applications of quantum statistics: 1. Molecular speed and energies in an ideal gas; 2. The Black body spectrum, the failure of classical statistics to give the correct explanations - Bose-Einstein statistics applied to the Black Body radiation spectrum; Fermi-Dirac distribution, free electron theory, electronic specific heats, Fermi energy and average energy; Dying stars. [12Hrs]

Unit III

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 [12Hrs]

Unit IV

Introduction to Physics in Biology: Overview : from molecules to life - the building blocks of biology, DNA Packing and Structure, The relationship between shape and function of biomolecules, Numbers and Sizes, System Variability and Spatial Scales, Timescales in Biological Systems [4Hrs]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury, McGraw - Hill, 2017.

2. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.

References:

1. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Solid State Electronic Devices ,by* Streetman and Ben G Prentice Hall India Learning Private Limited; 2006
4. https://drive.google.com/file/d/169AQBvIzHzbRjZU6M8oe260ZUWp7iUm1/view [part of NPTEL Lectures https://nptel.ac.in/courses/115/101/115101121/#

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PaperCode: BS110	Paper: Probability and Statistics for Engineers	L	P	C
PaperID: 99110		3	2	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 50 marks
3. Term end Practical Examinations: 25 marks

Instruction for paper setter (Term end Theory Examinations):

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for design experiments and analysis.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to design experiments and analyse using ANOVA.

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	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplicationand Total Probability Rules, Independence, Bayes' Theorem, Random Variables.
Discrete and Continuous Random Variables andDistributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a RandomVariable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative BinomialDistributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution. [10Hrs]

Unit II

Joint Probability Distributions for Two RandomVariables, Conditional Probability Distributionsand Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.
Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the Central LimitTheorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a SingleSample. [10Hrs]

Unit III

Hypotheses Testing for a SingleSample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviationof a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference forTwo Samples.
Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR. [10Hrs]

Unit IV

ANOVA and Design of experiments: Designing Engineering Experiments, Completely Randomized Single-Factor Experiment, The Random Effects Model, Randomized complete block design, Concept of Factorial Experiments, Two Factor Factorial Experiments, General Factorial Experiments, 2^k Factorial Designs, Response Surface Methods and Designs. SQC: Quality improvement and Statistics, Control Charts including and R or S charts, P and U charts, time weighted charts. [10Hrs]

Note: Atleast two laboratory practicals in each unit to be conducted. The list of practicals to be notified by the concerned teacher to the school where the students are admitted at the start of the teaching in the semester.

Textbooks:

1.*Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018

References:

1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10th Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.

PaperCode: ICT114	Paper: Human Values and Ethics	L	P	C
PaperID: 164114		1	-	1

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, the examinations are to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.

Course Objectives:

1:	To help students regulate their behavior in a professional environment as employees
2:	To make students aware of the impact of taking non-ethical engineering decisions.
3:	To understand that mind and desire control is needed for being ethical.
4:	To understand organizational culture and to adapt to varying cultures withoutcompromising ethical values

Course Outcomes (CO):

CO1:	Realize the importance of human values.
CO2:	Understand that excessive desires of the mind make a person unethical and restless,while fewer desires lead to peace and professional progress
CO3:	Assess different types of risks involved in unethical practices. Know various means ofprotesting against unethical practices.
CO4:	Assess the benefits of restraining from unethical practices like bribery, extortion,nepotism, nexus between politicians and industrialists.

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	1	1	-	1
CO2	-	-	-	-	-	3	-	3	1	1	-	1
CO3	-	-	-	-	-	3	-	3	1	1	-	1
CO4	-	-	-	-	-	3	-	3	1	1	-	1

Unit I

Human Values: Morals, Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage,Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality [3Hrs]

Unit II

Engineering Ethics: Senses of engineering ethics, Variety of moral issues, Types of inquiries, Moral dilemma, Moral autonomy, Moral development (theories), Consensus and controversy, Profession, Models of professional roles, Responsibility, Theories about right action (Ethical theories), Self-control, Self-interest, Customs, Religion, Self-respect, Case study: Choice of the theory

Engineering as experimentation, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Case study: The challenger [3Hrs]

UnitIII

Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Safe exit, Risk-benefit analysis Sefety lessons from 'the challenger', Case study: Power plants,Collegiality and loyalty, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Human rights, Employee rights, Whistle blowing, Intellectual property rights. [4Hrs]

UnitIV

Globalization, Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership, Codes of ethics, Engineering council of India, Codes of ethics in Business Organizations [3Hrs]

Textbooks:

1. *A Textbook on Professional Ethics and Human Values*, by R. S. Naagarazan, New Age Publishers, 2006.

References:

1. *Professional Ethics and Human Values* by D. R. Kiran, McGraw-Hill, 2014.

2. *Engineering Ethics, by Charles E Harris and Micheal J Rabins, Cengage Learning Pub., 2012.*
3. *Ethics in Engineering, Mike Martin and Roland Schinzinger, McGraw Hill Pub., 2017.*
4. *Unwritten laws of Ethics and Change in Engineeringby The America Society of Mechanical Engineers, 2015.*
5. *Engineering Ethics by Charles B. Fleddermann, Pearson, 2014.*
6. *Introduction to Engineering Ethics* by Mike W. Martin and Roland Schinzinger, McGraw-Hill, 2010.
7. *Engineering Ethics: Concept and Cases* by Charles E. Harris, Michael S. Pritchard and Michael J.Rabins, Cengage, 2009.
8. *Ethics in Engineering Practiceand Research* by Caroline Whitbeck, Cambridge University Press, 2007.

PaperCode: EMES112	Paper: Environmental Studies	L	P	C
PaperID: 99112		4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	The course is designed to impart basic knowledge of the environment and its components.
2:	The course deals in creating awareness about the energy resources and current environmental problems faced by the world.
3:	To understand and learn about environment pollution, related case studies and measures taken for control to pollution.
4:	To understand and explore different approaches of conserving and protecting environment for the benefit of society.

Course Outcomes (CO):

CO1:	Environmental Studies course will provide necessary information and knowledge about the various aspects of environment, ecosystems and related biodiversity.
CO2:	Students will be able to learn and understand about the availability and sustainable use of resources, environmental problems and their short term and long term impacts to humans.
CO3:	Course will help them to learn about environmental policies and protocols, social issues and role of human in conservation and protection of environment.
CO4:	Overall, course will help students to develop skills and ability of understanding environment-human relationship.

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	2	1	1	1	1
CO2	-	1	1	-	-	2	3	2	1	1	1	1
CO3	-	1	1	-	-	2	3	2	1	1	1	1
CO4	-	1	1	-	-	2	3	2	1	1	1	1

Unit I

Fundamentals:The Multidisciplinary nature of environmental studies: Definition, components, scope and importance, need for public awareness;
Ecosystems: Concept, Structure and function of an ecosystem, energy flow in ecosystems, food chain, food web, ecological pyramids, ecological succession; Introduction to types, characteristics features, structure and function of different ecosystems including forest, grassland, desert and aquatic ecosystem;
Biodiversity: Introduction to biodiversity-definition, genetics, species, ecosystem diversity, biogeographical classification of India, value of biodiversity-consumptive uses, productive, social, ethical, aesthetic and option values, biodiversity at global, national and local level, India as a mega diversity nation, endangered and endemic species of India, hot spots of biodiversity, threats to biodiversity - habitat loss, poaching of wild life, man wildlife conflicts and conservation of biodiversity- in-situ and ex-situ conservation. [16Hrs]

Unit II

Renewable and Non-renewable Resources:Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources-green fuel.
Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems
Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forest and tribal people, case studies
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies
Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
Role of individual in conservation of natural resources, Resource Management-Sustainable development.
[8Hrs]

Unit III

Environmental Pollution: (a) Air Pollution: Types of pollutants, source, effects, sink & control of primary pollutants- CO, NOX, HC, SOx and particulates, effect of pollutants on man & environment: photochemical smog, acid rain and global warming, CO2 Sequestration. (b) Water Pollution: Classification of Pollutants, their sources, waste water treatment (domestic and industrial). (c) Soil Pollution: Composition of soil, classification and effects of solid pollutants and their control. (d) Solid Waste Management: Classification, waste treatment and disposal methods; compositing, sanitary land filling, thermal processes, recycling and reuse methods. (e) Hazardous wastes - Classification, radioactive, biomedical & chemical, treatment and disposal- Physical, chemical and biological processes. (f) Marine Pollution: Causes, effects and control of marine pollution, coastal zone management (g) Thermal pollution: Causes, effects and control of marine pollution, coastal zone management.

Disaster Management: Floods, earth quake, cyclone and landslides [8Hrs]

Unit IV

Environmental Policies, Human Population and Environment

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, case studies; Some important Environmental laws, issues involved in enforcement of environment legislations, Green bench; carbon footprint, Montreal and Kyoto Protocol, conservation of Biological Diversity, The Chemical Weapons Convention, Environment Impact Assessment; population growth and variation among nations, Impacts on environment and human health, human right, Tribal people and rights, Human and wildlife conflicts in Indian context, Environmental ethics; Role of government and non government organizations in public awareness and environment improvement. [13Hrs]

Field work (equal to 5 hours) : visit to local areas to document environmental assets, study of simple ecosystems, study and identification of common plants, birds and insects.

Suggested Readings and References:

1. A textbook of environmental studies, R. Gadi, S. Rattan, S. Mohaptra, Kataria Publication, 2014.
2. Elements of environmental sciences & engineering, P. Meenakshi, PHI Learning Pvt Ltd, 2014.
3. Basics of Environment and Ecology, A. kaushik & C.P. Kaushik, New Age International Publishers, 2010.
4. Fundamental concepts in environmental studies, D.D. Mishra, S Chand & Co. Ltd., 2008.
5. Textbook of environmental studies, E. Barucha, UGC, 2005.
6. Environmental studies, B. Joseph, Tata McGraw-Hill Publishing Company Ltd., 2005.

