SCHEME OF EXAMINATION

&

DETAILED SYLLABUS

FOR

BACHELOR OF TECHNOLOGY(B.TECH/M.TECH) DUAL DEGREE
FIRST YEAR

FOR

AUTOMATION AND ROBOTICS

Offered at University School of Automation and Robotics
from A.S. 2025-26 onwards

University School of Automation and Robotics

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY,
EAST DELHI CAMPUS, SURAJMAL VIHAR-110092

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 analyze 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 textbook 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 (modeled) within an appropriate mathematical framework; and
    e) that often require the 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 modeling 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 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:
ES: Engineering Science
VAC: Value Added Course
MDC: Multi Disciplinary Course

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 calculation of the duration of the study.

Programme of study shall mean Bachelor of Technology.

Acronyms:
APC: Academic programme committee comprising all faculty of the school.
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 end term examination shall be held. The evaluation shall be conducted As per the scheme of examinations as described in the scheme of study.

First Semester					
Group	**Paper Code**	**Paper Title**	**L**	**P**	**Credits**
Theory Papers					
ES	AR101	Programming for Problem Solving	3	-	3
ES	AR103	Engineering Mathematics- I	3	-	3
ES	AR113	Analog Electronics and Digital Logic	3	-	3
ES	AR115	Mechanics and Applied Physics	3	-	3
VAC	AR117	Communications Skills	2	-	2
VAC	AR119	Environment Studies	2	-	2
VAC	AR121	Human Values & Ethics	2	-	2
Practical/ Viva Voce					
ES	AR151	Programming for Problem Solving Lab	-	2	1
ES	AR161	Analog Electronics Lab	-	2	1
ES	AR163	Physics for Engineers Lab	-	2	1
ES	AR165	Environment Studies Lab	-	2	1
Total			**18**	**08**	**22**

Second Semester					
Group	**Paper Code**	**Paper Title**	**L**	**P**	**Credits**
Theory Papers					
ES	AR102	Data Structures	3	-	3
ES	AR104	Engineering Mathematics-II	3	-	3
ES	AR116	Basic Electrical Engineering	3	-	3
ES	AR118	Applied Engineering Materials	3	-	3
MDC	AR120	Manufacturing Processes*	3	-	3
	AR122	Computer Architecture and Organisation**			
VAC	AR124	NCC/NSS/DSW Clubs/ USAR Tech and Non-Tech Clubs# **(NUES)**	-	-	2
Practical/ Viva Voce					
ES	AR152	Data Structures Lab	-	2	1
ES	AR160	Programming in Python Lab	-	2	1
ES	AR162	Applied Engineering Materials Lab	-	2	1
ES	AR164	Engineering Drawing with Autocad Lab	-	2	1
ES	AR166	Basic Electrical Engineering Lab	-	2	1
Total			**15**	**10**	**22**

*For B.Tech(AR)
** For B.Tech (IIOT)
# NUES

Exit After Completion of an Academic Year: A student may exit after completion of any of the year of study. That is, a student may take a break after any year of study, and if he/she satisfies the required conditions as per table below, then the Certificate/ Diploma/Degree to be awarded shall awarded. The interim awards shall be as follows (***for Regular Students admitted in the first year/first semester***):

On Completion of	Be Awarded	Condition to be Satisfied	Remarks
1st Year	Certificate in Automation and Robotics (AR)	Has earned at least 40 credits in the 1st year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper of 1st year on re-joining in the second year to complete the requirement for the award of the degree. (Interim Degree)
2nd Year	Diploma in Automation and Robotics (AR)	Has earned at least 80 credits upto and including the 2nd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 2nd year on re-joining in the third year to complete the requirement for the award of the degree. (Interim Degree)
3rd Year	Advanced Diploma in Automation and Robotics (AR)	Has earned at least 120 credits upto and including the 3rd year from the subjects / courses / papers offered	Shall not be allowed to reappear in any failed paper studied till 3rd year on re-joining in the fourth year to complete the requirement for the award of the degree. (Interim Degree)
4th Year	B.Tech Degree in Automation and Robotics (AR)	Has earned at least 160 credits upto and including the 4th year from the subjects / courses / papers offered	(Final Degree)

DETAILED SYLLABUS FOR 1st SEMESTER

Paper code : AR101	L	P	Credit
Paper Title : Programming for Problem Solving	3		3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Understand the basic structure of C programming, number systems, and the compilation process of a C program. [K1]
CO2: Apply programming constructs like operators, loops, conditionals, and arrays in C to solve problems. [K2]
CO3: Analyze and implement advanced programming constructs such as functions, recursion, strings, and pointers. [K1,K2]
CO4: Develop and implement programs involving structures, unions, and file handling. [K2]

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	0	0	0	0	0	0	0	0	0	0	0
CO2	3	2	2	1	0	0	0	0	1	0	0	0
CO3	3	2	3	2	2	0	0	1	0	0	0	2
CO4	2	2	3	0	0	3	0	1	1	0	0	2

Course Content	**No of Lectures**
Unit-I **Introduction to Programming:** 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:** Basic structure of C programs, process of compiling and running a C program, tokens, keywords, identifiers, constants, strings, special symbols, variables, data types, 1/0 statements. Interconversion of variables. 'C' Standard Libraries: stdio.h, stdlib.h, assert.h, math.h, time.h, ctype.h, setjmp.h, string.h, stdarg.h, unistd.h	[9]

