

Computer Science and Engineering (Data Science)

Preamble: The curriculum of B. Tech. Computer Science and Engineering (Data Science) program offered by the Department of Computer Science and Engineering under Academic Regulation 2023 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE) aligned with National Education Policy 2020. Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit System (CBCS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like Computer Society of India (CSI) as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system is completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes facilitating the learners to achieve their Professional and Career Accomplishments.

The Vision

To become the Centre of Excellence for technically competent and innovative computer engineers

The Mission

- To provide quality education and spread professional & technical knowledge, leading to a career as computer professionals in different domains of industry, governance and academia
- To provide state-of-art environment for learning and practice
- To impart hands on training in latest methodologies and technologies as per industry requirements.

Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Computer Science and Engineering (Data Science) of NSRIT will


1. Continue to demonstrate the application of the knowledge of data science to solve real-time engineering challenges in the tech landscape that use programming abilities, statistical analysis of data, build and assess data-based models, statistical analysis and data management in addition to the application of fundamental and conceptual knowledge of computer science and engineering
2. Sustain their satisfactory professional career in their own start-ups or as a team member/team lead in an IT or allied industry
3. Engage in self-directed learning and advanced studies based on the demand driven need of the industries and their interest for their professional and career accomplishments

Program Specific Outcomes (PSOs)

1. Design and develop intelligent systems by applying analytical and programming skills to solve real world and engineering problems
2. Ability to apply the knowledge of computing tools and techniques in the field of Data Science for solving real world problems encountered in the Software Industries maintaining the professional standards and ethics.

Category-wise Credit Distribution of Courses

Category		AICTE	JNTU - GV	NSRIT(A)
HS	Humanities and Social Sciences	08 - 9%	08%	3.125%
BS	Basic Sciences	12 - 16%	13%	15.6%
ES	Engineering Sciences	10 - 18%	14%	10.3%
PC	Professional Core	30 - 36%	34%	38.4%
PE	Professional Elective	19 - 23%	21%	15.6%
MI	Inter- / Trans - Disciplinary Electives			
IN	Internship(s), Project & Seminars	8 - 11%	10%	10.3%
SC	Skill Oriented Courses	-	-	7.5%
MC	Mandatory Courses	-	-	-
AC	Audit Courses	-	-	-


 Head of the Department
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 Sontyam, Visakhapatnam - 5311

**Curriculum with Multiple Entry & Multiple Exit (ME-ME) adhering to NEP 2020
(Academic Regulation 2023 – 2024)**

Department of Computer Science Engineering (Data Science)

	Credit requirement	Exit credit requirement	Total credit	Level as per NCRF
Undergraduate Certificate (After the one year of study)	40	10	50	L5
Diploma (After two year of study)	80	10	90	L6
Advanced Diploma (After two year of study) - Lateral Entrants	40	10	50	L6
B.Sc. in Engineering (After three years of study)	120	-	120	L7
B. Tech. (Regular) (Four years of study)	160	-	160	L8
B. Tech. (Minor)	12 (inclusive of 160)	-	160	L8
B. Tech. (Honors)	175	15 (160+15)	175	L8

Semester I								Category
No.	Code	Course Title	POs / PSOs	L/D ¹	T ²	P	Credit	
1	23BSX31	Engineering Physics	1, 2, 7	3	0	0	3.0	HS
2	23BSX11	Linear Algebra & Calculus	1, 2	3	0	0	3.0	BS
3	23ESX03	Basics of Civil & Mechanical Engineering	1	3	0	0	3.0	ES
4	23ESX02	Introduction to Programming	1, 2, 3	3	0	0	3.0	ES
5	23BSX32	Engineering Physics Lab	1, 4	0	0	2	1.0	BS
6	23ESX06	Engineering Workshop	1	0	0	3	1.5	ES
7	23ESX05	Computer Programming Lab	1, 2, 3, 4, 5	0	0	3	1.5	ES
8	23ESX07	Engineering Graphics	1, 10	2	0	2	3.0	ES
9	23SOC01	IT Workshop	1, 2, 3, 4, 5	0	0	2	1.0	SOC
10	23WLP01	Health, Wellness, Yoga & Sports	2, 7, 12	-	-	1	0.5	Wellness
Sub-total							20.5	
Semester II								Category
No.	Code	Course Title	POs / PSOs	L/D ¹	T ²	P	Credit	
1	23HSX01	Communicative English	5, 8, 10	2	0	2	2.0	HS
2	23BSX21	Chemistry	1, 2, 7	3	0	0	3.0	BS
3	23BSX12	Differential Equations and Vector Calculus	1, 2, 5	3	0	0	3.0	BS
4	23CS201	Data Structures	1, 2, 3, PSO # 1, 2	3	0	0	3.0	PC
5	23ESX01	Basics of Electrical and Electronics Engg.	1, 2, 3	3	0	0	3.0	ES
6	23BSX22	Chemistry Lab	1, 4	0	0	2	1.0	BS
7	23HSX02	Communicative English Lab	9, 10	0	0	2	1.0	HS
8	23ESX04	Electrical and Electronics Engineering Workshop	1, 2, 4	0	0	3	1.5	ES
9	23CS202	Data Structures Lab	1, 2, 3, 4, 5, PSO # 1, 2	0	0	3	1.5	PC
10	23CSP01	NSS/ NCC/Scouts & Guides/Community Service	7, 8, 12	-	-	1	0.5	CSP
Sub-total							19.5	
Exit mandate at the level of I year for the award of Undergraduate Certificate ³								
1		Certification #1		Min. 60 hours			2.0	SOC
2		Certification #2		Min. 60 hours			2.0	SOC
3		Job Specific Internship / OJT / Apprenticeship		Min. 60 Days			6.0	OJT

¹ In case of digital learning other than face-to-face learning, double the number of learning hours is mandate for the equivalent credit as per NCRF

² Suggested tutorials do not carry credits

³ Students exiting at the level of first year of study must complete two skill-oriented courses and Job specific Internship/ OJT/ Apprenticeship that tunes to a total of 10 credits

Certification #1 & 2							
1	23SOC07	Plumbing	-	0	0	2	2.0 SOC
2	23SOC08	Refrigeration and Air Conditioning	-	0	0	2	2.0 SOC
3	23SOC09	Mobile Troubleshooting	-	0	0	2	2.0 SOC
4	23SOC10	Computer Servicing	-	0	0	2	2.0 SOC
5	23SOC11	Digital Marketing	-	0	0	2	2.0 SOC
6	23SOC12	Machining	-	0	0	2	2.0 SOC
7	23SOC13	Electrical Wiring	-	0	0	2	2.0 SOC
8	23SOC14	Masonry	-	0	0	2	2.0 SOC
9	23SOC15	Automobile Servicing and Maintenance	-	0	0	2	2.0 SOC

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BS 23BSX31 Engineering Physics**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO7	
23BSX31.1	Choose the experimental evidence of wave nature of light to understand interference in thin films, diffraction and polarization	3	2	1	L1 - L3
23BSX31.2	Apply the laws of physics, classify various types of lasers & optical fibers	3	2	1	L1 - L3
23BSX31.3	Interpret the concepts and applications of magnetic and dielectric materials	3	2	1	L1 - L3
23BSX31.4	Identify and summarize the crystal structures and XRD techniques	3	2	1	L1 - L3
23BSX31.5	Interpret the microscopic behaviour of matter with quantum mechanics, summarise various types of solids based on band theory and identify the type of semiconductor using Hall effect	3	2	1	L1 - L3

All the COs are mapped to PO12 as few self-learning topics are inbuilt in syllabus promoting autonomous learning

Unit I: Wave Optics**9 Hours**

Interference: Introduction, Interference in thin films by reflection-Newton's rings (Theory, Experimental study), applications (wavelength of a source and refractive index of a liquid). Diffraction: Concept of diffraction difference between Fresnel's and Fraunhofer diffraction-Fraunhofer diffraction at single slit (quantitative), diffraction at double slit Diffraction grating, Raleigh's criteria, Resolving Power of grating. Polarization: Types of polarization, polarization by reflection, refraction and Double refraction – Nicol's prism construction and working Wave plates: half wave plate and quarter wave plate

COs: CO1*Self – Learning Topic: Young's double slit experiment***9 Hours****Unit II: Lasers and Fiber Optics**

Laser: Concept of laser, Characteristics of laser, Spontaneous and Stimulated emission of radiation, Einstein's Coefficients, pumping mechanisms, Ruby laser, Helium Neon Laser-Applications of Laser (Communications, R&D, Medicinal, etc.)

Fiber Optics: Introduction to Optical fiber, Principle and structure of optical fiber, classification of optical fibers (based on modes and refractive index profile). Acceptance angle, Acceptance cone Numerical Aperture-Applications of optical fiber. (Communications, Medicinal etc.)