Pravin Chandra

PaperCode: ICT152	Paper: Engineering Graphics-II	L	P	C
PaperID: 164152		-	2	1

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

Course Objectives:

1:	The students will learn sectioning of solid figures.
2:	The students will understand 3D projections. They will have understanding of isometric and oblique projections.
3:	The students will have understanding of perspective projections,
4:	The students will learn computer aided drafting.

Course Outcomes (CO):

CO1:	Ability to draw sectional diagrams of solids
CO2:	Ability to draw 3S projections (isometric and oblique).
CO3:	Ability to draw perspective projections.
CO4:	Understand and use a CAD tool (AutoCAD).

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	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I
Section of Solids: Definition of Sectioning and its purpose, Procedure of Sectioning, Illustration through examples, Types of sectional planes-application to few examples.

Unit II
Isometric Projection: Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and drawing, Isometric projection of solids such as cube, prism, pyramid and cylinder.
Oblique Projection: Principle of oblique projection, difference between oblique projection and isometric projection, receding lines and receding angles, oblique drawing of circle, cylinder, prism and pyramid.

Unit III
Perspective Projection: Principle of perspective projection, definitions of perspective elements, visual ray method, vanishing point method.
Conversion of 3D to 2D figures.

Unit IV
Introduction to CADD: Interfacing and Introduction to CAD Software, Coordinate System, 2D drafting: lines, circles, arc, polygon, etc., Dimensioning, 2-D Modelling, Use of CAD Software for engineering drawing practices.

Note: The sheets to be created shall be notified by the concerned teacher in the first week of teaching.

Textbooks:
1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:
1. *Engineering Drawing*by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing*by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.
4. *AutoCAD 2017 for Engineers & Designers*by Sham Tickoo,, Dreamtech Press 2016.

Pravin Chandra

PaperCode: BS156	Paper: Engineering Chemistry - II Lab.		L	P	C
PaperID: 99156			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:
1. The course objectives and course outcomes are identical to that of BA104 (Engineering Chemistry - II) as this is the practical component of the corresponding theory paper.
2. 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: BS158	Paper: Engineering Physics - II Lab.		L	P	C
PaperID: 99158			-	2	1
Teachers Continuous Evaluation:	40 marks	Term End Examinations:	60 Marks		

Instructions:
1. The course objectives and course outcomes are identical to that of BA108 (Engineering physics - II) as this is the practical component of the corresponding theory paper.
2. 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.

Pravin Chandra

PaperCode: ICT154	Paper: Workshop Technology	L	P	C
PaperID: 164154		-	2	1

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

Instructions:
1. 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.

Course Objectives:

1:	The students will learn basics of safety precautions to be taken in lab. / workshop
2:	The students will have an overview of different machines used in workshop and the operations performed on these machines.
3:	The students will have understanding of various welding processes.
4:	The students will have understanding of sheet metals hop and fitting shop

Course Outcomes (CO):

CO1:	Ability to safely work in a Lab./workshop.
CO2:	Ability to use machines (lathe, mill, shaper, planer, grinder, drill).
CO3:	Ability to weld.
CO4:	Ability to use sheet metal tools and fitting shop tools.

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	1	2	2	3	3	-	-	-	-	-	2
CO2	2	1	2	2	3	1	-	-	-	-	-	2
CO3	2	1	2	2	3	1	-	-	-	-	-	2
CO4	2	1	2	2	3	1	-	-	-	-	-	2

Unit I
Safety, precautions and maintenance: Safety in shop, safety devices, safety and precautions - moving machine and equipment parts, electrical parts and connections, fire, various driving systems like chain, belt and ropes, electrical accidents, an overview of predictive, preventive and scheduled maintenance, standard guidelines to be followed in shop.

Unit II
Introduction to machine shop: Introduction to Lathe, Milling, shaper, Planer, grinder, drilling and overview of operations performed on these machines by making some jobs.

Unit III
Introduction to welding shop: Welding, types of welding, tools and applications, gas welding and arc welding, edge preparation, various joints formation by gas welding and electric arc welding.

Unit IV
Introduction to sheet metal shop: Sheet metal tools and operations, formation of a box using sheet.
Introduction to fitting shop: Introduction to fitting, tools and applications, some jobs in fitting shop.

Textbooks:
1. *Workshop Technology Vol. 1 and Vol. 2*, Hajra Choudhary and Roy, Media Promoters and Publishers, 2018.

References:
1. *A course in Workshop Technology Vol.1 and Vol. 2*, B. S. Raghuvanshi, Dhanpat Rai and Compnay, 2015.
2. *Workshop Technology (Manufacturing Processes)*, Khurmi and Gupta, S. Chand Publication, 2010.

Pranav Chandra

PaperCode: ICT160	Paper: Programming in Python	L	P	C
PaperID: 164160			2	1

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

Instructions:
1. 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.

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 the object oriented features of the Python Language.
4:	The students will learn usage of the Numpy, Panda and Matplotlib

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 use Numpy, Panda and Matplotlib modules to write programs.

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
Identifiers, keywords, statements & expressions, variables, operators, precedence & associativity, data types, indention, comments, console I/O, type conversion. Control flow statements (if family; while & for loops; continue & break statements), exception handling. Functions, command line arguments.

Unit II
String management & usage, Lists, Dictionaries, Tuples & Sets. The operations on these data structures. Filter, Map and Reduce Function,

Unit III
Object Oriented Programming: Properties / attributes, methods, inheritance, class variables & functions, static methods, delegation, abstract base classes, Generic function.
File Handling.

Unit IV
Numpy: Dtypes, Multidimensional Arrays, Slicing,Numpy Array & Memory, Array element-wise operations, Numpy Data I/O, floating point numbers, Advanced Numpy dtypes.
Pandas: Using series and Dataframes, Indexing &Reindexing, Deleting and merging items, Common operations, Memory usage and dtypes, Pipes, Displying dataframes, Rolling & Filling operations.
Matplotlib: Setting defaults, Legends, Subplots, Sharing Axes, 3D surfaces.

Note: Atleast two laboratory practicals in each unit to be conducted. The list of practicals to be notified by the concerned teacher at the start of the teaching in the semester.

Textbooks:
1. *Introduction to Python Programming*, Gowrishankar S. and Veena A., CRC Press, 2019.
2. *Python Programming for Data Analysis*, Jose Unpingco, Springer Nature, 2021.

References:
1. *Python: An Introduction to Programming*, James R. Parker, 2nd Ed., Mercury Learning And Information, 2021.
2. *Introduction to Computation and Programming Using Python*, John V. Guttag, The MIT Press, 2021.
3. *Python Programming: A Practical Approach*, Vijay Kumar Sharma, Vimal Kumar, Swati Pathak, and Shashwat Pathak, CRC Press, 2021.

Pravin Chandra

PaperCode: ICT116	Paper: Introduction to Manufacturing Process	L	T/P	C
PaperID: 164116		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	The students will have basic understanding of various manufacturing processes. The students will have knowledge about casting process.
2:	The students will have understanding of joining processes.
3:	The students will have understanding of forging and sheet metal works.
4:	The students will have basic idea of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO):

CO1:	Understand casting process.
CO2:	Understand joining process.
CO3:	Understand forging and sheet metal work.
CO4:	Basic understanding of powder metallurgy and manufacturing of plastic components.

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	1	1	1	2	-	-	-	-	-	1	1
CO2	2	1	1	1	2	-	-	-	-	-	1	1
CO3	2	1	1	1	2	-	-	-	-	-	1	1
CO4	2	1	1	1	2	-	-	-	-	-	1	1

Unit I

Definition of manufacturing, Importance of manufacturing towards technological and social economic development, Classification of manufacturing processes, Properties of materials.
Metal Casting Processes: Sand casting, Sand moulds, Type of patterns, Pattern materials, Pattern allowances, Types of Moulding sand and their Properties, Core making, Elements of gating system. Description and operation of cupola.
Working principle of Special casting processes - Shell casting, Pressure die casting, Centrifugal casting. Casting defects. [10Hrs]

Unit II

Joining Processes: Welding principles, classification of welding processes, Fusion welding, Gas welding, Equipments used, Filler and Flux materials. Electric arc welding, Gas metal arc welding, Submerged arc welding, Electro slag welding, TIG and MIG welding process, resistance welding, welding defects. [10Hrs]

Unit III

Deformation Processes: Hot working and cold working of metals, Forging processes, Open and closed die forging process. Typical forging operations, Rolling of metals, Principle of rod and wire drawing, Tube drawing. Principle of Extrusion, Types of Extrusion, Hot and Cold extrusion.
Sheet metal characteristics -Typical shearing operations, bending and drawing operations, Stretch forming operations, Metal spinning. [10Hrs]

Unit IV

Powder Metallurgy: Introduction of powder metallurgy process, powder production, blending, compaction, sintering
Manufacturing Of Plastic Components: Types of plastics, Characteristics of the forming and shaping processes, Moulding of Thermoplastics, Injection moulding, Blow moulding, Rotational moulding, Film blowing, Extrusion, Thermoforming. Moulding of thermosets- Compression moulding, Transfer moulding, Bonding of Thermoplastics. [10Hrs]

Textbooks:

1. *Manufacturing Technology: Foundry, Forming and WeldingVolume 1*, P. N Rao, , McGrawHill, 5e, 2018.
2.*Elements of Workshop TechnologyVol. 1 and* 2by Hajra Choudhury, Media Promoters Pvt Ltd.,2008.

References:

1. *Manufacturing Processes for Engineering Materials*, by Serope Kalpajian and Steven R.Schmid, Pearson Education, 5e, 2014.
2. *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems* by Mikell P. Groover, John Wiley and Sons, 4e, 2010 .
3. *Production Technology* byR.K.Jain and S.C. Gupta, Khanna Publishers. 16th Edition, 2001.