Unit-II **Basics of Number Systems:** Introduction to Number Systems, Types of Number Systems (Binary, Decimal, Octal, Hexadecimal), Conversion Between Number Systems, Signed and Unsigned Numbers: Representation of negative numbers (Sign-magnitude, 1's complement, 2's complement) **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. **Control structures:** Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements. **Arrays:** One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays.	[10]
Unit-III **Functions:** User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion. **Strings:** Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions. **Pointers:** Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers/ returning pointers, Dynamic memory allocation. Pointers to functions. Pointers and Strings	[10]
Unit-IV **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..	[9]
Reference Books **[T1]** Balagurusamy, E. (2019). *Programming in ANSI C* (8th ed.). McGraw Hill Education. **[T2]** Kanetkar, Y. (2018). *Let Us C* (17th ed.). BPB Publications. **[T3]** Kernighan, B. W., & Ritchie, D. M. (1988). *The C Programming Language* (2nd ed.). Prentice Hall. *(Known as K&R, the classic authoritative book on C)*	
Reference Books **[R1]** Engineering Problem Solving With C by Delores M. Etter, Pearson, 2013. Problem Solving and **[R2]** Program Design in C by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016. **[R3]** Venugopal, K. R., & Prasad, S. R. (2007). *Mastering C*. Tata McGraw Hill. **[R4]** Das, S. (2008). *The C Programming Language*. BPB Publications. **[R5]** Morris Mano, M. (2017). *Digital Logic and Computer Design* (4th ed.). Pearson Education. **[R6]** Rajaraman, V. (2010). *Fundamentals of Computers* (5th ed.). PHI Learning. **[R7]** Gottfried, B. S. (1996). *Programming with C* (2nd ed.). Schaum's Outline Series, McGraw-Hill. **[R8]** Kochan, S. G. (2005). *Programming in C* (3rd ed.). Sams Publishing.	

Paper code : AR103	L	P	Credit
Paper Title : Engineering Mathematics-I	3	0	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Ability of students to apply basic calculus **[K1, K2, K3]**
CO2: Ability of students to apply vector calculus to solve engineering problems **[K1, K2, K3, K4]**
CO3: Ability of students to understand complex analysis **[K1,K2]**
CO4: Ability of students to understand laplace transforms and fourier analysis **[K1, K2, K3]]**

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	3	3	2	1	0	0	2	0	1	3
CO2	3	3	3	3	2	1	0	0	2	0	1	3
CO3	3	3	3	2	2	1	0	0	2	0	1	3
CO4	3	3	3	2	2	1	0	0	2	0	1	3

Course Content	**No of Lectures**
Calculus I: Extreme values of a continuous function, mean value theorem, Solving definite and improper integrals: Area between two curves, Integration by parts and method of partial Fractions, Partial differentiation, Chain rule.	[10]
Calculus II: Total derivative, Directional derivatives and the gradient, divergence and curl, series, Taylor series (in one and two variables), maxima and minima of functions, Method of Lagrange multiplier, line and surface integrals, applications of Gauss, Stokes and Green's theorem.	[10]

Complex Analysis: Complex numbers, polar form of complex numbers, Analytic functions Cauchy-Riemann Equations, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor and Maclaurin Series, Laurent Series, Singularities and zeros, Residue Integration method.	[10]
Laplace Transform: Basic definition, Linearity of Laplace transform, first shifting theorem (s-shifting), Transforms of derivatives and integrals, Using Laplace transform to solve ODE with initial value problems. **Fourier Series and Transform:** Basic definition of fourier series, Half range expansions, Fourier Cosine and sine transforms	[10]

Text books:

1. Strauss, M. J., Bradley, G. L., & Smith, K. J. (2002). Calculus. Pearson Education India.
2. Erwin Kreyszig., (1999) Advanced Engineering Mathematics, John Wiley

Reference books:

1. Weir, M.D. Hass, J., Giordano, F.R. (2009) Thomas' Calculus, Pearson
2. Dennis G. Zill., (2018) Advanced Engineering Mathematics. Jones & Bartlett Learning.

Paper Code: AR113	L	P	Credit
Paper Title: Analog Electronics and Digital Logic	3	-	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Understanding the basics of Diodes and designing biasing schemes for transistor circuits. [K1, K2, K3]
CO2: Analyzing the description of MOS and MOSFET devices & frequency response, and their application as an amplifier. [K1, K2, K3]
CO3: Apply operational amplifier (Op-Amp) characteristics to design and analyze various linear and non-linear Op-Amp circuits and filters. [K1, K2, K3]
CO4: Understand number systems and their applications. Minimize Boolean expressions and their applications to design digital circuits, and design Combinational circuits using logic gates. [K1, K2, K3, K4]

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	2	1	1	0	0	0	0	0	0	1
CO2	3	3	2	2	2	0	0	0	0	0	0	2
CO3	3	3	3	2	2	0	0	0	0	0	0	2
CO4	3	2	2	1	2	0	0	0	0	0	0	1

Course Content	**No of Lectures**
Unit I **P-N Junctions:** Junction diode theory, forward bias, and reverse bias, reverse-bias breakdown, Diode applications- Limiters, clippers, clampers, half wave & full wave rectification, Special purpose diodes - Zener diode, Vractor Diode.	[9]