COs: CO2*Self – Learning Topic: Concepts of 3 level and 4 level LASER systems***9 Hours****Unit III: Magnetic Materials and Dielectric Materials**

Introduction, magnetic dipole moment, Magnetic Susceptibility-Magnetic permeability-Classification of Magnetic materials-Dia, Para, Ferro, Weiss Domain theory(qualitative) Hysteresis curve, Soft and Hard magnetic materials-Applications. Dielectric Materials: Dielectric Polarization-Dielectric Polarizability, Susceptibility and Dielectric constant-types of polarizations: Electronic, Ionic and Orientational polarizations (qualitative), Lorentz internal field (qualitative), Clausius-Mossotti Equation-Applications of dielectrics

COs: CO3*Self – Learning Topic: Relation between D, E and P & Dielectric losses*

Unit IV: Crystallography and X-Ray Diffraction**9 Hours**

Crystallography: Introduction, Space lattice, Basis, Unit cell, Bravais lattices–Crystal systems–structures and packing fractions of SC, BCC and FCC X-Ray Diffraction: Directions and planes in crystals–Miller indices–Separation between successive (h k l) planes–Bragg's law. Bragg's spectrometer, X-ray diffraction methods (powder and Laue)

COs: CO4*Self – Learning Topic: Concept of Brillouin zones***Unit V: Quantum Mechanics and Semiconductor Physics****9 Hours**

Quantum Mechanics: Introduction De-Broglie's concept of Matter waves–Physical significance of wave function–Schrodinger Time Independent and time dependent wave equations–Particle in a one-dimensional potential box Semiconductor physics: Origin of energy band formation in solids, classification of materials into conductors, semiconductors and insulators using band diagram, Intrinsic and Extrinsic semiconductors. Hall Effect, Hall coefficient and applications of Hall Effect

COs: CO5*Self – Learning Topic: Density of states - Fermi energy*

Board of Studies

Basic Science & Humanities (Physics)

Approved in: BoS No. II

October 06, 2023

Approved in ACM: ACM No. VIII

October 21, 2023

Expert talk (To be delivered by SMEs from industries)**COs****POs**

- 1 LASER as a source in optical fiber communications
- 2 Merits and demerits of X-ray diffraction

CO2
CO4PO1, PO2, PO7
PO1, PO2, PO7**Text Books**

1. Avadhanulu M. N. & K Shirasagar P.G., "A Text Book of Engineering Physics", 1st Edition S. Chand Publications, 2011
2. Palanisamy P. K., "Engineering Physics", 4th Edition, SciTech Publishers, 2014
3. Pillai S.O., "Applied Physics", 2nd Edition, New Age international Publishers, 2008

Reference Books

1. Charles Kittel, "Introduction to solid state physics", 5th Edition, Wiley India Pvt. Ltd., 2012
2. Arumugam M., "Applied Physics", 4th Edition, Anuradha Agencies, 2013
3. Bhattacharya D. K., "Engineering Physics", 2nd Edition, Oxford University Press, 2010
4. Sanjay D Jain and Girish G Sahasrabudhe "Engineering Physics", 1st Edition, University Press, 2010
5. Pandey B. K. & Chaturvedi S., "Engineering Physics", 1st Edition, Cengage Learning, 2012
6. Srinivasan M. R., "Engineering Physics", 2nd Edition, New Age international Publishers, 2014

Web References

1. <http://link.springer.com/physics>
2. <http://www.thphys.physics.ox.ac.uk>
3. <http://www.sciencedirect.com/science>
4. <http://www.e-booksdirectory.com>
5. <https://nptel.ac.in>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Define interference
2. Define types of polarization
3. State Dielectric polarization and electric susceptibility
4. Define types of polarization in dielectrics
5. Define Spontaneous emission of radiation

L2: Understand

1. Explain the construction and working principle of Nicol's prism
2. Demonstrate working principle of He-Ne laser with energy level diagram
3. Outline de Broglie concept of matter waves
4. Discuss polarization by reflection
5. Explain the Raleigh's criteria

L3: Apply

1. Suggest a dielectric material with high dielectric constant, high operating voltage range and also which can be eco friendly for the preparation of a capacitor. Justify your answer
2. Suggest a soft magnetic material with low retentivity and coercivity, and also which can be eco friendly for the preparation of an electromagnet. Justify your answer
3. Even though based on quantum mechanical principles quantum free theory is a partly successful theory. Justify the statement


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Board of Studies (BS & H)

BS 23BSX11 Linear Algebra and Calculus

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO2	
23BSX11.1	Solve homogenous & non- homogenous linear system of equations	3	2	L1 – L4
23BSX11.2	Use Cayley- Hamilton theorem to find inverse & powers of a matrix and identify the nature of the quadratic forms using eigen values and eigen vectors	3	2	L1 – L4
23BSX11.3	Solve a given inequality using mean value theorems	3	2	L1 – L4
23BSX11.4	Make use of functions of several variables which is useful in optimization	3	2	L1 – L4
23BSX11.5	Analyze double and triple integrals using Beta and Gamma functions	3	3	L1 – L4

All the COs are mapped to PO12 as few self-learning topics are inbuilt in syllabus promoting autonomous learning

Unit I: Solving Homogeneous and Non-Homogeneous Systems of linear equations

9 Hours

Rank of a matrix by echelon form, normal form. Inverse of Non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method

COs: CO1

*Self – Learning Topic: Rank by using minors***Unit II: Eigen Values and Eigen Vectors, Cayley - Hamilton theorem and Quadratic forms**

9 Hours

Eigen values, Eigen vectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

COs: CO2

*Self – Learning Topic: Applications of Eigen Values and Eigen Vectors***Unit III: Calculus (Mean value theorems)**

9 Hours

Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems on the above theorems.

COs: CO3

*Self – Learning Topic: Applications on the above theorems***Unit IV: Partial Differentiation and applications (Multi Variable Calculus)**

9 Hours

Partial Derivatives, Total derivatives, Chain Rule, Change of variables, Taylor's and Maclaurin's series expansion of functions of two variables, Jacobians, maxima and minima of functions of two variables, method of lagrange multipliers.

COs: CO4

*Self – Learning Topic: Jacobian of Implicit functions***Unit V: Beta and Gamma Functions & Multiple Integrals**

9 Hours

Gamma, Beta Functions and their Properties - Relation between Beta and Gamma Functions - Evaluation of Improper Integrals. Evaluation of Double triple Integrals - Direct Method

COs: CO5

Self – Learning Topic: Dirichlet's Integrals

Board of Studies

Approved in: BoS No. VI

Approved in: ACM No. VIII

Expert talk (To be delivered by SMEs from industries)

1 Introduction to MATLAB

Applications of Singular Value Decomposition

Basic Science & Humanities (Mathematics)

October 06, 2023

October 21, 2023

COs

CO1-CO5

CO2

POs

PO2 -

PO2

Text Books

1. Grewal, B. S. "Higher Engineering Mathematics", 44th Edition, 12th reprint, Khanna Publishers, 2022
2. Ramana, B. V. "Higher Engineering Mathematics", 1st Edition, 35th Reprint, Tata McGraw Hill Education, 2019

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2021
2. Bali, N. P. "Engineering Mathematics", 1st Edition, Lakshmi Publications, 2017
3. Peter O' Neil, "Advanced Engineering Mathematics", 1st Edition, Cengage, 2010
4. Iyengar, T. K. V. Prasad, M. V. S. S. N., Ranganatham S. & B. Krishna Gandhi, "Engineering Mathematics – II", 3rd Edition, S. Chand Publications, 2020

Web References

1. <http://nptel.ac.in/courses/>
2. <https://onlinecourses.nptel.ac.in>
3. <https://www.classcentral.com/course/swayam-basic-linear-algebra-13003>
4. <https://ocw.mit.edu/courses>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	15	15
L2	55	55
L3	20	20
L4	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. State Cayley-Hamilton theorem
2. State Euler's theorem
3. Define the rank of a matrix
4. What is an orthogonal transformation?
5. What is the necessary condition for a non-homogenous system $AX=B$ to be consistent
6. What is the index of a quadratic form?
7. State Rolle's Theorem

L2: Understand

1. Check whether $x = r \cos \theta$ and $y = r \sin \theta$ are functionally dependent.
2. Check the consistency of the system $x + y + z = 4$, $2x + 3y - 2z = 3$, $x + 7y - 7z = 5$
3. Find whether the homogenous system $x + y - 3z + 2w = 0$, $2x - y + 2z - 3w = 0$, $3x - 2y + z - 4w = 0$, $-4x + y - 3z + w = 0$ possess a non-trivial solution

- If $u = x^2 + y^2 + z^2$, $v = xy + yz + zx$, $w = x + y + z$, show that u, v, w are functionally dependent and find the relationship between them
- Verify Rolle's theorem for $f(x) = (x+2)^3(x-3)^4$ in $[-2, 3]$

L3: Apply

- Find non-singular matrices P and Q such that PAQ is in the normal form for $A = \begin{bmatrix} 2 & 3 & -1 \\ 0 & 1 & 2 \\ 3 & -4 & -2 \end{bmatrix}$
- Reduce the matrix A to echelon form where $A = \begin{bmatrix} 1 & 2 & 4 & -3 \\ -2 & 7 & 5 & 2 \\ 4 & 13 & 0 & -4 \\ 6 & 5 & -3 & 3 \end{bmatrix}$
- Find the shortest distance from origin to the surface $xyz^2 = 2$
- Find the points on the surface $z^2 = xy + 1$ that are nearest to the origin