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PaperCode: BS118	Paper: Industrial Chemistry	L	T/P	C
PaperID: 99118		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	Learn about the functioning of drugs and dyes.
2:	Learn about the most important ways of preventing corrosion.
3:	Learn about the properties of heterocycles
4:	Learn about techniques of synthesis.

Course Outcomes (CO):

CO1:	Understand the functioning of drugs and dyes.
CO2:	Understand the most important ways of preventing corrosion.
CO3:	Understand the properties of heterocycles
CO4:	Understand techniques of 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	2	3	3	1	1	1	-	-	-	-	1
CO2	3	2	3	3	1	1	2	-	-	-	-	1
CO3	3	2	3	3	1	-	-	-	-	-	-	1
CO4	3	2	3	3	1	-	-	-	-	-	-	1

Unit I

Polymerization technology, dyes and drugs: classification of polymers, plastics, fibres, elastomers. Dyes: Requirements of a dye, chemical nature, classification, chemistry of representative important dyes. Pharmaceuticals: sulfa drugs, antipyretics and analgesics, antibiotics, antimalarials. Caustic soda & Chlorine. Hydrochloric acid. Sulphur & sulphuric Acid. [10Hrs]

Unit II

Corrosion: Corrosion and its economic aspects, Thermodynamics of corrosion, Immunity, corrosivity and passivation. Mechanism and kinetics of Corrosion. Electrochemical methods for corrosion testing. Corrosion Prevention Techniques: Metallic coatings, organic paints, varnishes, corrosion inhibitors, cathodic and anodic protection. Corrosion Prevention Techniques: Metallic coatings, organic paints, varnishes, corrosion inhibitors, cathodic and anodic protection. [10Hrs]

Unit III

Chemistry of Heterocyclic Compounds: Introduction, nomenclature, structures, and reactivities of heterocyclic compounds. Chemistry and reactivity of five and six membered heterocyclic compounds with one hetero atoms. Chemistry of selected industrially important heterocyclic compounds. [8Hrs]

Unit IV

Synthetic Methods: Introduction to synthesis, strategy of synthesis. Designing of green synthesis: choice of starting materials, reagents, catalysts and solvents. Basic principles of green chemistry and synthesis of organic compounds involving basic principles of green chemistry methodology of synthesis. New methods in organic synthesis: microwave technique, use of phase transfer catalyst in organic synthesis. [12Hrs]

Textbooks and References:

1. J.P. Mukhlyonov: Fundamentals of Chemical Technology.
2.M.G. Rao, M.Sittig: Dryden's out line of Chemicals Technology.
3.Emil Raymond Riegel: Industrial Chemistry.
4. Frank Hall Thorp: Outlines of Industrial Chemistry.
5.M.G. Fontana: Corrosion Engineering, McGraw Hill International Book Co. London.
6.L.L. Shreir: Corrosion, Vol I and Vol II, Newness Butterworths, Edward Arnold Ltd, London.
7.J.C. Scully: Fundamental of Corrosion, Pargmon Press Inc. New York, USA
8.J.A. Joule, K. Mills and G.F. Smith: Heterocyclic chemistry, III Ed., East West Press vt Ltd, ND.
9.A.R. Katrizky and J.A. Boulton: Advances in Heterocyclic chemistry, Vol 1-27, Academic Press, NY.

10.R.M. Achesion: An Introduction to the Chemistry of Heterocyclic Compounds, II Ed, NY.

PaperCode: BT120	Paper: Introduction to Biotechnology	L	T/P	C
PaperID: 160120		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. 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.
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 / 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.
5. The requirement of (scientific) calculators / log-tables / data - tables may be specified if required.

Course Objectives:

1:	To introduce different areas in Biotechnology to students, laying a foundation for future courses within our biotechnology programme.
2:	To provide a historical perspective of the growth and development of biotechnology, as well as its scope and importance.
3:	To help students understand the interdisciplinary nature of biotechnology, involving integration of several disciplines to generate knowledge and technology impacting society and environment.
4:	To sensitize students towards IPR, safety and ethical concerns in biotechnology research and applications.

Course Outcomes (CO):

CO1:	Understand the history, scope, interdisciplinary nature and significance of biotechnology.
CO2:	Understand the basics of recombinant DNA technology, protein structure and engineering, bioinformatics and principle(s) underlying basic biotechnological techniques.
CO3:	Describe the basics of culturing microbes, animal cells and plant cells in laboratory, and their respective applications in Biotechnology.
CO4:	Have an awareness about the IPR, safety and ethical issues involved in use of biotechnology.

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	3	1	1	1	-	-	-	-	1
CO2	3	2	3	3	1	1	2	-	-	-	-	1
CO3	3	2	3	3	1	-	-	-	-	-	-	1
CO4	3	2	3	3	1	-	-	-	-	-	-	1

Unit I

Introduction: Historical perspective, Definition of Biotechnology; Areas of biotechnology; Scope; Importance and Commercial potential; Interdisciplinary nature;

Solutions and Buffers: Introduction to Solutions and Buffers; Modes of expressing concentration of a solution, Making solutions, Concept of pH and buffers, Henderson-Hasselbach equation, Criteria for selection of buffers; [8Hrs]

Unit II

Recombinant DNA Technology: Tools of rDNA Technology; Making recombinant DNA; Introduction of recombinant DNA into host cells; Introduction to selection and screening techniques for identification of recombinants; Agarose Gel Electrophoresis; Principle, Steps and Applications of Polymerase Chain Reaction;

Protein Structure and Engineering: Introduction to the world of Proteins, Amino acids as building blocks, Non-covalent interactions, Structure of proteins, Structure Function relationship in Proteins, Recombinant proteins of high value, Introduction to Protein Engineering and Design, Introduction to Proteomics.

Introduction to basic techniques in Biotechnology: Beer-Lambert's Law, Spectrophotometer, Agarose Gel Electrophoresis, SDS-PAGE, Gel-Filtration Chromatography, Ion Exchange Chromatography, Affinity chromatography.

Introduction to Bioinformatics: Concept of Primary and Secondary databases, Nucleic acid and Protein databases, Introduction to sequence alignment, Applications of bioinformatics. [12Hrs]

Unit III

Microbial Biotechnology: Microbial Culture Techniques; Measurement and Kinetics of Microbial Growth; Scale up of microbial process; Isolation of microbial products; Strain Isolation; Improvement and Preservation;

Plant Biotechnology: History of plant tissue culture; Plant cell and tissue culture techniques; Transgenic plants with beneficial traits;

Animal Biotechnology: History of animal tissue culture; Animal Cell culture techniques; Finite and Continuous cell lines; Characterization of cell lines; Scale-up of animal cell culture; Applications of microbial, plant and animal biotechnology. [12Hrs]

Unit IV

Biotechnology and Society: Introduction to Patenting; Criterion for patents; Reading a patent; National and International Patent Laws; Safety and Ethical issues in Biotechnology; Biotechnology in India and global trends; Product safety and marketing. [8Hrs]

Text / Reference Books:

1. *Introduction to Biotechnology*, W.J. Thieman and M.A. Palladino, Pearson, 2019.
2. *Biotechnology Foundations*, J.O. Grady, 2019.
3. *Gene cloning and DNA Analysis. An introduction*. T. A Brown, Wiley-Blackwell Science, 2016.
4. *Concepts in Biotechnology: History, Science and Business*, K.Buchholz and J. Collins, Wiley-VCH, 2011.
5. *Biotechnology*, H.K. Das, 2010, Wiley Publishers.
6. *Biotechnology*, Smith, 2009, Cambridge Press.
7. *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson & Walker, Cambridge Press, 2008.

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THE SCHEME OF EXAMINATIONS OF 2nd to 4thYEAR

for

Dual degree Programs (B.Tech./M.Tech.)

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

Offered by

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COMPUTER SCIENCE AND ENGINEERING

Programme Education Objectives (PEO)

PEO 1: Our students will apply their knowledge and skills to succeed in their careers and/or obtain advanced degrees.

PEO 2: Our students will behave ethically and responsibly, and will remain informed and involved as full participants in their profession and society.

PEO 3: Our students will creatively solve problems, communicate effectively, and successfully function in diverse and inclusive multi-disciplinary teams.

PEO4 4: Our students will apply principles and practices of computing grounded in mathematics and science to successfully complete hardware and/or software-related engineering projects to meet customer business objectives and/or productively engage in research.

Programme Specific Outcomes (PSO)

On completion of the programme of study, the students will have the ability to:

PSO 1: Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

PSO 2: Apply engineering analysis & design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

PSO 3: Communicate effectively with a range of audiences.

PSO 4: Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

PSO 5: Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

PSO 6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

PSO 7: Acquire and apply new knowledge as needed, using appropriate learning strategies.