Bipolar Junction Transistor: BJT basics, configurations, DC operating Point, variation and its stability, BJT characteristics and parameters, BJT as an amplifier and as a switch, Biasing circuits, single stage BJT amplifiers.	
Unit II **MOSFET Circuits:** Fundamentals of MOS structure, FET Types, Depletion-type and Enhancement-type MOSFET structures, I-V characteristics, MOSFET as a switch. **Small signal equivalent circuits:** Gain, input, and output impedances, small-signal model, and common-source, common-gate, and common-drain amplifiers, transconductance, high-frequency equivalent circuit.	[9]
Unit III **Differential Amplifiers:** MOSFET differential Pair, Small signal operation, frequency response of Differential amplifier. **Operational Amplifiers:** Ideal op-amp: definition, block diagram, operation, characteristics, applications, µA 741 pin diagram, Output offset voltage, input bias current, input offset current, CMRR, slew rate, gain-bandwidth product, Inverting and non-inverting amplifier, Differentiator, integrator, Op-amp voltage adder, Square-wave and triangular-wave generators, Log and Antilog amplifier.	[9]
Unit IV **Digital Logic:** **Number Systems:** Decimal, binary, octal, hexadecimal number systems and conversion, binary weighted codes, signed numbers, 1's and 2's complement codes, Binary arithmetic. **Boolean Algebra:** Binary logic operations, Boolean laws, associative and distributive properties, DeMorgan's theorems, and realization of switching functions using logic gates. **Combinational Logic:** Canonical logic forms, Karnaugh maps, two, three, and four variable Karnaugh maps, Half-adder and Full-adder.	[9]
Text Books: [T1] Adel S. Sedra, Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press, Eighth Edition, 2020. [T2] Thomas L. Floyd, David M. Buchla, Electronics Fundamentals: Circuits, Devices & Applications, 8th Edition, Pearson Education, 2014. [T3] Mano M. M., Digital Logic & Computer Design, 4/e, Pearson Education, 2013 [T4] Floyd T. L., Digital Fundamentals, 11/e, Pearson Education, 2024.	
Reference Books: [R1] Donald E. Neaman, "Electronic Circuit, Analysis and Design", Tata McGraw-Hill Publishing Company Limited, Second Edition, 2006. [R2] David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press India, 2008. [R3]Rajaraman V. and T. Radhakrishnan, An Introduction to Digital Computer Design, 5/e, Prentice Hall India Private Limited, 2012.	

Paper code : AR115	L	P	Credit
Paper Title : Mechanics and Applied Physics	3	0	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Outcomes [Bloom's Knowledge Level (KL)]:

CO1:Ability to understand, apply and distinguish various interference phenomena. [K1,K2,K3,K4]
CO2:Ability to understand, apply and distinguish diffraction phenomena and laser systems. [K1,K2,K3,K4]
CO3: Understand and apply the concepts of the quantum nature of reality. [K1,K2,K3]
CO4: Ability to apply the concepts to solve problems pertaining to force systems, equilibrium, distributed systems and friction. [K1,K2,K3]

CO/PO	**)01**	**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	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	2

Course Content	**No of Lectures**
Interference: Interference by division of wave front, interference by division of amplitude, Interference phenomenon in thin films, Interference due to reflected light in thin films, Interference due to transmitted light in thin films, Theory of Newton's rings and applications (determination of wavelength of sodium light and determination of refractive index of a liquid), Michelson's interferometer.	[10]

Diffraction: Difference between Fraunhofer and Fresnel diffraction; Fraunhofer diffraction for Single slit, double slit, and N-slit diffraction grating, resolving power and dispersive power of a grating, Rayleigh criterion, resolving power of optical instruments. Introduction to Laser Physics: Coherence, Einstein A and B coefficients, population inversion, basic principle and operation of a laser, the He-Ne laser and the Ruby laser.	[10]
Quantum Mechanics: Physical interpretation of the wave function, properties, the wave packet, group and phase velocity, the uncertainty principle. The Schrödinger wave equation (1D), Eigenvalues and Eigenfunctions, expectation values, simple Eigenvalue problems – solutions of the Schrödinger's equations for the free particle, the infinite well, tunneling effect and its applications, tunnel diode.	[10]
Force System: principle of transmissibility of force, 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. Friction: Static and Kinetic friction, laws of dry friction, coefficient of friction, angle of friction, angle of repose, cone of friction, frictional lock, friction in flat belts.	[10]

Text books:

1) Physics for Scientists and Engineers by Raymond A. Serway and John W. Jewett, 9th Edition , Cengage, 2017
2) Concepts of Modern Physics (SIE)by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury,McGraw – Hill, 2017.
3) Engineering Mechanics by A.K.Tayal, Umesh Publications.

Reference books:

1) Optics by Ajoy Ghatak, McGraw Hill, 2020.
2) Modern Physics by Kenneth S. Krane, Wiley, 2020.
3) Engineering Mechanics-Statics and Dynamics' by Irwing H. Shames, PHI.