L4: Analyze

- Consider the matrix $A = \begin{bmatrix} 2 & 0 & 0 \\ -1 & 3 & 2 \\ 1 & -1 & 0 \end{bmatrix}$. If the characteristic polynomial of T is
 - $C_T(\lambda) = (\lambda - 1)^p(\lambda - 1)^q$ then $P = \underline{\hspace{1cm}}$ $q = \underline{\hspace{1cm}}$
- Find the minimal polynomial? what can be concluded from minimal polynomial?
- Find a matrix S (if one exists) that diagonalizes $[T]$. What is the diagonal form of A of $[T]$ produced
 - by the matrix, Answer: $S = \begin{bmatrix} a & b & a \\ b & b & -c \\ -b & a & b \end{bmatrix}$ then $a = \underline{\hspace{1cm}}$ $b = \underline{\hspace{1cm}}$ $c = \underline{\hspace{1cm}}$
- The matrices $A = \begin{bmatrix} a & 1 \\ -2 & d \end{bmatrix}$ and $B = \frac{1}{25} \begin{bmatrix} a & 1 \\ -2 & d \end{bmatrix}$ have same Eigen values then find the values
 - of a and d
5. Consider the matrix $A = \begin{bmatrix} a & 1 & 1 \\ 1 & a & 1 \\ 1 & 1 & a \end{bmatrix}$ for what ranges of values of a the matrix is positive definite?
- Compare Rolles theorem with LMVT and identify which is the the generalized onest
- Test whether the pair of functions $\frac{x+y}{1-xy}$ and $\tan^{-1}x + \tan^{-1}y$ are functionally dependent and if so find the relation between them?


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 Chairman
Board of Studies (BS & H)

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ES 23ESX03 Basics of Civil and Mechanical Engineering**3 0 0 3**

At the end of the course, student will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PSO1	
23ESX03.1	Comprehend the evolution of civil engineering, scope, functions and various building elements and materials	3	2	L1, L2
23ESX03.2	Demonstrate the principles of surveying	3	2	L1, L2
23ESX03.3	Calculate the required quantity of water and the purification process involved, solid waste management along with the sewage systems	3	2	L1, L2
23ESX03.4	Outline the role of mechanical engineering in the society and study of various metals and materials	3	2	L1, L2
23ESX03.5	Demonstrate the different manufacturing process, working principles of thermal systems	3	2	L1, L2
23ESX03.6	Illustrate the working principles of various power plants, Power transmission systems and fundamentals of robotics	3	2	L1, L2

All the COs are mapped to PO12 as few self-learning topics are inbuilt in syllabus promoting autonomous learning

Unit I: Introduction to Civil Engineering**9 Hours**

History and development of civil engineering – scope for the civil engineering – Functions of civil engineering. Characteristics of good building materials like stone, brick, tile, timber, cement aggregate and concrete. General concepts relating to Buildings: Selection of site – Basic functions of buildings – Major components of buildings. Foundations - Purpose of a foundation – Bearing capacity of soils – types of foundations and their uses.

COs: CO1*Self - Learning Topic: Representation of the building plan***Unit II: Surveying****9 Hours**

Surveying: Definition and purpose – classification – Basic principles – Measurement of length by chains and tapes – Calculation of area of a plot – Introduction to Bearings, basic problems of Bearing - Levelling instruments used for levelling, calculation of the instrument height. Types of Highways, Types of pavements, Cross-section of the pavements, Camber

COs: CO2*Self - Learning Topics: Rise & fall method, Materials used for the various pavements***Unit III: Water supply & Sanitary Engineering****9 Hours**

Sources of water supply – Quantity of water requirements – Purification of water involving sedimentation, filtration and disinfection. Definition of terms – Collection and disposal of solid wastes – Sewage systems – Septic tanks – Oxidation ponds.

COs: CO3*Self - Learning Topics: Methods of water distribution, types of filters***Unit IV: Introduction to Mechanical Engineering****9 Hours**

Role of mechanical engineering in industries and society - Technologies in different sectors such as energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Engineering Materials – Metals - Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

COs: CO4*Self - Learning Topic: Nanomaterials***Unit V: Manufacturing Processes & Thermal Engineering****9 Hours**

Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – Working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning

COs: CO5

cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

Self - Learning Topic: Surface finishing

Unit VI: Power plants, mechanical power transmission and Robotics

9 Hours

Power plants – Working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics – Joints & links, configurations, and applications of robotics.

COs: CO6

Self - Learning Topic: Kinematics of robotics

Board of Studies

Approved in: BoS No. VI

Approved in: ACM No. VIII

Expert talk (To be delivered by SMEs from industries)

1 Importance of the safe bearing capacity of soils

2 Real time applications of mechanical systems

Civil Engineering & Mechanical Engineering

October 06, 2023

October 21, 2023

COs

POs

CO1

PO1

CO4 - CO6

PO1

Text Books

1. Shanmugam G. and Palanisamy M. S., "Basic Civil and the Mechanical Engineering", 4th Edition, Tata McGraw Hill Publications (India) Pvt. Ltd., 2013
2. Bhavikatti S. S., "Basic Civil Engineering", 3rd Edition, New Age International Publishers, 2022
3. Ganesan V., "Internal Combustion Engines", Tata McGraw Hill Publications (India) Pvt. Ltd., 2017
4. Rattan S. S., "A Text book of Theory of Machines", Tata McGraw Hill Publications, (India) Pvt. Ltd., 2012

Reference Books

1. Punmai B. C., "Surveying Volume-1", 16th Edition, Laxmi Publications Pvt Ltd, 2006
2. Duggal S. N., "Environmental Engineering-1", 8th Edition, Tata McGraw Hill Publications (India) Pvt. Ltd., 2013
3. Appu Kuttan K. K., "Robotics" Volume-I, 1st Edition, I. K. International Publishing House Pvt. Ltd., 2013
4. Jyothish Kumar L, Pulak M Pandey, "3D printing & Additive Manufacturing Technology", 2nd Edition, Springer Publications, 2018
5. Mahesh M Rathore, "Thermal Engineering", 5th Edition, Tata McGraw Hill Publications (India) Pvt. Ltd., 2010
6. Rao P. N., "Manufacturing Technology" – Vol. 1, 4th Edition, Tata McGraw Hill publications (India) Pvt. Ltd., 2017
7. Rao P. N., "Manufacturing Technology" – Vol. 2, 4th Edition, Tata McGraw Hill publications (India) Pvt. Ltd., 2018

Web References

1. <https://www.youtube.com/watch?v=f2uuyKh02n4>
2. <https://www.youtube.com/watch?v=jdVgwbXZef8>
3. <https://nptel.ac.in/courses/112/103/112103019/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100


Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the properties of good stone?
2. What are the basic principles of surveying?
3. What are the sources of water supply?
4. What are ferrous metals?
5. List any two joining process
6. Define Robot
7. What is meant by pulverization?

L2: Understand

1. Identify the requirements in the selection of site for a construction
2. Illustrate the way to find the levels at various points of the plain area which is irregular in shape
3. Demonstrate the procedure which you want to follow in collecting and disposing the waste in your own community
4. How to calculate the area for the given plot by the use of conventional practice?
5. How to calculate the quantity of water requires for the given area?
6. Explain the role of mechanical engineer in manufacturing industry
7. Classify various engineering materials
8. Compare two stroke and four stroke IC engines
9. Explain the working principle of Hydro - electric power plant
10. Differentiate between two stroke and four stroke engines
11. Explain the working of overfeed and underfeed fuel beds
12. Explain the auxiliaries of a diesel power plant with neat sketch


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Computer Science and Engineering
M.S. Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

ES 23ESX02 Introduction to Programming**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs / PSOs					DoK
		PO1	PO2	PO3	PSO1	PSO2	
23ESX02.1	Illustrate basics of computers, problem solving approach and algorithmic thinking	3	3	2	3	2	L1, L2
23ESX02.2	Demonstrate the control structures, branching and looping statements	3	3	3	3	2	L1 – L3
23ESX02.3	Make use of arrays, pointers and string fundamentals	3	3	3	3	2	L1 – L3
23ESX02.4	Develop Modular program aspects in solving complex problems	3	3	3	3	2	L1 – L3
23ESX02.5	Identify the use of userdefined data types and files	3	3	3	3	2	L1 – L3

All the COs are mapped to PO12 as few self learning topics are inbuilt in syllabus promoting autonomous learning

Unit I: Introduction to Programming and Problem Solving**9 Hours**

Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

COs : CO1*Self - Learning Topics: Compilation and Interpretation***Unit II: Basics of C Programming****9 Hours**

Introduction, Structure of a C Program, Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements, Operators, Type Conversion, Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else-if, switch, Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement.