PEO to PO Mapping

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

(scale 1: low, 2: Medium, 3: High)

PSO to PO Mapping

PSO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
PSO 1	3	-	-	-	-	-	-	-	-	-	-	3
PSO 2	-	3	3	3	3	3	3	-	-	-	-	-
PSO 3	-	-	-	-	-	3	-	-	3	3		-
PSO 4	-	-	-	-	-	3	3	3	1	-	-	-
PSO 5	-	-	-	-	-	-	-	1	3	1	3	-
PSO 6	1	2	2	3	3	1	1	1	-	-	-	3
PSO 7	-	-	-	-	-	-	-	-	-	-	-	3

(scale 1: low, 2: Medium, 3: High)

Third Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT201	Foundations of Computer Science	4	-	4
PC	ICT203	Operating Systems	4	-	4
PC	ICT205	Digital Logic & Computer Design	4	-	4
PC	ICT207	Database Management Systems	4	-	4
PC	ICT209	Object Oriented Programming using C++	4	-	4
PC	ICT211	Data Structures	4	-	4
HS/MS	ECO213	Engineering Economics	2	-	2
Practical/Viva Voce					
PC	ICT251	Database Management Systems Lab.	-	2	1
PC	ICT253	Object Oriented Programming Using C++ Lab.	-	2	1
PC	ICT255	Data Structures Lab.	-	2	1
Total			**26**	**6**	**29**

Fourth Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT202	Computer Graphics	4	-	4
PC	ICT204	Computational Methods	4	-	4
PC	ICT206	Design and Analysis of Algorithms	4	-	4
PC	ICT208	Theory of Computation	4	-	4
PC	ICT210	Software Engineering	4	-	4
PC	ICT212	Computer Networks	4	-	4
HS/MS	MS214	Accountancy for Engineers	2	-	2
Practical/Viva Voce					
PC	ICT252	Computer Graphics and Computer Networks Lab.	-	2	1
PC	ICT254	Design and Analysis of Algorithms Lab.	-	2	1
PC	ICT256	Computational Methods Lab.	-	2	1
Total			**26**	**6**	**29**

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Fifth Semester					
Code	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT301	Digital Signal Processing	4	-	4
PC	ICT303**	Compiler Design	3	2	4
PCE		Core area Elective - 1			4
EAE		Elective in Emerging Areas 1 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 1.			4
HS	HS305	Elements of Indian History for Engineers	2		2
MS	MS307	Entrepreneurship Mindset	2		2
Practical/Viva Voce					
PC	ICT391	Digital Signal Processing Lab.		2	1
PC	ICT393	Summer Training (after 4th semester) Report *			1
Total				2	26

*NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the school,

** The Teachers' Continuous Evaluation Component shall be 25, Term end theory examinations of 50 marks and term end practical marks shall be of 25 marks maximum. The marks obtained in each component by the student shall be reflected in the marksheet.

Sixth Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PCE		Core area Elective - 2			4
PCE		Core area Elective - 3			4
EAE		Elective in Emerging Areas -2 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 3 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 2			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 3			4
HS/MS	HS302	Technical Writing	2		2
Practical/Viva Voce					
HS/MC	ICT392*	NSS / NCC / Cultural clubs / Technical Society / Technical club*			2
Total					28

*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.

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Seventh Semester					
Group	Paper Code	Paper	L	T/P	Credits
Theory Papers					
PCE		Core area Elective - 4			4
PCE		Core area Elective - 5			4
EAE		Elective in Emerging Areas -4 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 5(Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 4			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 5			4
Practical/Viva Voce					
PC	ICT497	Minor Project**			4
PC	ICT499	Summer Training (after 6th semester) Report *			1
Total					**29**

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

** 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.

Pravin Chandra

Eighth Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Practical/Viva Voce/Internship%					
PC / Project	ICT452	Major Project - Dissertation**,#			15
	ICT454	Major Project Viva Voce@			4
	ICT456	Project Progress Evaluation*			2
PC / Internship	ICT458	Internship Report#			15
	ICT460	Internship Viva Voce#			4
	ICT462	Internship Progress Evaluation*,#			2
Total					**21**

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

% By default every student shall do the project work (ICT452, ICT454, and ICT456). A student shall either be allowed to do a project work (ICT452, ICT454, and ICT456) or an internship (ICT458, ICT460, and ICT462). The student must apply for approval to do internship before the commencement of the 8th semester to the school, and only after approval of Dean of the school through Training and Placement Officer of the School, shall proceed for internship.

** The student offered project work 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.

Students may be allowed to do internship in this semester in lieu of Major project. 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.

ICT452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by an external examiner deputed by examinations division (COE), for a total of 100 marks.

ICT454: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by examinations division (COE), for a total of 100 marks.

ICT456/ICT462: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ICT458/ICT460: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the training and placement officer of the School on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the School and the external examiner deputed by examinations division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and placement officer (as the case may be), the Dean of the school can assign the responsibility of the supervisor or the Training and Placement officer (for purpose of examinations) to any faculty of the school.

Note on Elective Papers: 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.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 marks continuous evaluation by the teacher and 75 marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 marks continuous evaluation by the teacher and 60 marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(c) Papers with both theory and practical components shall have 25 marks continuous evaluation by the teacher and 25 marks term-end examinations for practical and 50 marks term end examination for the theory component. All three component marks shall be reflected on the marksheet of the student.

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PROGRAMME CORE ELECTIVE PAPERS

Paper Code	Paper	T	P	Credits
	Semester 5: Choose any one paper			
ICT311	Artificial Intelligence	3	2	4
ICT313	Microprocessors and Interfacing	3	2	4
ICT315	Engineering Optimization	3	2	4
ICT317	Social Network Analysis and Sentiment Analysis	3	2	4
ICT319	Software Requirements and Estimation	3	2	4
ICT321	Graph Theory for Computer Science	4	-	4
	Semester 6: Choose any Two Paper			
ICT312	Java Programming	3	2	4
ICT314	Systems Programming	3	2	4
ICT316	Introduction to Robotics Engineering	3	2	4
ICT318	Network Security and Cryptography	3	2	4
ICT320	Visual Basic.Net Programming	3	2	4
ICT322	Quantum Computing	3	2	4
ICT324	Natural Language Processing	3	2	4
ICT326	Object Technology and UML	3	2	4
ICT328	Design Patterns	3	2	4
ICT330	Data Warehousing and Data Mining	3	2	4
ICT332	Computational Geometry	3	2	4
ICT334	Introduction to Mobile Ad Hoc Networks	3	2	4
	Semester 7: Choose any Two Papers			
ICT401	Advanced Java Programming	3	2	4
ICT403	Blockchain Technology	3	2	4
ICT405	Semantic Web	3	2	4
ICT407	C#.net Programming	3	2	4
ICT409	Cyber Security and Forensics	3	2	4
ICT411	Software Testing	4	-	4
ICT413	Cloud Computing	3	2	4
ICT415	Introduction to IoT	3	2	4
ICT417	Complexity Theory	3	2	4
ICT419	Human Computer Interface	3	2	4
ICT421	Software Project Management	3	2	4
ICT423	Next Generation Web	3	2	4
ICT425	Web Mining	3	2	4

Pranin Chandra

Implementation Rules:

1. The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University. The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

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).

3. Maximum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 6 years (N+2 years). After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 165 from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

4. 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).

5. 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.

6. The students shall undergo the following group of Courses / Papers as enumerated in the scheme.

Group	Semester (Credits)								Total Credits	Mandatory Credits
	I	II	III	IV	V	VI	VII	VIII		
BS	12	20							32	16
HS	5	4	2	2	4	4			21	10
ES	12	5							17	17
PC			27	27	10		5	21	90	90
PCE					4	8	8		20	16
EAE					4	8	8		20	16
OAE / EAE					4	8	8		20	10
Total	29	29	27	29	26	28	29	21	220	175

TABLE 1: Distribution of Credits. (Project / internship credits are 27 out of the 90 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 21 credits for humanities / management / social science group (HS)).

7. Mandatory Credits (175) specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree. See clause 12 and 13 also.

8. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. See clause 12 and 13 also.

9. The open electives of the OAE group of courses may be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the school for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the School for onwards transfer to the Examination Division. The Examinations Divisions shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by

the examination division of the University. If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for two minor specialization. The degree to the student on fulfilment of other requirements for such cases shall be through clause 13.b. or 13.c or 13.d.

These MOOC courses taken by the students, if allowed by the APC of the school shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student. Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the examination division from the result for the papers conducted by the examination division of the University.

However, if the student opts for emerging area electives in this group also, the same shall be allowed subject to other conditions specified in the rules / scheme.

10. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14, 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.

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 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. 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.

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.

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.

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 14 also.

11. Maximum Credits: at least 220 (Table 1), these are the credits for which the student shall have to study for the non-Honours component of the curriculum. The student has to appear in the examinations for these credits.

12. Minimum Credits: atleast 200 (out of the 220 non Honours papers credits). See clause 7 also.

13. The following degree route can be taken by a student (also refer point 14):

a. The students shall be awarded two minor specializations, one from EAE and one from OAE / EAE route under the following conditions:
   i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
   ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
   iii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.

iv. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE discipline>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE / EAE specialization>) (Honours)"***, if in addition to point 13.a.i, 13.a.ii, 13.a.iii, and 13.a.iv, the student fulfils the criteria for Honours as specified at point 10.

b. The students shall be awarded one minor specialization from EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>) (Honours)"***, if in addition to point 13.b.i, 13.b.ii, and 13.b.iii, the student fulfils the criteria for Honours as specified at point 10.

c. The students shall be awarded one minor specialization from OAE / EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OAE / EAE specialization>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OEA / EAE specialization>) (Honours)"***, if in addition to point 13.c.i, 13.c.ii, and 13.c.iii, the student fulfils the criteria for Honours as specified at point 10.

d. The students shall be awarded the degree without any minor specialization under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Major Discipline)"***; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Major Discipline) (Honours)"***, if in addition to point 13.d.i and 13.d.ii, the student fulfils the criteria for Honours as specified at point 10.

e. If the student does not fulfil any of the above criterions (point 13.a, 13.b, 13.c or 13.d), if the student earns atleast 200 credits out of 216 credits as enumerated in Table 1 (disregarding the mandatory credits clause of Table 1 and Clause 7), then the student shall be award the degree as ***Bachelor of Technology (Major Discipline)***. Such students shall not be eligible for the award of an Honours degree. Though if credits are accumulated through MOOCs as per clause 10, the same shall be reflected in the marksheets of the students.