Paper Code: AR117	L	P	Credit
Paper Title: Communication Skills	2		2

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per University norms

- ➢ There should be 9 questions in the end-term examination question paper.
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Understand foundational grammar and vocabulary for technical/professional contexts [K1, K2]
CO2: Apply writing principles for professional documents (e.g., emails, resumes, reports) [K3, K4]
CO3: Demonstrate verbal and non-verbal communication in workplace scenarios [K3,K6]
CO4: Critically analyze and interpret spoken/written material for effective communication[K4, K5]

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

Course Content	**No of Lectures**
Unit I: Language Basics and Functional Grammar ● Parts of Speech: Role and contextual use ● Sentence Structure: Types, transformation (simple, compound, complex) (Ruskin Bond – "The Eyes Have It") ● Subject-Verb Agreement: Logical agreement in complex subjects ● Tense and Voice: Focus on relevance in technical writing(Sudha Murty – "How I Taught My Grandmother to Read") ● Vocabulary Building: Root words, collocations, and context-based usage TED Talk: The Danger of a Single Story by Chimamanda Ngozi Adichie (https://www.youtube.com/watch?v=D9Ihs241zeg)	[6]
Unit II: Writing for the Workplace ● Professional Email Writing (format, tone, clarity) ● Resume Writing and Cover Letters (tailoring for technical profiles) ● Notice, Circular, Memo (Anuja Chauhan – "The Zoya Factor" (chapter on ad pitch))	[6]

• Short Report Writing (basic structure: intro, body, conclusion) • Summarizing and Paraphrasing (précis writing basics)	
Unit III: Speaking and Presentation Skills • Group Discussion Techniques (initiation, contribution, summarizing) • Mock Interviews (self-introduction, HR + tech blend questions) • Body Language, Voice Modulation and Presentation Basics (Poem – "An Elementary School Classroom in a Slum" by Stephen Spender) • Verbal vs. Non-Verbal Communication (eye contact, gestures, tone) • Barriers to Effective Communication and Remedies (TVF's *Panchayat* (Season 1, Episode 1)	[6]
Unit IV: Textual and Visual Comprehension + Practical Integration • Reading Comprehension: 2 passages from speeches/articles (e.g., Spielberg's speech at Harvard Commencement 2016 https://www.youtube.com/watch?v=Ty0toDunfu0) • Audio-Visual Analysis: Johan Rockstrom's TED Talk; key takeaways discussion *Let the Environment Guide our Development* http://www.ted.com/talks/johan_rockstrom_let_the_environment_guide_our_development) • Cultural Sensitivity and Inclusivity: Brief on UN gender-neutral language (United Nations https://www.un.org/en/gender-inclusive-language/index.shtml) • Final Integration: Practice mock interview and group discussion formats	[6]

Textbooks

1. Bond, Ruskin. *The Eyes Have It*. Penguin Books, 2000.
   (*Originally published in *The Night Train at Deoli and Other Stories*)
2. Chauhan, Anuja. *The Zoya Factor*. HarperCollins Publishers India, 2008.
3. Murty, Sudha. *How I Taught My Grandmother to Read and Other Stories*. Penguin Books India, 2004.
4. Spender, Stephen. "An Elementary School Classroom in a Slum." *Poetry of the Modern Age*, Oxford University Press, 1995.
5. Wren, P. C., and H. Martin. *High School English Grammar and Composition*. S. Chand & Company Ltd., 2020.
6. Raman, Meenakshi. *Technical Communication: Principles and Practice*. 3rd ed., Oxford University Press, 2015.

Readings

1. Eastwood, John. *Be Grammar Ready*, Oxford, 2020
2. Sanjay Kumar & Pushp Lata. *Communication Skills: A Workbook*, Oxford, 2018
3. Kavita Tyagi & Padma Mishra. *Basic Technical Communication*, PHI, 2012

Paper code : AR119	L	P	Credit
Paper Title : Environment Studies	2	0	2

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
The course is designed to impart basic knowledge of the environment and its components. **[K2, K3]**
The course deals with creating awareness about the environmental resources, their sustainable management, current environmental problems faced by the world and their probable solutions.**[K1, K2,K3,K4]**
A detailed understanding of the cause, effect and controlling measures of environmental pollution, waste management and related case studies. **[K2,K3,K4]**
To understand and explore different approaches, government initiatives for protecting the environment, conserving ecosystems, and maintaining sustainability for the benefit of society. **[K1, K2,K3]**

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

Course Content	**No of Lectures**
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, bio-geographical classification of India, value of biodiversity-consumptive uses, productive, social, ethical, aesthetic and option values, India as a mega diversity nation, hot spots of biodiversity, threats to	[6]

biodiversity– habitat loss, poaching of wild life, man wildlife conflicts and conservation of biodiversity-in-situ and ex-situ conservation.	
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 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. Sustainable management: Energy, water, air, infrastructure, mobility, greenhouse effects.	[6]
Environmental Pollution: (a) Air Pollution: Types of pollutants, source, effects, sink & control of primary pollutants CO, NO_X, HC, SO_x, and particulates (b) Water Pollution: Classification of Pollutants, their sources, wastewater treatment (domestic and industrial). (c) Soil Pollution: Composition of soil, classification, and effects of solid pollutants and their control. (d) Marine Pollution: Causes, effects, and control of marine pollution, coastal zone management. (e) Thermal pollution: Causes, effects, and control of marine pollution, coastal zone management. Waste Management: (a) Solid Waste Management: Classification, waste treatment and disposal methods; composting, sanitary land filling, thermal processes, recycling and reuse methods. (b) Hazardous wastes - Classification, radioactive, biomedical & chemical, treatment and disposal- Physical, chemical and biological processes.	[8]
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, The Chemical Weapons Convention, Environment Impact Assessment; population growth and variation among nations; Role of government and non-government organizations in public awareness and environment improvement. Disaster Management: Floods, earthquakes, cyclones, and landslides.	[6]

Text Books:

[T1] A textbook of environmental studies, R. Gadi, S. Rattan, S. Mohaptra, Kataria Publication, 2014.

[T2] Elements of environmental sciences & engineering, P. Meenakshi, PHI Learning Pvt Ltd, 2014.