COs: CO2*Self - Learning Topic: Escape Sequence***Unit III: Arrays, Pointers and Strings****9 Hours**

Introduction, Operations on Arrays, Two Dimensional Arrays, Multidimensional Arrays, Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer. Strings: String Fundamentals, String handling functions.

COs: CO3*Self - Learning Topic: String pattern matching***Unit IV: Functions****9 Hours**

Introduction to Function: Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Arrays as Function Arguments, Pointers as Function Arguments, Command Line Arguments, Variable Storage Classes, Recursion.

COs: CO4*Self - Learning Topic: Implementation of recursion***Unit V: User Defined Data types, File Handling****9 Hours**

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type — Enum variables, Using Typedef keyword, Bit Fields, Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

COs: CO5*Self - Learning Topics: Binary files and operations on binary files*

Board of Studies

Approved in: BoS No. VI

Approved in ACM: ACM No. VIII

Expert talk (To be delivered by SMEs from industries)

1. Logic building using C Programming
2. Real time applications of C Programming

Computer Science and Engineering

October 06, 2023

October 21, 2023

COs POs / PSOs

- | | |
|-----------|---------------------------------|
| CO1 – CO6 | PO1, PO2, PO3, PO12, PSO1, PSO2 |
| CO2 – CO6 | PO1, PO2, PO3, PO12, PSO1, PSO2 |

Text Books

1. Behrouz A. Forouzan., Richard F. Gilberg, "A Structured Programming Approach Using C", 3rd Edition, Cengage, 2007
2. Dromey R. G., "How To Solve It By Computer", 1st Edition, Pearson Education, 2014
3. Byron Gottfried, "Programming with C", 3rd Edition, Tata McGraw Hill, 2017
4. Herbert Schildt, "C The Complete Reference", 4th Edition, TMH, 2017
5. Ajay Mittal, "Programming In C A-Practical Approach", 1st Edition, Pearson, 2010

Reference Books

1. Balagurusamy E., "Computing fundamentals and C Programming", 2nd Edition, McGraw-Hill Education, 2017
2. Rema Theraja, "Programming in C", 2nd Edition, OUP India, 2016
3. Prasad F. E. V, "C Programming: A Problem-Solving Approach", Gilberg, Cengage Learning, 2010
4. Yashavant Kanetkar, "Let Us C", 16th Edition, BPB, 2017

Web References

1. <https://www.geeksforgeeks.org/c-programming-language>
2. <https://www.tutorialspoint.com/cprogramming/index.html>
3. <https://www.javatpoint.com/c-programming-language-tutorial>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. What do you mean by flowchart?
2. What are the components in the flowchart?
3. What are various storage classes in C?
4. What is a string?
5. Write a C program to copy one string to another
6. Write a C program to read and display the content of a file
7. What is recursive function?
8. What are the constraints for defining a recursive function with an example?
9. Why switch statement is more advantageous than nested if-else statement?
10. What is meant by a variable in C programming?
11. Write a C program to count number of vowels and consonants in a string using pointers

L2: Understand

1. Explain about enumerated types with example
2. Explain counter controlled and exit controlled loops with examples
3. Write a program to compare two strings for equality without using strcmp() function
4. Demonstrate about declaration and initialization of string in C. How strings are displayed with different formats? Explain with examples
5. Illustrate a C program to find the sum of first and last digit of a number
6. Illustrate a C program to merge two files into single file
7. Explain different looping statement with syntax and example
8. Explain function prototype and different methods to call the function
9. Explain in detail about array of structure and pointer to structure with example
10. Discuss the usage of bitwise logical operators used in C? Compare them from logical operators with suitable program
11. Explain about call by value and call by reference with reference to functions with example
12. Explain the term dynamic memory allocation and the terms malloc(), calloc() and realloc() functions

L3: Apply

1. Write a C program to check whether the given number is palindrome or not
2. Write a C program to solve the factorial of a given number using for loop
3. Write an algorithm, flowchart and pseudo code to identify largest of given 3 numbers using conditional operator
4. Write a C program to perform the operation of multiplication of two matrices
5. Write a C program to interchange the largest and smallest elements in an array
6. Write a C program by applying pointers to count number of vowels and consonants in a string
7. Write a C program to select any arithmetic operations using switch cases
8. Write a C program to find given number is Armstrong or not
9. Write a C program to check whether the given string is palindrome or not
10. List file handling functions. Utilize file handling functions with an example
11. Design a modular banking application using C programme that can facilitate transactions such as deposit and withdrawal of funds
12. How can you design an efficient algorithm to generate a list of the first n prime numbers? Can you analyse the time complexity of your algorithm? Implement and test your program to ensure it works correctly for a range of input values
13. Write a C program that finds the second largest element in an array of integers. Explain how you handle different cases such as empty array, array with only one element, array with duplicate elements, etc
14. Write a C program that simulates a simple calculator that can perform addition, subtraction, multiplication, and division operations on two operands. Explain how you handle user input, error checking, and precedence of operators
15. Write a C program that reads a text file and counts the number of words, lines, and characters in it. Explain how you handle different types of delimiters and end-of-file conditions


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Chairman
Board of Studies (CSE)

Head of the Department
Computer Science and Engineering
N.S. Raju Institute of Technology
Sontyam, Visakhapatnam - 531175

BS 23BSX32 Engineering Physics Lab

0 0 2 1

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO1	PO4
23BSX32.1	Relate the principle of physics in engineering field and compare the results with theoretical calculations	3	3
23BSX32.2	Demonstrate modern engineering physics techniques and tools in real time applications in engineering studies	3	3
23BSX32.3	Develop the laboratory skills in handling of electrical and optical instruments	3	3
23BSX32.4	Demonstrate the interference and diffraction phenomena of light	3	3
23BSX32.5	Analyse the effect of sound on physical parameters	3	3

List of Experiments

1. Determination of Radius of Curvature of Plano Convex Lens by Newton's rings	COs: CO1-CO4
2. Determination of wavelength of a source using Diffraction Grating Normal incidence method	COs: CO1-CO4
3. Determination of thickness of thin Object- Air wedge method	COs: CO1-CO4
4. Determination of wavelength of Laser source	COs: CO1-CO4
5. Verify the relation between frequency and volume- Using Volume resonator	COs: CO1,CO5
6. Determination of Rigidity modulus of material (wire)- (torsional pendulum)	COs: CO1,CO2
7. Verify magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus	COs: CO1-CO3
8. Determination of dispersive power of prism	COs: CO1-CO3
9. Determine acceleration due to gravity and radius of gyration using compound pendulum	COs: CO1,CO2
10. To find the Energy Band gap of a Semiconductor using p - n junction	COs: CO1-CO3
11. Study the characteristics of a Thermistor and obtain its temperature coefficient	COs: CO1-CO3
12. Determination of dielectric constant using charging discharging method	COs: CO1-CO3
13. Determination of resolving power of a grating	COs: CO1-CO4
14. Verification of laws of stretched string by using Sonometer	COs: CO1,CO5
15. Estimation of Planck's constant using photo electric effect	COs: CO1-CO4
16. Study the variation of B versus H by magnetizing the magnetic material (B-H curve)	COs: CO1-CO4
17. Verification of Brewster's law	COs: CO1,CO2, CO4
18. Determination of frequency of electrically maintained tuning fork by Melde's experiment	COs: CO1-CO3

Note: In the above experiments at least 10 assessment experiments should be completed in a semester, out of which 2 experiments may be conducted in virtual mode

References

1. Balasubramanian S., Srinivasan M. N., 'A Text Book of Practical Physics'- S. Chand Publishers, 2017
2. Lab Manual for Engineering Physics, Department of Basic Science and Humanities, NSRIT, 2023

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Chairman
Board of Studies (BS & H)

Head of the Department
Computer Science and Engineering
N.S .Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

ES 23ESX06 Engineering Workshop**0 0 3 1.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO1
23ESX06.1	Demonstrate the workshop tools and their operational capabilities	1
23ESX06.2	Employ workshop tools for various joints and fitting.	1
23ESX06.3	Interpret the development of sheet metal using tin smithy tools	1
23ESX06.4	Illustrate the house wiring	1
23ESX06.5	Make use of moulding tools prepare a pattern	1

List of Experiments

Student shall do two experiments from five trades

Demonstration: Safety practices and precautions to be observed in workshop.