14. The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of

the 4th of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

15. The scheme of examinations for the B.Tech. Programmes at the affiliated institutions shall be notified separately.

16. Pass marks in every paper shall be 40.

17. Grading System shall be as per Ordinance 11 of the University.

18. The programme core electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school and minor specializations and papers for OAE shall be defined by the concerned school. The school shall offer atleast two emerging area elective groups for students of each major discipline, and atleast two open area elective groups for students of each major discipline of the school. In addition, the school shall offer minor specialization groups as OAE to other school students. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The prerequisites for a specific paper, offered by the school, shall be defined in the detailed scheme and syllabus document of the school. The school shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the school, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the school may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The students desirous to continue to the Master of Technology part of the dual degree programme, must first complete the requirements for the award of the Bachelor of Technology degree, before being allowed to proceed for the Master of Technology part.

20. 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.

21. The medium of instructions shall be English.

Pranav Chandra

INFORMATION TECHNOLOGY

Programme Education Objectives (PEO)

PEO 1: Our students will apply their knowledge and skills to succeed in their careers and/or obtain an advanced degree.

PEO 2: Our students will behave ethically and responsibly, and will remain informed and involved as full participants in their profession and society.

PEO 3: Our students will creatively solve problems, communicate effectively, and successfully function in diverse and inclusive multi-disciplinary teams.

PEO 4: Our students will apply principles and practices of information technology to identify, implement, and enable effective technologies and apply fundamental computing knowledge to solve information technology problems and be capable of doing research.

Programme Specifc Outcomes (PSO)

On completion of the programme of study, the students will have the ability to:

PSO 1: Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

PSO 2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

PSO 3: Communicate effectively in a variety of professional contexts.

PSO 4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

PSO 5: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

PSO 6: Identify and analyze user needs and to take them into account in the selection, creation, integration, evaluation, and administration of computing-based systems.

PEO to PO Mapping

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

(scale 1: low, 2: Medium, 3: High)

PSO to PO Mapping

PSO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
PSO 1	3	3	-	3	-	-	-	-	-	-	-	3
PSO 2	-	3	3	3	3	1	1	-	-	-	-	3
PSO 3	-	-	-	-	-	3	-	-	3	3	3	-
PSO 4	-	-	-	-	-	3	3	3	1	-	-	-
PSO 5	-	-	-	-	-	-	-	1	3	1	3	-
PSO 6	1	3	3	3	3	1	1	1	-	-	-	3

(scale 1: low, 2: Medium, 3: High)

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Third Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT201	Foundations of Computer Science	4	-	4
PC	ICT203	Operating Systems	4	-	4
PC	ICT205	Digital Logic & Computer Design	4	-	4
PC	ICT207	Database Management Systems	4	-	4
PC	ICT209	Object Oriented Programming	4	-	4
PC	ICT211	Data Structures	4	-	4
HS/MS	ECO213	Engineering Economics	2	-	2
Practical/Viva Voce					
PC	ICT251	Database Management Systems Lab.	-	2	1
PC	ICT253	Object Oriented Programming Lab.	-	2	1
PC	ICT255	Data Structures Lab.	-	2	1
Total			26	6	29

Fourth Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT202	Computer Graphics	4	-	4
PC	ICT204	Computational Methods	4	-	4
PC	ICT206	Design and Analysis of Algorithms	4	-	4
PC	ICT208	Theory of Computation	4	-	4
PC	ICT210	Software Engineering	4	-	4
PC	ICT212	Computer Networks	4	-	4
HS/MS	MS214	Accountancy for Engineers	2	-	2
Practical/Viva Voce					
PC	ICT252	Computer Graphics and Computer Networks Lab.	-	2	1
PC	ICT254	Design and Analysis of Algorithms Lab.	-	2	1
PC	ICT256	Computational Methods Lab.	-	2	1
Total			26	6	29

Fifth Semester					
Code	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT301	Digital Signal Processing	4	-	4
PC	ICT303**	Compiler Design	3	2	4
PCE		Core area Elective - 1			4
EAE		Elective in Emerging Areas 1 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 1.			4
HS	HS305	Elements of Indian History for Engineers	2		2
MS	MS307	Entrepreneurship Mindset	2		2
Practical/Viva Voce					
PC	ICT391	Digital Signal Processing Lab.		2	1
PC	ICT393	Summer Training (after 4th semester) Report *			1
Total				**2**	**26**

*NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the school,

** The Teachers' Continuous Evaluation Component shall be 25, Term end theory examinations of 50 marks and term end practical marks shall be of 25 marks maximum. The marks obtained in each component by the student shall be reflected in the marksheet.

Sixth Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PCE		Core area Elective - 2			4
PCE		Core area Elective - 3			4
EAE		Elective in Emerging Areas -2 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 3 (Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 2			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 3			4
HS/MS	HS302	Technical Writing	2		2
Practical/Viva Voce					
HS/MC	ICT392*	NSS / NCC / Cultural clubs / Technical Society / Technical club*			2
Total					**28**

*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.

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Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PCE		Core area Elective - 4			4
PCE		Core area Elective - 5			4
EAE		Elective in Emerging Areas -4 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 5(Students to choose one group)			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 4			4
OAE		Elective from other schools or emerging area / open elective offered by the school - 5			4
Practical/Viva Voce					
PC	ICT497	Minor Project**			4
PC	ICT499	Summer Training (after 6th semester) Report *			1
Total					**29**

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

** 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.

Eight Semester					
Group	Paper Code	Paper	L	T/P	Credits
Practical/Viva Voce/Internship[%]					
PC / Project	ICT452	Major Project - Dissertation[**,#]			15
	ICT454	Major Project Viva Voce[@]			4
	ICT456	Project Progress Evaluation[*]			2
PC / Internship	ICT458	Internship Report[#]			15
	ICT460	Internship Viva Voce[#]			4
	ICT462	Internship Progress Evaluation[*,#]			2
Total					21

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

% By default every student shall do the project work (ICT452, ICT454, and ICT456). A student shall either be allowed to do a project work (ICT452, ICT454, and ICT456) or an internship (ICT458, ICT460, and ICT462). The student must apply for approval to do internship before the commencement of the 8th semester to the school, and only after approval of Dean of the school through Training and Placement Officer of the School shall proceed for internship.

** The student offered project work 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.

Students may be allowed to do internship in this semester in lieu of Major project. 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.

ICT452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by an external examiner deputed by examinations division (COE), for a total of 100 marks.

ICT454: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by examinations division (COE), for a total of 100 marks.

ICT456/ICT462: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ICT458/ICT460: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the training and placement officer of the School on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the School and the external examiner deputed by examinations division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and placement officer (as the case may be), the Dean of the school can assign the responsibility of the supervisor or the Training and Placement officer (for purpose of examinations) to any faculty of the school.

Note on Elective Papers: 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.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 marks continuous evaluation by the teacher and 75 marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 marks continuous evaluation by the teacher and 60 marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(c) Papers with both theory and practical components shall have 25 marks continuous evaluation by the teacher and 25 marks term-end examinations for practical and 50 marks term end examination for the theory component. All three component marks shall be reflected on the marksheet of the student.

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PROGRAMME CORE ELECTIVE PAPERS

Paper Code	Paper	T	P	Credits
	Semester 5: Choose any one paper			
ICT311	Artificial Intelligence	3	2	4
ICT313	Microprocessors and Interfacing	3	2	4
ICT315	Engineering Optimization	3	2	4
ICT317	Social Network Analysis and Sentiment Analysis	3	2	4
ICT323	VHDL Programming	3	2	4
ICT325	Multimedia Technologies	3	2	4
	Semester 6: Choose any Two Paper			
ICT312	Java Programming	3	2	4
ICT314	Systems Programming	3	2	4
ICT316	Introduction to Robotics Engineering	3	2	4
ICT318	Network Security and Cryptography	3	2	4
ICT320	Visual Basic.Net Programming	3	2	4
ICT322	Quantum Computing	3	2	4
ICT324	Natural Language Processing	3	2	4
ICT336	Introduction to Information and Communication Theory	3	2	4
ICT338	Database Modelling and Design	3	2	4
ICT340	Analog and Digital Communication	3	2	4
ICT342	Wireless Communications and Networks	3	2	4
	Semester 7: Choose any Two Papers			
ICT401	Advanced Java Programming	3	2	4
ICT403	Blockchain Technology	3	2	4
ICT405	Semantic Web	3	2	4
ICT407	C#.net Programming	3	2	4
ICT409	Cyber Security and Forensic	3	2	4
ICT411	Software Testing	3	2	4
ICT413	Cloud Computing	3	2	4
ICT415	Introduction to IoT	3	2	4
ICT427	Middleware Technologies	4	-	4
ICT429	Mobile Computing	4	-	4
ICT431	E-Commerce	4	-	4
ICT433	IT Project Management	3	2	4
ICT435	Network Programming on Linux	3	2	4

Pravin Chandra

Implementation Rules:

1. The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University. The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

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).

3. Maximum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 6 years (N+2 years). After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 165 from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

4. 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).

5. 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.

6. The students shall undergo the following group of Courses / Papers as enumerated in the scheme.

Group	Semester (Credits)								Total Credits	Mandatory Credits
	I	II	III	IV	V	VI	VII	VIII		
BS	12	20							32	16
HS	5	4	2	2	4	4			21	10
ES	12	5							17	17
PC			27	27	10		5	21	90	90
PCE					4	8	8		20	16
EAE					4	8	8		20	16
OAE / EAE					4	8	8		20	10
Total	**29**	**29**	**27**	**29**	**26**	**28**	**29**	**21**	**220**	**175**

TABLE 1: Distribution of Credits. (Project / internship credits are 27 out of the 90 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 21 credits for humanities / management / social science group (HS)).

7. Mandatory Credits (175) specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree. See clause 12 and 13 also.

8. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. See clause 12 and 13 also.

9. The open electives of the OAE group of courses may be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the school for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the School for onwards transfer to the Examination Division. The Examinations Divisions shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by

the examination division of the University. If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for two minor specialization. The degree to the student on fulfilment of other requirements for such cases shall be through clause 13.b. or 13.c or 13.d.