[T3] Basics of Environment and Ecology, A. Kaushik & C.P. Kaushik, New Age International Publishers, 2010.

Reference Books:

[R1] Fundamental concepts in environmental studies, D.D. Mishra, S Chand & Co. Ltd., 2008.

[R2] Textbook of environmental studies, E. Barucha, UGC, 2005.

[R3] Environmental studies, B. Joseph, Tata McGraw-Hill Publishing Company Ltd., 2005.

Paper code : AR121	L	P	Credit
Paper Title : Human Value and Ethics	2	-	2

Marking Scheme:

1. Teachers Continuous Evaluation: 100 marks
2. This is an NUES paper, the examinations are to be conducted by the concerned teacher.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:

CO1: Understand the basics of instructions sets and their impact on processor design. [K2,K3]
CO2: Demonstrate an understanding of the design of the functional units of a digital computer system. [K2,K3,K4]
CO3: Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory. [K3,K4,K5]
CO4: Design a pipeline for consistent execution of instructions with minimum hazards. [K4,K5]

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

Course Content	**No of Lectures**
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 workplace, Spirituality	[6]
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	[6]

UNIT- III Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Safe exit, Risk-benefit analysis Safety 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.	[6]
UNIT- IV 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.	[6]
Text Books: A Textbook on Professional Ethics and Human Values, by R. S. Nangerakdn, New Age Publishers 2006	
Reference Books: 1. Engineering Ethics, by Charles E. Harris and Michael J. Rabins, Cengage Learning Pub., 2012. 2. Ethics in Engineering, Mike Martin and Roland Schinzinger, McGraw Hill Pub., 2017. 3. Unwritten Laws of Ethics and Change in Engineering, by The American Society of Mechanical Engineers, 2015. 4. Engineering Ethics by Charles B. Fleddermann, Pearson, 2014. 5. Introduction to Engineering Ethics by Mike W. Martin and Roland Schinzinger, McGraw-Hill, 2010. 6. Engineering Ethics: Concept and Cases by Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Cengage, 2009. 7. Ethics in Engineering Practice and Research by Caroline Whitbeck, Cambridge University Press, 2007.	

DETAILED SYLLABUS FOR 2nd SEMESTER

Paper code : AR102	L	P	Credit
Paper Title : Data Structures	3	-	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Understand the fundamentals of data structures, types of data, asymptotic analysis, and abstract data types. [K2]
CO2: Apply linear data structures such as arrays, linked lists, stacks, and queues in solving computational problems. [K3]
CO3: Analyze and implement non-linear data structures like trees and graphs, along with traversal, searching, and optimization algorithms. [K4]
CO4: Evaluate and implement efficient searching, sorting, and hashing techniques for data organization and retrieval. [K5}

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	0	0	0	0	0	0	0	0	0	2
CO2	3	3	2	0	2	0	0	0	0	1	0	2
CO3	3	3	3	2	2	0	0	0	1	0	0	2
CO4	3	3	2	2	3	0	0	0	1	1	0	3

Course Content	**No of Lectures**
Unit I: Introduction to Data Structures Overview of Data Structures, Data types – primitive and non-primitive, Basics of Algorithms Analysis, Performance Analysis and Measurement (Time and space analysis of algorithms-Average, best and worst case analysis), Asymptotic Notations, Types of Data Structures- Linear & Non Linear Data Structures, Concept of Abstract Data Types. Sorting – Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Merge Sort, Heap Sort Searching – Sequential (Linear) Search and Binary Search	[10]

Unit II: Linear Data Structures Array: Representation of arrays, Applications of arrays, sparse matrix, its representation and arithmetics, polynomials and polynomials arithmetics Linked List: Singly Linked List, Doubly Linked list, Circular linked list, Applications of linked list. Stack: Stack-Definitions & Concepts, Operations On Stacks, Linked List and Array implementation of Stack, Applications of Stacks, Prefix, Infix and Postfix Expressions, Recursion Queue: Representation Of Queue, Operations On Queue, Linked List and Array implementation of Queue, Circular Queue, Priority Queue, Double Ended Queue, Applications of Queue	[10]
Unit III: Trees Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Threaded binary tree, Binary search trees, Conversion of General Trees To Binary Trees, Applications Of Trees, Balanced trees: AVL trees, Red-Black Tree, 2-3 trees, Height Balanced Tree, Weight Balance Tree, B Tree, B+ Tree.	[10]
Unit IV: Introduction to Graphs and Hashing Disjoint Data Structures, Union-Find Algorithm, Graph-Representation Of Graphs, Graph Traversals: Breadth First Search and Depth First Search Minimum Spanning Tree Algorithms: Kruskal and Prims. Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques	[10]

Text Books:

[T1] Tremblay, J.-P., & Sorenson, P. G. (n.d.). *An Introduction to Data Structures with Applications*. Tata McGraw Hill.

[T2] Tenbaum. (n.d.). *Data Structures using C & C++*. Prentice-Hall International.

[T3] Horowitz, E., Sahni, S., & Rajasekaran, S. (2001). *Fundamentals of Computer Algorithms*. Galgotia Publications.

[T4] Sahni, S. (n.d.). *Fundamentals of Data Structures in C++*. Galgotia Publications.

[T5] Gilberg, R. F., & Forouzan, B. A. (n.d.). *Data Structures: A Pseudo-code Approach with C*. Thomson Learning.

[T6] Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). *Introduction to Algorithms* (4th ed.). MIT Press.