- | | | |
|---|--|--------------|
| 1 | Wood Working: Familiarity with different types of woods and tools used in wood working and make following joints.
a) Half -Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint | COs:CO1, CO2 |
| 2 | Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing | COs:CO1, CO2 |
| 3 | Fitting: Familiarity with different types of tools used in fitting and do the following fitting exercises.
a) V-fit b) Dove tail fit c) Semi-circular fit
d) Bicycle tyre puncture and change of two-wheeler tyre | COs:CO1, CO2 |
| 4 | Electrical Wiring: Familiarity with different types of basic electrical circuits and make the following connections.
a) Parallel and series b) Two-way switch c) Go-down lighting
d) Tube light e) Three phase motor f) Soldering of wires | COs:CO1, CO3 |
| 5 | Foundry Trade: Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns. | COs:CO1, CO4 |

Add-on Experiments

- | | | |
|---|---|----------|
| 1 | Welding Shop: Demonstration and practice on Arc Welding and Gas welding, Preparation of Lap joint and Butt joint | COs: CO1 |
| 2 | Plumbing: Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters | COs: CO1 |

References

1. Lab Manual for Engineering Workshop, Department of Mechanical Engineering, NSRIT


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 Chairman
 Board of Studies (ME)

 Head of the Department
 Computer Science and Engineering
 N.S .Raju Institute of Technology
 Sontyarn, Visakhanatnam - 531173

ES 23ESX05 Computer Programming Lab**0 0 3 1.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs / PSOs						
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
23ESX05.1	Demonstrate the use of basic language features	2	2	2	1	3	2	1
23ESX05.2	Apply the right control structure for solving the problem	3	3	3	3	3	3	2
23ESX05.3	Implement simple programs to solve computing problems using user defined functions	3	3	3	3	3	3	2
23ESX05.4	Develop programs using arrays and pointers	3	3	3	3	3	3	2
23ESX05.5	Experiment with user defined data types and file operations	3	3	3	3	3	3	2

List of Experiments

1.	Write C programs to familiarization with programming environment	COs: CO1
2.	Write simple C programs with printf(), scanf() functions	COs: CO1
3.	Write C programs to simple computational problems using arithmetic expressions	COs: CO1
4.	Write C programs to computational problems using the operator' precedence and associativity	COs: CO1
5.	Write C programs involving if-then-else structures	COs: CO2
6.	Write C programs on while and for loops	COs: CO2
7.	Write C programs on 1D array manipulation, linear search	COs: CO4
8.	Write C programs on matrix, string operations	COs: CO4
9.	Write C programs on functions, call by value, scope and extent	COs: CO3
10.	Write C programs to implement recursive functions	COs: CO3
11.	Write C programs on simple functions using call by reference, dangling pointers	COs: CO4
12.	Write C programs on pointers, structures and dynamic memory allocation	COs: CO4
13.	Write C programs on bitfields, self-referential structures	COs: CO4
14.	Write C programs to implement file operations	COs: CO5
15.	Domain Specific Applications	
(i)	Write a program to implement employee management system	COs: CO5
(ii)	Write a program to implement election system	COs: CO4
(iii)	Calculate the Euler's load for a column with various end conditions	COs: CO2
(iv)	Calculate the Shear force and Bending Moments for a beam under the various loading condition	COs: CO2
(v)	Write a C program for resolution of forces	COs: CO3
(vi)	Write a C program for calculation of coefficient of discharge	COs: CO2
(vii)	Write a C program to find the efficiency of the DC motor for different values of time T	COs: CO2
(viii)	Write a C program to derive the transfer function of a DC motor for given values	COs: CO2

Exercise problems

1. Basic Linux environment and its editors like Vi, Vim & Emacs etc.
2. Exposure to Turbo C, gcc
3. Writing simple programs using printf(), scanf()
4. Write a C program to find sum and average of 3 numbers

5. Conversion of Fahrenheit to Celsius and vice versa
6. Simple interest calculation
7. Finding the square root of a given number
8. Finding compound interest
9. Area of a triangle using heron's formulae
10. Distance travelled by an object
11. Evaluate the following expressions
 - a. $A+B*C+(D*E)+F*G$
 - b. $A/B*C-B+A*D/3$
 - c. $A+++B-A$
 - d. $J=(i++)+(++i)$
12. Find the maximum of three numbers using conditional operator
13. Take marks of 5 subjects in integers, and find the total, average in float
14. Write a C program to find the max and min of four numbers using if-else
15. Write a C program to generate electricity bill
16. Find the roots of the quadratic equation
17. Write a C program to simulate a calculator using switch case
18. Write a C program to find the given year is a leap year or not
19. Find the factorial of given number using any loop
20. Find the given number is a prime or not
21. Compute sine and cos series
22. Checking a number palindrome
23. Construct a pyramid of numbers
24. Find the min and max of a 1-D integer array
25. Perform linear search on 1D array
26. The reverse of a 1D integer array
27. Find 2's complement of the given binary number
28. Eliminate duplicate elements in an array
29. Addition of two matrices
30. Multiplication two matrices
31. Write a C program to concatenate two strings without built-in functions
32. Write a C program to find reverse a string using built-in and without built-in string functions
33. Write a C function to calculate NCR value
34. Write a C function to find the length of a string
35. Write a C function to transpose of a matrix
36. Write a C function to demonstrate numerical integration of differential equations using Euler's method
37. Write a recursive function to generate Fibonacci series
38. Write a recursive function to find the lcm of two numbers
39. Write a recursive function to find the factorial of a number
40. Write a C program to swap two numbers using call by reference
41. Demonstrate Dangling pointer problem using a C program
42. Write a C program to copy one string into another using pointer
43. Write a C program to find no of lowercase, uppercase, digits and other characters using pointers
44. Write a C program to find the sum of a 1D array using malloc()
45. Write a C program to find the total, average of n students using structures
46. Enter n students data using calloc() and display failed students list
47. Write a C program to implement realloc()
48. Read student name and marks from the command line and display the student details along with the total marks
49. Create and display a singly linked list using self-referential structure
50. Demonstrate the differences between structures and unions using a C program
51. Write a C program to shift/rotate using bitfields
52. Write a C program to copy one structure variable to another structure of the same type
53. Write a C program to write and read text into a file
54. Write a C program to write and read text into a binary file using fread() and fwrite()
55. Write a C program to copy the contents of one file to another file

56. Write a C program to merge two files into the third file using command-line arguments
57. Write a C program to find no. of lines, words and characters in a file
58. Write a C program to print last n characters of a given file

References

1. Ajay Mittal, "Programming in C – A Practical Approach", 1st Edition, Pearson, 2010
2. Behrouz A. Forouzan, Richard F. Gilberg, "A Structured Programming Approach Using C", 3rd Edition, Cengage, 2007
3. Forouzan, Gilberg, Prasad, "C Programming: A Problem - Solving Approach", 1st Edition, Cengage Learning, 2011
4. Lab Manual for Computer Programming, Department of Computer Science & Engineering, NSRIT



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Chairman
Board of Studies (CSE)

Head of the Department
Computer Science and Engineering
N.S. Raju Institute of Technology
Sontyam, Visakhapatnam - 531073

ES 23ESX07 Engineering Graphics**1 0 3 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO10	PSO1	
23ESX07.1	Demonstrate the principles of engineering drawing, including engineering curves, scales, orthographic and isometric projections.	3	3	2	L1 - L3
23ESX07.2	Construct the orthographic projections of points and lines in front and top views.	3	3	2	L1 - L3
23ESX07.3	Construct the systems of projection of planes and solids with respect to the observer, object and the reference planes	3	3	2	L1 - L3
23ESX07.4	Develop the concepts of sectional views to represent details of solids in simple positions.	3	3	2	L1 - L3
23ESX07.5	Develop the ability to draw isometric views and orthographic views and should be able to convert isometric views to orthographic views and vice versa.	3	3	2	L1 - L3

All the COs are mapped to PO12 as few self-learning topics are inbuilt in syllabus promoting autonomous learning

Unit I: Introduction of Geometrical Constructions**9 Hours**

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general, Involute, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

COs: CO1

*Self - Learning Topic: Construct polygons by special methods***Unit II: Introduction of Orthographic Projections****9 Hours**

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

COs: CO2

*Self - Learning Topic: Traces of lines***Unit III: Projections of Planes and Solids****9 Hours**

Projections of planes: Regular planes perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes

Projections of solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of solids with axis inclined to one reference plane and parallel to other

COs: CO3

Self - Learning Topic: Auxiliary views of planes

Unit IV: Projection and Section of solids**9 Hours**

Projections of Solids Projection of Solids with axis inclined to one reference plane and parallel to other
 Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section,
 Sections of solids in simple position only

**COs: CO4,
CO5***Self - Learning Topic: Development of surfaces***Unit V: Conversion of Views****9 Hours**

Conversion of Views: Conversion of isometric views to orthographic views and vice versa.