These MOOC courses taken by the students, if allowed by the APC of the school shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student. Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the examination division from the result for the papers conducted by the examination division of the University.

However, if the student opts for emerging area electives in this group also, the same shall be allowed subject to other conditions specified in the rules / scheme.

10. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14, 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.

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 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. 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.

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.

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.

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 14 also.

11. Maximum Credits: at least 220 (Table 1), these are the credits for which the student shall have to study for the non-Honours component of the curriculum. The student has to appear in the examinations for these credits.

12. Minimum Credits: atleast 200 (out of the 220 non Honours papers credits). See clause 7 also.

13. The following degree route can be taken by a student (also refer point 14):

a. The students shall be awarded two minor specializations, one from EAE and one from OAE / EAE route under the following conditions:
   i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
   ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
   iii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.

iv. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE discipline>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE / EAE specialization>) (Honours)"***, if in addition to point 13.a.i, 13.a.ii, 13.a.iii, and 13.a.iv, the student fulfils the criteria for Honours as specified at point 10.

b. The students shall be awarded one minor specialization from EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>) (Honours)"***, if in addition to point 13.b.i, 13.b.ii, and 13.b.iii, the student fulfils the criteria for Honours as specified at point 10.

c. The students shall be awarded one minor specialization from OAE / EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OAE / EAE specialization>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OEA / EAE specialization>) (Honours)"***, if in addition to point 13.c.i, 13.c.ii, and 13.c.iii, the student fulfils the criteria for Honours as specified at point 10.

d. The students shall be awarded the degree without any minor specialization under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Major Discipline)"***; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Major Discipline) (Honours)"***, if in addition to point 13.d.i and 13.d.ii, the student fulfils the criteria for Honours as specified at point 10.

e. If the student does not fulfil any of the above criterions (point 13.a, 13.b, 13.c or 13.d), if the student earns atleast 200 credits out of 216 credits as enumerated in Table 1 (disregarding the mandatory credits clause of Table 1 and Clause 7), then the student shall be award the degree as ***Bachelor of Technology (Major Discipline)***. Such students shall not be eligible for the award of an Honours degree. Though if credits are accumulated through MOOCs as per clause 10, the same shall be reflected in the marksheets of the students.

14. The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of

the 4th of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

15. The scheme of examinations for the B.Tech. Programmes at the affiliated institutions shall be notified separately.

16. Pass marks in every paper shall be 40.

17. Grading System shall be as per Ordinance 11 of the University.

18. The programme core electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school and minor specializations and papers for OAE shall be defined by the concerned school. The school shall offer atleast two emerging area elective groups for students of each major discipline, and atleast two open area elective groups for students of each major discipline of the school. In addition, the school shall offer minor specialization groups as OAE to other school students. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The prerequisites for a specific paper, offered by the school, shall be defined in the detailed scheme and syllabus document of the school. The school shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the school, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the school may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The students desirous to continue to the Master of Technology part of the dual degree programme, must first complete the requirements for the award of the Bachelor of Technology degree, before being allowed to proceed for the Master of Technology part.

20. 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.

21. The medium of instructions shall be English.

ELECTRONICS AND COMMUNICATIONS ENGINEERING

Programme Education Objectives (PEO)

PEO 1: To be well acquainted with fundamentals of Electronics & Communication Engineering for leading a successful career in industry or as an entrepreneur or pursuing higher education.

PEO 2: To inculcate rational approach towards constantly evolving technologies with ethical responsibilities.

PEO 3: To foster technical skills for innovative solutions in Electronics & Communication Engineering or related areas.

PEO 4: To participate in life-long learning in the relevant domain for addressing global societal needs.

Programme Specifc Outcomes (PSO)

On completion of the programme of study, the students will have the ability to:

PSO 1: To understand and analyse the principles and working of different electronic systems.

PSO 2: To utilize their knowledge, skills and resources to demonstrate and implement technology-based systems as per the requirement.

PSO 3: To offer real time and efficient solutions problems that are directly or indirectly related to Electronics and Communication Engineering areas and will contribute towards the development of society.

PSO 4: Ability to collaborate different fields of science and technology with right blend of attitude and aptitude for placements and higher education or to become a successful Entrepreneur and a worthy global citizen.

PEO to PO Mapping

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

(scale 1: low, 2: Medium, 3: High)

PSO to PO Mapping

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

(scale 1: low, 2: Medium, 3: High)

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Third Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT215	Signal and Systems	4	-	4
PC	ICT217	Computation Methods	4	-	4
PC	ICT219	Digital Electronics	4	-	4
PC	ICT221	Analog Electronics - I	4	-	4
PC	ICT223	Analog Communications	4	-	4
PC	ICT225	Engineering Electromagnetics	4	-	4
HS/MS	ECO213	Engineering Economics	2	-	2
Practical/Viva Voce					
PC	ICT257	Computational Methods Lab.	-	2	1
PC	ICT259	Analog and Digital Electronics Lab.	-	2	1
PC	ICT261	Analog Communications Lab.	-	2	1
Total			**26**	**6**	**29**

Fourth Semester					
Group	Paper Code	Paper	L	P	Credits
Theory Papers					
PC	ICT202	Network Analysis and Synthesis	4	-	4
PC	ICT204	Control Systems	4	-	4
PC	ICT206	Analog Electronics - II	4	-	4
PC	ICT208	Digital Communications	4	-	4
PC	ICT210	Microprocessors	4	-	4
PC	ICT212	Computer Networks	4	-	4
HS/MS	MS214	Accountancy for Engineers	2	-	2
Practical/Viva Voce					
PC	ICT258	Digital Communications and Computer Networks Lab.	-	2	1
PC	ICT260	Analog Electronics - II Lab.	-	2	1
PC	ICT262	Microprocessors Lab.	-	2	1
Total			**26**	**6**	**29**

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Fifth Semester					
Code	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PC	ICT301	Digital Signal Processing	4	-	4
PC	ICT305**	Microelectronics	3	2	4
PCE		Core area Elective - 1			4
EAE		Elective in Emerging Areas 1 (Students to choose one group)			4
OAE		Elective from other schools or open elective offered by the school - 1.			4
HS	HS307	Elements of Indian History for Engineers	2		2
MS	MS309	Entrepreneurship Mindset	2		2
Practical/Viva Voce					
PC	ICT391	Digital Signal Processing Lab.		2	1
PC	ICT393	Summer Training (after 4th semester) Report *			1
Total				**2**	**26**

*NUES : Comprehensive evaluation by the a committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the school,

** The Teachers' Continuous Evaluation Component shall be 25, Term end theory examinations of 50 marks and term end practical marks shall be of 25 marks maximum. The marks obtained in each component by the student shall be reflected in the marksheet.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
PCE		Core area Elective - 2			4
PCE		Core area Elective - 3			4
EAE		Elective in Emerging Areas -2 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 3 (Students to choose one group)			4
OAE		Elective from other schools or open elective offered by the school - 2			4
OAE		Elective from other schools or open elective offered by the school - 3			4
HS/MS	HS302	Technical Writing	2		2
Practical/Viva Voce					
HS/MC	ICT392*	NSS / NCC / Cultural clubs / Technical Society / Technical club*			2
Total					**28**

*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.

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Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Theory Papers					
PCE		Core area Elective - 4			4
PCE		Core area Elective - 5			4
EAE		Elective in Emerging Areas -4 (Students to choose one group)			4
EAE		Elective in Emerging Areas - 5(Students to choose one group)			4
OAE		Elective from other schools or open elective offered by the school - 4			4
OAE		Elective from other schools or open elective offered by the school - 5			4
Practical/Viva Voce					
PC	ICT497	Minor Project**			4
PC	ICT499	Summer Training (after 6th semester) Report *			1
Total					**29**

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

** 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.

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Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**T/P**	**Credits**
Practical/Viva Voce/Internship*					
PC / Project	ICT452	Major Project - Dissertation**,#			15
	ICT454	Major Project Viva Voce@			4
	ICT456	Project Progress Evaluation*			2
PC / Internship	ICT458	Internship Report#			15
	ICT460	Internship Viva Voce#			4
	ICT462	Internship Progress Evaluation*,#			2
Total					21

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

% By default every student shall do the project work (ICT452, ICT454, and ICT456). A student shall either be allowed to do a project work (ICT452, ICT454, and ICT456) or an internship (ICT458, ICT460, and ICT462). The student must apply for approval to do internship before the commencement of the 8th semester to the school, and only after approval of Dean of the school through Training and Placement Officer of the School, shall proceed for internship.

** The student offered project work 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.

Students may be allowed to do internship in this semester in lieu of Major project. 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.

ICT452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by an external examiner deputed by examinations division (COE), for a total of 100 marks.

ICT454: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by examinations division (COE), for a total of 100 marks.

ICT456/ICT462: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ICT458/ICT460: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the training and placement officer of the School on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the School and the external examiner deputed by examinations division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and placement officer (as the case may be), the Dean of the school can assign the responsibility of the supervisor or the Training and Placement officer (for purpose of examinations) to any faculty of the school.

Note on Elective Papers: 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.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 marks continuous evaluation by the teacher and 75 marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 marks continuous evaluation by the teacher and 60 marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(c) Papers with both theory and practical components shall have 25 marks continuous evaluation by the teacher and 25 marks term-end examinations for practical and 50 marks term end examination for the theory component. All three component marks shall be reflected on the marksheet of the student.