Reference Books:

[R1] Cormen, T. H., Leierson, C. E., Riest, R. L., & Stein, C. (2022). Introduction to algorithms. MIT press.

[R2] Weiss, M. A. (2014). *Data Structures and Algorithm Analysis in C++* (4th ed.). Pearson Education.

Paper code : AR104	L	P	Credit
Paper Title : Engineering Mathematics-II	3	0	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Ability of students to understand, apply and analyze the basic concepts of linear algebra and matrix theory **[K1,K2,K3,K4]**
CO2: Ability of students to solve system of linear equations, determine eigenvalue, eigen vectors and apply them to real world problems **[K1, K2, K3]**
CO3: Ability of students to solve ordinary differential equations to solve engineering problems **[K1,K2, K3]**
CO4: Ability of students to solve some important partial differential equations like wave, heat and laplace equation **[K1, K2, K3, K4]**

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

Course Content	**No of Lectures**
Linear Algebra I: Vector space, subspaces, linear dependence and independence of vectors, bases, and dimension, matrices, Rank and nullity of a matrix, rank -nullity theorem (without proof), Projection matrix, symmetric, skew-symmetric matrix, Orthogonal and unitary matrix, Idempotent matrix, Partition matrix	[10]
Linear Algebra II: Solution of systems of linear equations, Gaussian elimination, Eigenvalues and Eigenvectors with applications, Algebraic and geometric multiplicity, Determinant and its properties, Projections, LU decomposition, Singular value decomposition, Quadratic forms	[10]

Ordinary Differential Equations: First order linear and nonlinear differential equations: : Separable ODEs, exact ODEs and integrating factor, Bernoulli equations. Homogeneous linear ODEs of second (and higher) order with constant coefficients, Euler-Cauchy equations, Wronskian, Solution of non homogeneous linear ODEs: : method of undetermined coefficients, Method of variation of parameters	[10]
Partial Differential Equations: Basic concepts of PDEs, heat, wave, and Laplace equation and their solution by method of separating variables, D'Alembert's solution of wave equation.	[10]

Text books:

1. Erwin Kreyszig. (1999) Advanced Engineering Mathematics, John Wiley .
2. Insel, A., Spence, L.E., and Friedberg, S.H. 2015. Linear Algebra. Pearson

Reference books:

1. K.A. Stroud with Dexter J. Booth (2020) Engineering Mathematics. Macmillan.
2. Dennis G. Zill., (2018) Advanced Engineering Mathematics. Jones & Bartlett Learning.

Paper code: AR116	L	P	Credit
Paper Title: Basic Electrical Engineering	3	-	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Ability of students to understand the fundamental concepts of core electrical engineering especially direct current and circuit theory with network theorems [K1, K2, K3].
CO2: Ability of students to provide knowledge about single phase and three phase electrical circuits [K2, K3, K4].
CO3: Ability of students to understand the basics of magnetic circuits and electrical transformers [K1, K2].
CO4: Ability of students to basic understanding of electrical rotating DC and AC machines [K1, K2].

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

Course Content	**No of Lectures**
Unit I D.C. Circuits: Active and passive elements, Voltage and current sources, dependent and independent sources, Source conversion, Ohm's Law, Kirchhoff's Law, Superposition theorem, Thevenin's theorem, Norton theorem, Maximum Power Transfer Theorem and their application for analysis of series and parallel resistive circuits, Power & Energy in such circuits. Mesh & nodal analysis, Star-Delta transformation & circuits.	[10]
Unit II AC Circuits: 1- phase AC Circuits: Generation of sinusoidal AC voltage, definition of average value, R.M.S. value, form factor and peak factor of AC quantity, Concept of Phasor, Concept of Power factor,	[10]

Concept of impedance and admittance, Active, reactive and apparent power, analysis of R-L, R-C, R-L-C series & parallel circuit. 3-phase AC Circuits: Necessity and advantages of three phase systems, Relationship between line and phase values for balanced star and delta connections, Power in balanced & unbalanced three-phase system.	
Unit III Magnetic Circuits: Basic definitions, magnetization characteristics of Ferromagnetic materials, self-inductance and mutual inductance, energy in linear magnetic systems, coils connected in series, AC excitation in magnetic circuits, magnetic field produced by current carrying conductor, Force on a current carrying conductor. Induced voltage, laws of electromagnetic Induction, direction of induced E.M.F. Single phase transformer: General construction, working principle, e.m.f. equation, equivalent circuits, phasor diagram, voltage regulation, losses and efficiency, open circuit and short circuit test.	[9]
Unit IV Electrical Machines: Construction, Classification & Working Principle of DC machine and 1-Phase induction machine. Working principle of 3-Phase induction motor, Concept of slip in 3- Phase induction motor, Torque-slip characteristics of 3-Phase induction motor. Types of losses occurring in electrical machines. Applications of DC machine and induction machine.	[9]
Text Books: [T1] D.P. Kothari & I.J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, latest edition. [T2] S.N. Singh, Basic Electrical Engineering, P.H.I.,2013. [T3] C.L. Wadhwa, Basic Electrical Engineering, New Age International. [T4] B.L. Theraja & A.K Theraja Textbook of Electrical Technology - Vol. 1, S. Chand Publication.	
Reference Books: [R1] R. Muthusubramanian, S Salivahanan, "Basic Electrical and Electronics Engineering", 2nd Edition (2025). [R2] S. B. Lal Seksena and Kaustuv Dasgupta, "Fundamentals of Electrical Engineering, Cambridge University Press (2016).	