Computer graphics: Creating 2D & 3D drawings of objects including PCB and Transformations using
 Auto CAD (Not for end examination)

COs: CO5*Self - Learning Topic: Isometric Projection***Board of Studies**

Approved in: BoS No. VI

Approved in: ACM No. VIII

Mechanical Engineering

October 07, 2023

October 21, 2023

Expert talk (To be delivered by SMEs from Industries)

- 1 Real time applications of engineering graphics
- 2 Spatial Visualization

COs

CO4 - CO5

CO4 - CO5

POs

PO1, PO10

PSO1

Text Books

1. Bhatt N.D., "Engineering Drawing", 53rd Edition, Chait Publications, 2018
2. Agarwal and Agarwal, "Engineering Drawing", 3rd Edition, Tata McGraw Hill Publishers, 2017
3. Sham Tickoo, "Auto CAD 2017", Engineers & Designers", 23rd Edition, Dream tech Press, 2016

Reference Books

1. Narayana K. L. and Kanniah P., "Engineering Drawing", 5th Edition, Scitech Publishers, 2017
2. Varghese P.I., "Engineering Graphics", Mc Graw Hill Publishers, 2013
3. Venugopal K. Prabhu Raja V., "Engineering Drawing + Auto Cad", 5th Edition, New Age Publications, 2011

Web References

1. <https://nptel.ac.in/courses/112/103/112103019/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	40	30
L3	40	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Divide a straight-line AB of 60 mm long into eight numbers of equal parts
2. How to draw an Octagon given the length of side 25 mm
3. Draw an equilateral triangle of 75 mm side and inscribe a circle in it

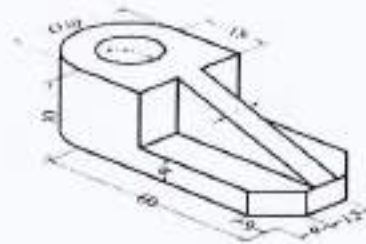
4. Show a regular pentagon in a circle of 100 mm diameter

L2: Understand

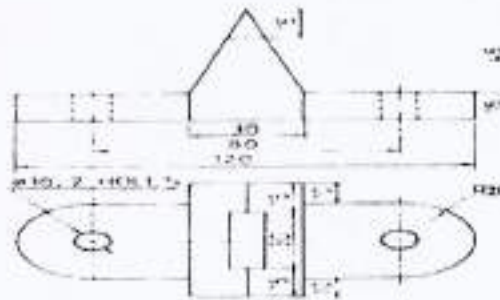
1. Construct a cycloid for a generating circle of radius 30 mm. Also draw a tangent and normal at any point on the cycloid
2. A line AB is on HP and its one end A is 20 mm in front of VP. The line makes an angle of 45° with VP and its front view is 60 mm long. Draw the projections of the line and determine the true length
3. A regular hexagon of 40 mm side has a corner in the HP. Its surface inclined at 45° to the HP. And the top view of the diagonal through the corner which is in the HP, makes an angle of 60° with the VP. Demonstrate its projections
4. A pentagonal pyramid has an edge of the base in the VP and inclined at 30° to the HP, while triangular face containing that edge makes an angle of 45° with the VP. Illustrate the three views of the pyramid. Length of side of the base is 30 mm, while that of the axis is 65 mm

L3: Apply

1. A thin circular plate of 45mm diameter with its centre 35 mm above HP and 40 mm in front of VP is perpendicular to VP and inclined to HP at angle of 30° . Develop the projections of the plate
2. A square pyramid of base 40 mm and height 60 mm is on HP with one of its base edges so that the axis is making 45° with HP and the base edge making 30° with VP. Construct the projections
3. Construct a scale of 1.5 inches = 1 foot to show inches and long enough to measure up to 4 feet
4. Draw (i) Front View (ii) Top View (iii) Left Hand Side View



5. Build the Isometric view



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Chairman
Board of Studies (ME)

Head of the Department
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N.S.Raju Institute of Technology
Sunturam, Visakhapatnam - 531173

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs / PSOs						
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
23SOC01.1	Perform Hardware troubleshooting	3	2	-	-	2	2	1
23SOC01.2	Explain the world wide web and Internet	3	2	2	-	2	2	2
23SOC01.3	Develop a working knowledge of HTML, CSS	2	2	-	-	3	2	2
23SOC01.4	Demonstrate the usage of MS-Word, MS-Excel spreadsheets	3	3	3	2	3	2	2
23SOC01.5	Show the use of MS-PowerPoint for presentations and experiment with ChatGPT AI tool	3	2	2	1	3	2	2

List of Experiments

PC Hardware

COs: CO1

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

COs: CO2

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop-up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

HTML and Introduction to CSS**COs: CO3**

Task 1: Coding Basics: Introduction to HTML syntax, HTML, head, title, & body tags headings, paragraphs, & lists, strong & em tags, doctype, lang attribute, meta tag & Unicode character set

Task 2: Coding Links: Absolute & Relative URLs, Anchor tags & hrefs Linking to other websites, Linking to pages within a website Opening a link in a new browser window/tab

Task 3: Adding Images: Break tag, image tag & source attribute using the width, height, & alt attributes, using horizontal rules

Task 4: Introduction to Cascading Style Sheets (CSS): Style tag, tag selectors, font-size, font-family, color, & line-height properties, hexadecimal color codes

WORD**COs: CO4**

Task 1: Creating project abstract Features to be covered: Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 2: Creating a Newsletter: Features to be covered: Table of Content, Newspaper columns, Images from files and clipart, drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

Excel**COs: CO4**

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA - Features to be covered: Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

LOOKUP/VLOOKUP**COs: CO4**

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

Power point**COs: CO5**

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide sorter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI Tools – ChatGPT**COs: CO5**

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model

completes them.

Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3.1: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Task 3.2: Futuristic Predictions: Have fun by asking the model to predict future technological advancements, societal changes, or even hypothetical scenarios. Compare its responses with your own ideas.

Ex: Prompt: "Predict how artificial intelligence will transform everyday life in the next 20 years."

References

1. Vikas Gupta, "Comdex Information Technology Course tool Kit", 6th Edition, Dreamtech Press, 2005
2. Cheryl A. Schmidt, "The Complete Computer Upgrade and Repair Book", 3rd Edition, Dreamtech Press, 2002
3. ITL ESL, "Introduction to Information Technology", 2nd Edition, Pearson, 2012
4. Kate J. Chase, "PC Hardware and A+ Handbook", Microsoft Press, 2004
5. Lab Manual for IT-Workshop, Department of Computer Science & Engineering, NSRIT



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Chairman
Board of Studies (CSE)

Head of the Department
Computer Science and Engineering
N.S. Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

Wellness 23WLP01 Health And Wellness, Yoga and Sports

0 0 1 0.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO7	PO12
23WLP01.1	Be physical fit to perform daily routine without undue fatigue	1	1
23WLP01.2	Be mentally alert and socially cohesive	1	1
23WLP01.3	Consider success and failure equally	2	1
23WLP01.4	Develop positive personality	1	1
23WLP01.5	Improve leadership qualities	2	1

Unit I: Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups. **3 Hours**

Activities

- Organizing health awareness programmes in community
- Preparation of health profile
- Preparation of chart for balance diet for all age groups

COs: CO1

Unit II: Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice. **3 Hours**

Activities

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

COs: CO2

Unit III: Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games. **3 Hours**

Activities

- Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics
- Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running

COs: CO3

General Guidelines

- Institutes must assign slots in the timetable for the activities of Health/Sports/Yoga
- Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports
- Institutes are required to provide sports instructor / yoga teacher to mentor the students

Assessment Pattern

- Evaluated for a total of 100 marks
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject

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Board of Studies (B S & H)

HS 23HSX01 Communicative English**2 0 0 2**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO 5	PO 8	PO 10	
23HSX01.1	Make use of the setting, subject, and specific details from social or transactional discussions	1	1	3	L1 – L3
23HSX01.2	Identify grammatical frameworks to construct sentences and select the appropriate word forms	1	1	3	L1 – L3
23HSX01.3	Examine discourse markers to talk coherently about a subject in informal conversations	1	1	3	L1 – L3
23HSX01.4	Assessing the reader's or listener's overall comprehension of reading, listening, and summary materials	1	1	3	L1 – L6
23HSX01.5	Justify intelligible essays, resumes, and paragraphs	1	1	3	L1 – L6

All the Cos are mapped to PO12 as few self learning topics are inbuilt in syllabus promoting autonomous learning.

**Unit I: HUMAN VALUES: A Power of a Plate of Rice by Ifeoma Okoye
"Tomorrow is waiting" by Holli Mintzer - Strange Horizons****9 Hours****Listening:** Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions**Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing one self and others**Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information**Writing:** Mechanics of Writing - Capitalization, Spellings, Punctuation – Parts of Sentences**Grammar:** Parts of Speech, Basic Sentence Structures – forming question**Vocabulary:** Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words**COs: CO1***Self Learning Topic: The Time Machine – H.G. Wells***Unit II: NATURE: Night of the Scorpion by Nissim Ezekiel (Indian & Contemporary)
Patterns of a Murmuration, in billions of data points by Jy Yang - Clares World
The Brook by Alfred Tennyson (Poem)****9 Hours****Listening:** Answering a series of questions about main ideas and supporting ideas after listening to audio texts**Speaking:** Discussion in pairs/small groups on specific topics followed by short structure talks**Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together**Writing:** Structure of a paragraph – Paragraph writing (specific topics)**Grammar:** Cohesive devices - linkers, use of articles and zero article; prepositions**Vocabulary:** Homonyms, Homophones, Homographs**COs: CO2***Self Learning Topic: In Watermelon Sugar – Brautigan*

Unit III: BIOGRAPHY: Elon Musk/Steve Jobs**9 Hours**

"The Life cycle of Software Objects" is a novella by American writer Ted Chiang, originally published in 2010 by Subterranean Press.