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PROGRAMME CORE ELECTIVE PAPERS

Paper Code	Paper	T	P	Credits
	Semester 5: Choose any one paper			
ICT311	Artificial Intelligence	3	2	4
ICT313	Microprocessors and Interfacing	3	2	4
ICT323	VHDL Programming	3	2	4
ICT327	Telecommunication Switching and Networks	3	2	4
ICT329	Optoelectronic Devices	4	-	4
	Semester 6: Choose any Two Paper			
ICT316	Introduction to Robotics Engineering	3	2	4
ICT318	Network Security and Cryptography	3	2	4
ICT336	Introduction to Information and Communication Theory	4	-	4
ICT344	Random Processes and Stochastic Systems	4	-	4
ICT346	Antenna Design and Radiating Systems	3	2	4
ICT348	Optical Communication Systems and Networks	3	2	4
ICT350	Embedded Systems	3	2	4
ICT352	RF Components and Circuit Design	3	2	4
ICT354	Multimedia Communications	4	-	4
ICT356	Mobile Communication	3	2	4
	Semester 7: Choose any Two Papers			
ICT409	Cyber Security and Forensic	3	2	4
ICT415	Introduction to IoT	3	2	4
ICT429	Mobile Computing	4	-	4
ICT441	Advanced Computer Architecture	4	-	4
ICT443	Smart Antennas	4	-	4
ICT445	Fabrication Technology	4	-	4
ICT447	Power Electronics	4	-	4
ICT449	Electronic Measurements	4	-	4
ICT451	MEMS and Sensors	4	-	4
ICT453	Radar and Satellite Communication	3	2	4
ICT457	Engineering Optimization	3	2	4
ICT459	Radio and Television Engineering	3	2	4
ICT461	RF and Microwave Engineering	3	2	4

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Implementation Rules:

1. The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University. The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

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).

3. Maximum duration of the Bachelor of Technology part of the Bachelor / Master of Technology (Dual Degree) programme shall be 6 years (N+2 years). After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 165 from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

4. 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).

5. 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.

6. The students shall undergo the following group of Courses / Papers as enumerated in the scheme.

Group	Semester (Credits)								Total Credits	Mandatory Credits
	I	II	III	IV	V	VI	VII	VIII		
BS	12	20							32	16
HS	5	4	2	2	4	4			21	10
ES	12	5							17	17
PC			27	27	10		5	21	90	90
PCE					4	8	8		20	16
EAE					4	8	8		20	16
OAE / EAE					4	8	8		20	10
Total	**29**	**29**	**27**	**29**	**26**	**28**	**29**	**21**	**220**	**175**

TABLE 1: Distribution of Credits. (Project / internship credits are 27 out of the 90 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 21 credits for humanities / management / social science group (HS)).

7. Mandatory Credits (175) specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree. See clause 12 and 13 also.

8. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. See clause 12 and 13 also.

9. The open electives of the OAE group of courses may be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the school for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the School for onwards transfer to the Examination Division. The Examinations Divisions shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by

the examination division of the University. If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for two minor specialization. The degree to the student on fulfilment of other requirements for such cases shall be through clause 13.b. or 13.c or 13.d.

These MOOC courses taken by the students, if allowed by the APC of the school shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student. Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the examination division from the result for the papers conducted by the examination division of the University.

However, if the student opts for emerging area electives in this group also, the same shall be allowed subject to other conditions specified in the rules / scheme.

10. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14, 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.

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 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. 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.

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.

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.

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 14 also.

11. Maximum Credits: at least 220 (Table 1), these are the credits for which the student shall have to study for the non-Honours component of the curriculum. The student has to appear in the examinations for these credits.

12. Minimum Credits: atleast 200 (out of the 220 non Honours papers credits). See clause 7 also.

13. The following degree route can be taken by a student (also refer point 14):

a. The students shall be awarded two minor specializations, one from EAE and one from OAE / EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.

ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.

iii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.

iv. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE discipline>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specializations in <concerned EAE discipline> and <concerned OAE / EAE specialization>) (Honours)"***, if in addition to point 13.a.i, 13.a.ii, 13.a.iii, and 13.a.iv, the student fulfils the criteria for Honours as specified at point 10.

b. The students shall be awarded one minor specialization from EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of EAE courses offered as a minor specialization by USICT.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned EAE specialization>) (Honours)"***, if in addition to point 13.b.i, 13.b.ii, and 13.b.iii, the student fulfils the criteria for Honours as specified at point 10.

c. The students shall be awarded one minor specialization from OAE / EAE route under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. The student earns 20 credits from one group of OAE courses offered as a minor specialization by USICT or any other school. Papers taken through MOOCs for OAE shall not entitle the student to a minor specialization.
iii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OAE / EAE specialization>)"***; if criteria / point 10 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Primary Discipline) with minor specialization in <concerned OEA / EAE specialization>) (Honours)"***, if in addition to point 13.c.i, 13.c.ii, and 13.c.iii, the student fulfils the criteria for Honours as specified at point 10.

d. The students shall be awarded the degree without any minor specialization under the following conditions:

i. The student has earned The student has earned the mandatory credits as defined in Table 1 and clause 7.
ii. In addition, the total credits (including the above specified credits) earned by the student is atleast 200 credits.

The degree nomenclature of the degree shall be as: ***"Bachelor of Technology (Major Discipline)"***; if criteria / point 6 is not satisfied for Honours. Otherwise, if criteria / point 10 is met, then the degrees shall be an Honours degree and the nomenclature shall be as: ***"Bachelor of Technology (Major Discipline) (Honours)"***, if in addition to point 13.d.i and 13.d.ii, the student fulfils the criteria for Honours as specified at point 10.

e. If the student does not fulfil any of the above criterions (point 13.a, 13.b, 13.c or 13.d), if the student earns atleast 200 credits out of 216 credits as enumerated in Table 1 (disregarding the mandatory credits clause of Table 1 and Clause 7), then the student shall be award the degree as ***Bachelor of Technology (Major Discipline)***. Such students shall not be eligible for the award of an Honours degree. Though if credits are accumulated through MOOCs as per clause 10, the same shall be reflected in the marksheets of the students.

14. The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of

the 4th of the batch from the year of admission. No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

15. The scheme of examinations for the B.Tech. Programmes at the affiliated institutions shall be notified separately.

16. Pass marks in every paper shall be 40.

17. Grading System shall be as per Ordinance 11 of the University.

18. The programme core electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school and minor specializations and papers for OAE shall be defined by the concerned school. The school shall offer atleast two emerging area elective groups for students of each major discipline, and atleast two open area elective groups for students of each major discipline of the school. In addition, the school shall offer minor specialization groups as OAE to other school students. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The prerequisites for a specific paper, offered by the school, shall be defined in the detailed scheme and syllabus document of the school. The school shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the school, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the school may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The students desirous to continue to the Master of Technology part of the dual degree programme, must first complete the requirements for the award of the Bachelor of Technology degree, before being allowed to proceed for the Master of Technology part.

20. 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.

21. The medium of instructions shall be English.

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MINOR SPECIALIZATION STREAMS
(EMERGING AREA ELECTIVE GROUPS)

These papers / streams shall be offered as per the prerequisite specified. The papers are to be offered to at the undergraduate level to the students of B.Tech. programmes.

Emerging Area: Minor Specialization in Machine Learning & Data Analytics
Prerequisite: First Year Engineering Mathematics (3 papers), Programming in C at the level of the B.Tech. papers for these topics in the Curriculum of B.Tech. part of the USICT programmes of studies offered at the USICT campus). (Any Engineering Discipline).

Code	Paper	L	P	Credits	Semester
ITE301	Statistics, Statistical Modelling & Data Analytics	3	2	4	5th
ITE302	Machine Learning	3	2	4	6th
ITE304	Supervised and Deep Learning	3	2	4	6th
ITE401	Unsupervised Learning	3	2	4	7th
ITE403	Machine Learning and Data Analytics Case Studies OR	3	2	4	7th
ITE405	Machine Learning and Data Analytics Frameworks	3	2	4	

Note: For papers with practical component, the teacher's continuous evaluation component shall be 25 marks, term end examination theory component shall be 50 marks and term end practical examination component shall be 25 marks for a total of 100 marks. The marksheet shall reflect all three components and the total marks obtained

Emerging Area: Minor Specialization in Soft Computing
Prerequisite: First Year Engineering Mathematics (3 papers), Programming in C at the level of the B.Tech. papers for these topics in the Curriculum of B.Tech. part of the USICT programmes of studies offered at the USICT campus). (Any Engineering Discipline).

Code	Paper	L	P	Credits	Semester
ITE303	Statistics, Statistical Modelling & Data Analytics	3	2	4	5th
ITE306	Artificial Neural Networks and Deep Learning	3	2	4	6th
ITE308	Fuzzy logic and Systems	3	2	4	6th
ITE407	Global Optimization Methods	3	2	4	7th
ITE409	Soft Computing and Expert Systems	3	2	4	7th

Note: For papers with practical component, the teacher's continuous evaluation component shall be 25 marks, term end examination theory component shall be 50 marks and term end practical examination component shall be 25 marks for a total of 100 marks. The marksheet shall reflect all three components and the total marks obtained.

Emerging Area: Minor Specialization in Internet of Things
Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper	L	P	Credits	Semester
ITE305	Introduction to Internet of Things	3	2	4	5th
ITE310	Wireless and Sensor Networks	3	2	4	6th
ITE312	IoT with Arduino, ESP, and Raspberry Pi	3	2	4	6th
ITE411	Design of smart systems	3	2	4	7th
ITE413	Privacy and Security issues in IoT	4	-	4	7th

Note: For papers with practical component, the teacher's continuous evaluation component shall be 25 marks, term end examination theory component shall be 50 marks and term end practical examination component shall be 25 marks for a total of 100 marks. The marksheet shall reflect all three components and the total marks obtained.