Paper code : AR118	L	P	Credit
Paper Title : Applied Engineering Materials	3	0	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Ability of students to understand the basic concepts of engineering materials, their structure and properties. [K2, K3]
CO2: Ability of students to understand and analyze the materials to be applied in robotic systems. [K2,K3,K4]
CO3: Ability of students to understand and analyze the electronic and sensor materials. [K2,K3,K4]
CO4: Ability of students to understand about the characterization techniques and their implications to analyze the materials to be applied in different fields. [K2,K3,K4,K5]

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

Course Content	**No of Lectures**
Unit 1: Introduction to Engineering Materials Types of Materials: Metals, ceramics, polymers, and composites and their structure, properties, and typical applications. Bonding and Structure: Metallic, covalent, ionic, and van der Waals bonds; implications for material behaviour. Crystallography: Study unit cell configurations, crystal lattices, grain boundaries, and common defects like vacancies and dislocations. Mechanical Behaviour: Detailed analysis of stress-strain curves, modulus of elasticity, yield and tensile strength, ductility, toughness, and fatigue, Nanomaterials: Properties at the nanoscale, top-down vs. bottom-up fabrication.	[10]

Unit 2: Materials for Robotic Systems Material selection criteria for robotic systems; Properties and applications of aluminum, steel, titanium, corrosion resistance and surface treatments; Polymers and Elastomers: Thermoplastics vs. Thermosets; Use of ABS(Acrylonitrile Butadiene Styrene), PLA (Polylactic Acid), nylon, and polycarbonate in robotic components. Composites Materials: Carbon fiber and glass fiber composites, Smart materials: Shape Memory Alloys (e.g., Nitinol), Piezoelectric materials; Lightweight structures and high-strength application.	[10]
Unit 3: Electronic and Sensor Materials Conductors, semiconductors, and insulators; Silicon, GaAs, and emerging 2D materials (e.g., graphene, carbon nitride, MoS_2, WS_2); Printed electronics and flexible substrates; Types of sensors: thermal, optical, magnetic, chemical, mechanical; Sensor Materials: Piezoelectric, thermoelectric, optoelectronic and photoresists materials; thin film deposition techniques; Material selection for environmental and biomedical sensors.	[10]
Unit 4: Characterization of Materials Microscopy Techniques: Principles, magnification, resolution limits of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM). Spectroscopy Techniques: X-ray Diffraction (XRD); Energy Dispersive X-ray Spectroscopy (EDS/EDX): Elemental composition in conjunction with SEM; Infrared Spectroscopy (IR) and UV-Visible Spectroscopy. Thermal Analysis: Differential Scanning Calorimetry (DSC), Thermogravimetric Analysis (TGA): Weight changes with temperature, thermal stability. Mechanical and surface characterization: Hardness, tensile and impact testing, surface roughness and wettability.	[10]

Text Books:

1. James F. Shackelford, Introduction to Material Science for Engineers, 9th Edition, 2023, Pearson Education.
2. William D. Callister, and David G. Rethwisch, Materials Science and Engineering an Introduction, 10th Edition, 2018, Wiley.
3. Kenneth G. Budinski, and Michael K. Budinski, Engineering Materials: Properties and Selection, 9th edition, 2016, Pearson Education.
4. William Smith and Javad Hashemi, Foundations of Materials Science and Engineering, 7th Edition, 2023, McGraw – Hill

Reference Books:

1. Michael F. Ashby and David R.H. Jones, Engineering Materials 1: An Introduction to Properties and Design, 4th Edition, 2012, Elsevier.
2. H. Kaur, Instrumental Methods of Chemical Analysis, 13th Edition, 2020, Pragati Prakashan.
3. Upendra Kumar and Piyush Kumar Sonkar, Smart Materials for Science and Engineering, 2024, Wiley.

Paper code : AR120	L	P	Credit
Paper Title : Manufacturing Process	3	-	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
Explain fundamental manufacturing processes, their classifications and primary shaping process. **[K2, K3]**
Understand and implementation of joining and manufacturing techniques. **[K2,K3,K4]**
Understand and implementation of forming and sheet metal techniques. **[K2,K3]**
Fundamentals of plastic manufacturing and additive manufacturing. **[K1, K2]**

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

Course Content	**No of Lectures**
Unit I **Fundamentals of Manufacturing and Casting Processes** Introduction to Manufacturing: Technological & Socio-Economic Importance, Classification of Manufacturing Processes, Properties of Engineering Materials, Materials used in manufacturing: metals, polymers, ceramics, composites. Metal Casting Processes: Sand Casting, Patterns and Pattern Allowances, Moulding Materials, Core Making, Gating Systems, and Cupola Operation, Special Casting Methods: Shell Casting, Pressure Die Casting, Centrifugal Casting, Casting Defects.	[10]

Unit II **Machining:** Introduction to Lathe Machine, Shaper, Planer, Milling, Drilling and Grinding **Joining and Welding Processes with Smart Integration** Principles and Classification of Welding Processes, Fusion Welding, Gas and Arc Welding, Submerged Arc, TIG, MIG, Electro Slag Welding, Welding Equipment, Filler & Flux Materials, Resistance Welding, Welding Defects.	[10]
Unit III **Metal Forming and Deformation Processing** Hot Working vs Cold Working, Forging Processes: Open & Closed Die, Rolling, Drawing (Rod, Wire, Tube), Metal Spinning, Extrusion: Hot and Cold Types. Sheet Metal Forming: Shearing, Bending, Stretching, Deep Drawing.	[10]
Unit IV **Emerging Processes: Powder Metallurgy, Plastics, and Additive Manufacturing** Powder Metallurgy: Production, Blending, Compaction, Sintering, Plastic Manufacturing: Thermoplastics and Thermosets, Injection, Blow, Compression, Transfer, Rotational Molding, Extrusion, Thermoforming. Introduction to additive manufacturing: Introduction to AM, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM.	[10]

Text Books:

[T1] A Course in Workshop Technology: Manufacturing Processes - Vol. 1 Dhanpat Rai & Co. 2016.