Listening: Listening for global comprehension and summarizing what is listened to

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences-recognizing and interpreting specific context clues; strategies to use text clues for comprehension

Writing: Summarizing, Note-making, paraphrasing

COs: CO3

Grammar: Verbs-tenses; subject-verb agreement; Compound words, Collocations

Vocabulary: Compound words, Collocations

Self Learning Topic: The Reader – Bernhard Schlink

Unit IV: Inspiration: The Toys of Peace by Saki**9 Hours**

A Story Told by a Machine The Circuitous Path to AI Writing

Listening: Making predictions while listening to conversations/transactional dialogues without video; listening with video

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data

COs: CO4

Writing: Letter Writing: Official Letters, Resumes

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused, Jargons

Self Learning Topic: The Prime of Life – Simone De Beauvoir

Unit V: MOTIVATION: The Power of Intra personal Communication (An Essay)**9 Hours**

The interplay of AI, modern lives and literature by Mimi Mondal - Hindustan Times

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension

Speaking: Formal oral presentations on topics from academic contexts

Reading: Reading comprehension

Writing: Writing structured essays on specific topics

COs: CO5

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Vocabulary: Technical Jargons

Self Learning Topic: Do Androids Dream of electric ship? Philip K. Dick The City and the Stars – Arthur C. Clarke

Board of Studies

Approved in: BoS No. II

Approved in ACM: ACM No. VIII

Expert talk (To be delivered by SMEs from industries)

Workshop on Drama and enactive sessions

Seminar with Language expert

Basic Science & Humanities (English)

October 06, 2023

October 21, 2023

COs

POs

CO5

PO5, PO8, PO10

CO3

PO5, PO8, PO10

Text Books

1. Path finder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1, 2 & 3)
2. Empowering English by Cengage Publications, 2023 (Units 4 & 5)

Reference Books

1. Dubey, Shamji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen, Academic writing: A Handbook for International Students Routledge, 2014
3. Murphy, Raymond, English Grammar in Use, 4th Edition, Cambridge University Press, 2019
4. Lewis, Norman, Word Power Made Easy – The Complete Handbook for Building a Superior Vocabulary, Anchor, 2014

Web References**Grammar**

1. www.bbc.co.uk/learningenglish
2. <https://dictionary.cambridge.org/grammar/british-grammar/>
3. www.eslpod.com/index.html
4. <https://www.learngrammar.net/>
5. <https://english4today.com/english-grammar-online-with-quizzes/>
6. <https://www.talkenglish.com/grammar/grammar.aspx>

Vocabulary

1. <https://www.youtube.com/c/DailyVideoVocabulary/videos>
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	15
L2	20	30
L3	10	30
L4	10	15
L5	05	05
L6	05	05
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. List the major characters in the story
2. Who is the author of the poem "The Brook"?
3. What is the specific natural element that the poem revolves around?
4. Who is Elon Musk?
5. Can you name some of the companies founded or co-founded by Elon Musk?

L2: Understand

1. Can you summarize the plot of the story in your own words?
2. Explain the significance of the Brook's journey in the poem

3. What emotions or feelings does the poem evoke in you as a reader?
4. Explain the significance of SpaceX in Elon Musk's career and the aerospace industry
5. What are some of the major technological advancements associated with Elon Musk's companies?

L3: Apply

1. How would you apply the lessons from this story to your own life?
2. Can you apply the poem's themes to a different natural setting or body of water that you are familiar with?
3. Describe a real-life situation or natural phenomenon that parallels the Brook's journey in the poem
4. Apply Elon Musk's philosophy on sustainable energy to a current environmental issue
5. Describe a scenario in which the principles of innovation and risk-taking, as demonstrated by Elon Musk, could be applied in a different industry

L4: Analyze

1. How does the setting contribute to the overall mood of the story?
2. How does the poem's structure, including its rhyme scheme and meter, contribute to the overall meaning and mood of the poem?
3. Explore the role of sound and sensory imagery in conveying the Brook's essence
4. How has Elon Musk's leadership style contributed to the success of his companies?
5. Compare and contrast the goals and missions of SpaceX and Tesla, Inc.

L5: Evaluate

1. Evaluate the impact of the surprise ending in the story
2. Evaluate the effectiveness of the poem in conveying its themes and emotions
3. How might different readers interpret the poem's meaning based on their personal experiences or perspectives?
4. Do you agree with Elon Musk's vision for a sustainable future and his approach to achieving it? Why or why not?
5. Assess the ethical considerations surrounding some of Elon Musk's projects, such as Neuralink or the Hyperloop

L6: Create

1. Create a modern-day version of the story, updating the setting and circumstances while retaining the central theme of sacrifice
2. Write a short paragraph or poem that continues the story of the brook after the poem ends
3. Compose a piece of music inspired by the imagery and emotions conveyed in "The Brook"
4. Write a short essay discussing the potential long-term effects of Elon Musk's ventures on the global economy and society
5. Develop a concept for a new technology or project that aligns with Elon Musk's innovative spirit and goals


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Chairman
Board of Studies (B S & H)

Head of the Department
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N.S .Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

BS 23BSX21 Chemistry**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO7	
23BSX21.1	Compare the differences between temporary and permanent hardness of water	3	2	1	L1 - L3
23BSX21.2	Apply Nernst equation for calculating electrode, cell potentials and Pilling-Bedworth rule for corrosion	3	2	1	L1 - L3
23BSX21.3	Explain different types of polymers and their applications & solve the numerical problems based on Calorific value, octane number, refining of petroleum and cracking of oils.	3	2	1	L1 - L3
23BSX21.4	Explain the constituents of composites and its classification & the constituents of Portland cement & enumerate the reactions at setting and hardening of the cement	3	2	1	L1 - L3
23BSX21.5	Summarize the concepts of colloids, micelle and nanomaterials	3	2	1	L1 - L3

All the COs are mapped to PO12 as few self-learned topics are inbuilt in syllabus promoting autonomous learning

Unit I: Water Technology**9 Hours**

Soft and hard water, Estimation of hardness of water by EDTA Method, Estimation of dissolved oxygen - Boiler troubles - Priming, foaming, scale and sludge, caustic embrittlement, Industrial water treatment - Specifications for drinking water, Bureau of Indian Standards (BIS) and World Health Organization (WHO) standards, Ion-exchange processes - desalination of brackish water, Reverse Osmosis (RO) and electro dialysis

COs: CO1*Self - Learning Topic: Advanced softening methods***Unit II: Electrochemical Cells and Corrosion and Its Applications****9 Hours**

Electrodes - electrochemical cell, Nernst equation, cell potential calculations.

Primary cells - Zinc-air battery, Secondary cells - Nickel-Cadmium (NiCad), and lithium ion batteries - working principle of the batteries including cell reactions; Fuel cells - Basic concepts, the principle and working of hydrogen-oxygen fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling - Bedworth ratio and uses, factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

COs: CO2*Self - Learning Topic: Nano electrochemical sensor***Unit III: Polymers and Fuel Chemistry****9 Hours**

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization.

Thermoplastics and Thermo-setting plastics: Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.

Elastomers - Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers.

Fuels - Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid fuels, refining of petroleum, Octane and Cetane number-alternative fuels-propane, methanol, ethanol and bio fuel-bio diesel.

COs: CO3*Self - Learning Topic: Advanced techniques of synthetic petrol*

Unit IV: Modern Engineering Materials**9 Hours**

Composites-Definition, Constituents, Classification- Particle, Fibre and structural reinforced composites, properties and Engineering applications

Refractories-Classification, Properties, Factors affecting the refractory materials and Applications.

Lubricants-Classification, Functions of lubricants, Mechanism, Properties of lubricating oils-Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and applications.

COs: CO4

Building materials-Portland Cement, constituents, Setting and Hardening of cement.