Emerging Area: Minor Specialization in Embedded Systems
Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper	L	P	C	Semester
ITE307	One of the following (Depending on subjects already studied): Microprocessors and Interfacing	3	2	4	5th
ITE309	Real time operating systems	4	-	4	
ITE314	Embedded System Architecture and Design	3	2	4	6th
ITE316	One of the following (Depending on subjects already studied): VHDL Programming	3	2	4	6th
ITE318	Programming in C for Embedded Systems	3	2	4	
ITE415	Real Time Embedded System Programming	3	2	4	7th
ITE417	One of the following: Logic Design and Analysis Using Verilog	3	2	4	7th
ITE419	Embedded Linux	3	2	4	
ITE421	Sensors and Actuators	3	2	4	

Note: For papers with practical component, the teacher's continuous evaluation component shall be 25 marks,

term end examination theory component shall be 50 marks and term end practical examination component shall be 25 marks for a total of 100 marks. The marksheet shall reflect all three components and the total marks obtained.

Emerging Area: Minor Specialization in Software Engineering

Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT (B.Tech. Part)

Code	Paper	L	P	Credits	Semester
ITE311	Software Measurements, Metrics, and Modelling	3	2	4	5th
	One of the following (Depending on subjects already studied):				6th
ITE320	Software Project Management	3	2	4	
ITE322	Service Oriented Architecture	3	2	4	
ITE324	Mining Software Repositories and Predictive Modelling	3	2	4	6th
	One of the following (Depending on subjects already studied):				7th
ITE423	Software Verification, Validation and Testing	3	2	4	
ITE425	Software Security	4	-	4	
ITE427	Software Engineering Standards	4	-	4	7th

Emerging Area: Minor Specialization in VLSI Design

Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in ECE (B.Tech. Part)

Code	Paper	L	P	Credits	Semester
ITE313	Semiconductor devices and Modelling	3	2	4	5th
ITE326	VLSI Technology and Design	3	2	4	6th
ITE328	CMOS Analog Integrated Circuit Design	3	2	4	6th
ITE429	CMOS Digital Circuits Design	3	2	4	7th
	One of the following:				7th
ITE431	CMOS Mixed Signal Circuit Design	4	-	4	
ITE433	Low Power VLSI Design	3	2	4	
ITE435	VLSI Testing	4	-	4	

Emerging Area: Minor Specialization in Wireless and Mobile Communications

Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper	L	P	Credits	Semester
ITE315	Wireless Communication Systems	3	2	4	5th
ITE330	Cellular and Mobile communication	3	2	4	6th
ITE332	Ad hoc and Sensor Networks	3	2	4	6th
ITE437	Cognitive Radio & Networks	4	-	4	7th
ITE439	Privacy and Security in Wireless Networks	4	-	4	7th

Emerging Area: Minor Specialization in Image Processing & Computer Vision

Prerequisite: Only to be offered to students of B.Tech. / M.Tech. (Dual degree) in CSE / IT / ECE (B.Tech. Part)

Code	Paper	L	P	Credits	Semester
ITE317	Digital Image Processing	3	2	4	5th
ITE334	Pattern Recognition	3	2	4	6th
ITE336	Computer Vision	3	2	4	6th
	One of the following:				7th
ITE441	Remote Sensing Image Analysis and Classification	3	2	4	
ITE443	Medical Image Processing, Analysis and Reconstruction	3	2	4	
ITE445	Biometrics	3	2	4	
	One of the Following:				7th
ITE447	Machine Learning for Image and Vision Analysis	3	2	4	
ITE449	Deep Learning for Image Processing and Computer Vision	3	2	4	

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MINOR SPECIALIZATION STREAMS
(OPEN ELECTIVE GROUPS)

OPEN ELECTIVE GROUPS

1. One open elective stream shall be offered from CSE/IT discipline to be called "minor specialization in Computer Science and Engineering". This stream shall be offered to the B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in Electronics and Communication Engineering and other engineering branches of the University campus (other schools) as (This shall not be offered to Students of B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in CSE / IT):

Minor Specialization in Computer Engineering					
Paper Code.	**Minor Specialization in Computer Science and Engineering Paper**	**Offered in Semester**	**T**	**P**	**C**
ITE319 ITE321	One of the following (Depending on subjects already studied): Digital Logic and Computer Design Object Oriented Programming using C++	5th Semester (odd semester)	 4 3	 - 2	 4 4
ITE338	Data Structures and Algorithms	6th Semester (even semester)	3	2	4
ITE340	Database Management Systems	6th Semester (even semester)	3	2	4
ITE451	Operating Systems	7th Semester (odd semester)	3	2	4
ITE453 ITE455	One of the following (Depending on subjects already studied): Computer Networks Software Engineering	7th Semester (odd semester)	 3 3	 2 2	 4 4

Note: For papers with practical component, the teacher's continuous evaluation component shall be 25 marks, term end examination theory component shall be 50 marks and term end practical examination component shall be 25 marks for a total of 100 marks. The marksheet shall reflect all three components and the total marks obtained.

2. One open elective stream shall be offered from ECE discipline to be called "minor specialization in Electronics and Communications Engineering". This stream shall be offered to the B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in CSE / IT and other engineering branches of the University campus (other schools) as (This shall not be offered to Students of B.Tech. part of the B.Tech. / M.Tech. (Dual degree) in ECE):

Minor Specialization in Electronics and Communications Engineering					
Paper Code	**Minor Specialization in Electronics and Communications Engineering Paper**	**Offered in Semester**	**T**	**P**	**C**
ITE323	Circuits and Systems	5th Semester (odd semester)	4	-	4
ITE342	Electronic Devices and Circuits	6th Semester (even semester)	3	2	4
ITE344 ITE346	One of the following (Depending on subjects already studied): Digital Logic and Computer Design Microprocessors & Interfacing	6th Semester (even semester)	 4 3	 - 2	 4 4
ITE457 ITE459	One of the following (Depending on subjects already studied): Analog and Digital Communications Wireless and Sensor Networks	7th Semester (odd semester)	 3 3	 2 2	 4 4
ITE461 ITE463	One of the following (Depending on subjects already studied): Computer Networks Control Systems	7th Semester (odd semester)	 3 4	 2 -	 4 4

Note: For papers with practical component, the teacher's continuous evaluation component shall be 25 marks, term end examination theory component shall be 50 marks and term end practical

examination component shall be 25 marks for a total of 100 marks. The marksheet shall reflect all three components and the total marks obtained

3. One open area elective stream from Computer Applications shall be offered to all engineering branches of the University and shall be called "minor specialization in Software Development". This stream shall be offered to the B.Tech. part of the B.Tech. / M.Tech. (Dual degree) engineering branches of the University campus:

Minor Specialization in Software Development					
Paper Code	**Minor Specialization in Software Development**	**Offered in Semester**	**T**	**P**	**C**
ITE325 ITE327 ITE329	One of the following (Depending on subjects already studied): DBMS Software Engineering System Analysis and Design	5th Semester (odd semester)	 3 3 4	 2 2 -	 4 4 4
ITE348 ITE350	Any one of the following (Depending on subjects already studied): Web Development - I Object Oriented Programming using C++	6th Semester (even semester)	 3 3	 2 2	 4 4
ITE352 ITE354 ITE356	Any one of the following (Depending on subjects already studied): Programming in the Windows Environment Project Management Programming in Java	6th Semester (even semester)	 3 3 3	 2 2 2	 4 4 4
ITE465 ITE467	Any one of the following (Depending on subjects already studied): Web Development - II Programming in the Linux Environment	7th Semester (odd semester)	 3 3	 2 2	 4 4
ITE469 ITE471	Any one of the following (Depending on subjects already studied): Android Development Advanced Java Programming	7th Semester (odd semester)	 3 3	 2 2	 4 4

Note: For papers with practical component, the teacher's continuous evaluation component shall be 25 marks, term end examination theory component shall be 50 marks and term end practical examination component shall be 25 marks for a total of 100 marks. The marksheet shall reflect all three components and the total marks obtained

OPEN ELECTIVE PAPERS (LIST OF PAPERS THAT CAN BE OFFERED AS STAND ALONE PAPERS BY THE SCHOOL TO ANY ENGINEERING STUDENT OF THE UNIVERSITY CAMPUS.

1. Any paper that is a programme core paper (PC) (3rd Semester onwards offered by USICT through this document) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.
2. Any paper that is a programme core elective paper (5rd Semester onwards, offered by USICT through this document) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.
3. Any paper that is a emerging area elective paper (5rd Semester onwards offered by USICT through this document) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject

with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.

4. Any paper that is a open elective group paper (5thSemester onwards) can be offered as an open elective to other branches of engineering provided the prerequisite of the paper is satisfied by the student and the same paper is not a core / elective paper for the student. The students may be allowed to study such subject with the approval of the APC of USICT, subject to the condition that the paper is offered in the particular semester by the school.
5. The Board of School of University School of Information, Communication and Technology may approve inclusion of papers with detailed syllabus for undergraduate programmes of studies in the university campus (other school students) as open electives. The same shall become a part of the scheme and syllabi of examinations for the concerned student once approved by the APC of the school.
6. The above shall apply in consonance with other rules specified in this document.

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Assessment of Outcomes Achieved in a Course / Paper. That is, Learning Outcome Assessment Alignment Grid.

Learning Outcome	Course/Project	How Learning Will Be Assessed	Resources	Attainment Level

To complete the alignment grid, start by listing one learning outcome per row beneath the "Learning Outcome" column. Make sure that each learning outcome can be assessed by a single method.

Next, beneath the "Course/ Project" column, list the course(s) or project(s) or assignments or tests that students will complete in order to achieve the learning outcome.

In the "How Learning Will Be Assessed" column, list the assessment(s) tool that will be used for that particular learning outcome. It is fine for there to be more than one assessment used for a particular outcome, so long as each assessment captures the outcome in its entirety. Likewise, it is fine for a single assessment to be used for multiple outcomes.

In the column entitled "Resources", list any additional materials, technologies, or resources needed for students to meet the learning outcome.

In the column entitled "Attainment Level", list in a quantifiable manner the average attainment level.

Every teacher must make this sheet for every paper taught. Be that a paper with only theory component, only practical component or with both theory and practical component.

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