[T2] Elements of Workshop Technology, Vol. 1 and 2, by S K. Hajra Choudhury & Nirjhar Roy, Media Promoters Pvt. Ltd., 16th Edition, 2023.

[T3] Manufacturing Techniques 1 & 2 by P N Rao, 5e, Mc-Graw Hill Education, 2018.

Reference Books:

[R1] Production Technology, by R. K. Jain and S. C. Gupta, Khanna Publishers, 34th Edition, 2024.

[R2] Manufacturing Processes for Engineering Materials, by Serope Kalpakjian and Steven R. Schmid, Pearson Education, 5th Edition, 2014.

[R3] Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, by Mikell P. Groover, John Wiley and Sons, 4th Edition, 2010.

Paper code: AR122	L	P	Credit
Paper Title: Computer Architecture and Organisation	3	-	3

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

- ➢ There should be 9 questions in the end term examination question paper
- ➢ Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
- ➢ Apart from Question No. 1, the rest of the paper shall consist of four units As per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
- ➢ The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- ➢ The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:
CO1: Understand the basics of instructions sets and their impact on processor design. [K2,K3]
CO2: Demonstrate an understanding of the design of the functional units of a digital computer system.[K2,K3,K4]
CO3: Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory. [K3,K4,K5]
CO4: Design a pipeline for consistent execution of instructions with minimum hazards. [K4,K5]

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

Course Content	**No of Lectures**
UNIT I Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU - registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study - instruction sets of some common CPUs.	[9]

UNIT II Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, Booth multiplier, carry save multiplier, etc. Division - non-restoring and restoring techniques, floating point arithmetic. CPU control unit design: hardwired and micro-programmed design approaches, Case study - design of a simple hypothetical CPU.	[10]
UNIT- III Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O transfers -program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes - role of interrupts in process state transitions.	[10]
UNIT- IV Performance enhancement techniques: Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs block size, mapping functions, replacement algorithms, write policy.	[9]

Text Books:

[T1] M. Morris, Mano, ―Computer System Architecture‖, PHI 3rd Edition 2007.
[T2] Carl Hamacher, ―Computer Organization‖, McGraw Hill, 5th Edition 2002.
[T3] Computer Architecture and Organization – Designing for Performance, William Stallings, Ninth edition, Pearson Education series, 2014.

Reference Books:

[R1] W. Stallings, ―Computer organization and Architecture‖, PHI, 7th ed, 2005.
[R2] R. Gaonker, ―MicroProcessor Architecture, Programming and Application with the 8085, 5th Edition
[R3] J. D. Carpinelli, ―Computer Systems Organization and Architecture‖, Pearson Education, 2006.
[R4] J. P. Hayes, ―Computer Architecture and Organization‖, McGraw Hill, 1988.
[R5] J. L Hennessy and D. A. Patterson, ―Computer Architecture: A quantitative approach‖, Morgon Kauffman, 1992.

Paper code : AR160	L	P	Credit
Paper Title : Programming in Python Lab	0	2	1

Marking Scheme:
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : As per University norms

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 Outcomes [Bloom's Knowledge Level (KL)]:
CO1: The students will learn Programming in the Python Language. [K2]
CO2: The students will learn the usage of language implemented data structures. [K3]
CO3: The students shall learn the object-oriented features of the Python Language. [K4]
CO4: The students will learn the usage of the NumPy. [K5]

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	2	0	0	0	0	0	0	0	0	0	2
CO2	3	3	2	0	1	0	0	0	0	1	0	2
CO3	3	3	2	2	2	0	0	0	1	0	0	3
CO4	3	3	2	2	3	0	0	0	1	1	0	3

Course Content	**No of Lectures**
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 argument.	[6]
Unit II: String management & usage, Lists, Dictionaries, Tuples & Sets. The operations on these data structures. Filter, Map, and Reduce Function.	[6]
Unit III: Object Oriented Programming: Properties/attributes, methods, inheritance, class variables & functions, static methods, delegation, abstract base classes, and Generic functions.	[6]
Unit IV: Numpy: Dtypes, Multidimensional Arrays, Slicing, Numpy Array & Memory, Array element-wise operations, Numpy Data I/O, floating point numbers.	[6]

Pandas: Using series and Dataframes, Indexing & Reindexing, Deleting and merging items, Common operations, Memory usage and dtypes, Pipes, Displaying dataframes.	

Text Books:

[T1] Introduction to Python Programming, Gowrishankar S. and Veena A., CRC Press, 2019.
[T2] Python Programming for Data Analysis, Jose Unpingco, Springer Nature, 2021.

Reference Books:

[R1] Python: An Introduction to Programming, James R. Parker, 2nd Ed., Mercury Learning And Information.
[R2] Python Programming: A Practical Approach, Vijay Kumar Sharma, Vimal Kumar, Swati Pathak, and Shashwat Pathak; CRC Press, 2021.