*Self – Learning Topic: Design materials***Unit V: Surface Chemistry and Nanomaterials****9 Hours**

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (any two methods with examples), chemical and electrochemical methods (not more than two methods) of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, characterization of surface by physicochemical methods (SEM, TEM, X-ray diffraction), solid-gas interface, solid-liquid interface, adsorption isotherm, BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors

COs: CO5*Self – Learning Topic: Optical methods*

Board of Studies

Basic Science & Humanities (Chemistry)

Approved in: BoS No. II

October 06, 2023

Approved in ACM: ACM No. VIII

October 21, 2023

Expert talk (To be delivered by SMEs from industries)**COs****POs**

1 Corrosion and material protection

CO1

PO1, PO2, PO7

2 Principles and applications of chemical energy sources

CO2, CO3

PO1, PO2, PO7

Text Books

1. Jain and Jain, "Engineering Chemistry", 16th Edition, Dhanpatrai Publications, 2013
2. Peter Atkins, Julio de Paula and James Keeler, Atkins "Physical Chemistry", 10th Edition, Oxford University Press, 2010
3. Shikha Agarwal, Engineering Chemistry: Fundamentals and Applications* 13th Edition, 2012

Reference Books

1. Lee J. D., "Concise Inorganic Chemistry", 5th Edition, Oxford University Press, 2008
2. Taylor H. F. W., "Cement Chemistry", 2nd Edition, Thomas Telford Publications, 1997

Web References

1. <http://link.springer.com/chemistry>
2. <http://www.thphys.chemistry.ox.ac.uk>
3. <http://www.sciencedirect.com/science>
4. <http://www.e-booksdirectory.com>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	50	50
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is soft water & hard water?
2. What are the salts causing hardness?
3. Define corrosion & give an example
4. Write any four applications of fuel cells
5. Define octane number
6. List any three properties of PVC
7. Define Flash point

L2: Understand

1. Explain estimation of hardness of water by EDTA Method
2. Explain Ion-exchange process with neat sketch
3. Differentiate between primary cells & secondary cells
4. Explain electroplating and electroless plating process
5. Differentiate chain growth polymerization and step growth polymerization
6. Explain about Ultimate analysis of coal
7. Explain about various types of lubricants

L3: Apply

1. Estimate the hard water can be converted into soft water by ion exchange process
2. Explain how estimation of hardness of water by EDTA method can be used to measurement of hardness
3. Discuss the challenges that need to be overcome for fuel cells to become more widely used
4. Automotive tires, gaskets for industrial machinery, or medical devices, can you choose an appropriate elastomer material based on its properties, such as elasticity, chemical resistance, and durability? Justify your answer
5. Explain the choice of refractory materials, their composition, and how they can withstand extreme temperatures, chemical reactions, and mechanical stresses
6. Describe the choice of a nanomaterial, its synthesis method, and how it enhances catalytic activity for a particular chemical reaction
7. Discuss the use of colloidal nanoparticles as catalysts in industrial processes



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Board of Studies (BS & H)

Head of the Department
Computer Science and Engineering
N.S .Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

BS 23BSX12 Differential Equations and Vector Calculus**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO5	
23BSX12.1	Solve the first order differential equations related to various engineering fields	3	2	1	L1 - L4
23BSX12.2	Solve the second order differential equations related to various engineering fields	3	2	1	L1 - L4
23BSX12.3	Identify solution methods for partial differential equations that model physical processes	3	2	1	L1 - L4
23BSX12.4	Apply Gradient, Divergence, Curl and Laplacian to scalar and vector point functions	3	2	1	L1 - L4
23BSX12.5	Interpret Gradient, Directional Derivative, Divergence, Curl and Green's, Stoke's and Gauss theorems	3	2	1	L1 - L4

All the COs are mapped to PO12 as few self-learned topics are inbuilt in syllabus promoting autonomous learning

Unit I: Differential Equations of First Order and first degree**9 Hours**

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits, Orthogonal trajectories

COs: CO1*Self – Learning Topic: Orthogonal trajectories***Unit II: Linear differential equations of higher order (Constant Coefficients)****9 Hours**

Linear differential equations, linear differential equations with constant coefficients, The operator D, the inverse operator $\frac{1}{D}$, $\frac{1}{D-a}$, $\frac{1}{D+a}$, Homogeneous & Non-Homogeneous Differential equations, Complimentary Function, Particular Integral, General solution, Wronskian, Method of Variation of parameters, Applications to L-C-R circuit problems

COs: CO2*Self – Learning Topic: Simple Harmonic motion***Unit III: Partial Differential equations****9 Hours**

Formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

COs: CO3*Self – Learning Topic: Classification of second order partial differential equations***Unit IV: Vector Differentiation****9 Hours**

Scalar and vector point functions, vector operator del, del applied to scalar point functions - Gradient, del applied to vector point functions-Divergence and Curl, Laplacian operator, vector identities (without proofs)

COs: CO4*Self – Learning Topic: Geometrical meaning of all operators***Unit V: Vector Integration****9 Hours**

Line integral – circulation - work done, surface integral - flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).

COs: CO5*Self – Learning Topic: Applications of the above theorems*

Board of Studies

Approved in: BoS No. VI

Approved in: ACM No. VIII

Basic Science & Humanities (Mathematics)

October 06, 2023

October 21, 2023

Expert talk (To be delivered by SMEs from Industries)

	COs	POs
1 Solving one-dimensional wave equation and two-dimensional equations using MATLAB	CO3	PO1, PO2, PO5
2 Applications of vector calculus in different branches of Engineering	CO4	PO1, PO2

Text Books

1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, 12th Reprint, Khanna Publishers, 2022
2. Ramana B. V., "Higher Engineering Mathematics", 1st Edition, 35th Reprint, Tata McGraw Hill Education, 2019

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2021
2. Bali N.P., "Engineering Mathematics", 1st Edition, Lakshmi Publications, 2017
3. Peter O'Neil, "Advanced Engineering Mathematics", 1st Edition, Cengage Publications, 2010
4. Iyengar T. K. V., Prasad M. V. S. S. N., Ranganatham S. and Krishna Gandhi B., "Engineering Mathematics - I", 2nd Revised Edition, S. Chand Publications, 2021
5. Iyengar T. K. V., Prasad M. V. S. S. N., Ranganatham S. and Krishna Gandhi B., "Engineering Mathematics - III", 8th Revised Edition, S. Chand Publications, 2020

Web References

1. <http://nptel.ac.in/courses/>
2. <https://onlinecourses.nptel.ac.in>
3. <https://nptel.ac.in/courses/111/106/111106144/>
4. <https://ocw.mit.edu/courses>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	15	15
L2	55	55
L3	20	20
L4	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Define a partial differential equation
2. What is a Bernoulli's equation?
3. What is the general form of Leibnitz's equation in y?
4. What is the sufficient condition for the exactness of $Mdx + Ndy = 0$
5. Solve the PDE $z = px + qy - 2\sqrt{pq}$
6. Solve $(D^2 + 2DD_1 + 1)z = 0$
7. Find the unit normal vector at (1,2,2) to the surface $x^2 + y^2 + z^2 = 9$
8. Define a line integral and explain its significance in physics or engineering contexts
9. Define a homogeneous linear partial differential equation with constant coefficients

L2: Understand

1. Solve $(D^2 - DD_1 + D_1 - 1)z = \cos(x+2y) + e^{x-y}$
2. Find the directional derivative of the function $\phi = xy^2 + yz^3$ at the point $(2, -1, 1)$ in the direction of the normal to the surface $x \log z - y^2 + 4 = 0$ at $(-1, 2, 1)$
3. If $F = x^2yz$, $G = xy - 3z^2$ Then find $\text{div}(\text{grad } F \times \text{grad } G)$
4. Find the surface integral of $F = xyz(i + z^2j) + 2yzk(i)$ over the tetrahedron bounded by $x=0$, $y=0$, $z=0$ and the plane $x+y+z=1$
5. Solve $D_x + 2D_y u = u$, $u(x, 0) = 6e^{-3x}$ by the method of separation of variables
6. Solve $(1+y^2) dx + (x - e^{4x-1}) dy = 0$
7. Solve $(D^2 + 3D + 2)y = 4 \cos 2x$
8. Explain the process of forming a partial differential equation by eliminating arbitrary constants and arbitrary functions from a given expression
9. Explain how the Wronskian is used to determine linear independence of solutions
10. Explain the geometric interpretation of the dot product and cross product of two vectors. How are these operators used in vector calculus

L3: Apply

1. Find the area of the circle $x^2 + y^2 = a^2$ using double integral in polar coordinates
2. Find the volume of the sphere $x^2 + y^2 + z^2 = a^2$ using spherical coordinates
3. Find by double integration the area lying between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$
4. Find the scalar potential of the vector $F = (x^2 - yz)i + (y^2 - zx)j + (z^2 - xy)k$, if exists
5. Evaluate by Gauss divergence theorem $F = (x^3 - yz)i - 2x^2yj - zk$ taken over the surface of the cube formed by the planes $x=y=z=a$
6. Analyze the implications of having complex roots in the characteristic equation of a second order differential equation
7. Given the PDE $u_x + 2u_y = 0$, solve it using Lagrange's method to find the general solution

L4: Analyze

1. If $f(x, y, z) = 4x^2 + 7xy + 3xz^2$, what is the direction in which the function $f(x, y, z)$ increases more rapidly at the point $P = (1, 0, 2)$
2. List some physical examples of scalar and vector fields
3. From Stoke's theorem, analyze the form of Green's function for a curve lying in
i. xy - plane ii. zx - plane
4. Assess the circulation of the field $F = yj + (x+2y)j$ around the closed path $x^2 + y^2 = 4$ where circulation is in counter clockwise direction
5. Evaluate $\int (x + \sqrt{y}) dS$ along a curve C , where C is given by $C = C_1 + C_2$ such that
 $C_1 = \{x = t, y = t^2\}$ from $(0, 0)$ to $(1, 1)$ and $C_2 = \{x = t, y = t\}$ from $(1, 1)$ to $(0, 0)$



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N.S. Raju Institute of Technology,
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PC 23CS201 Data Structures**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs / PSOs					DoK
		PO1	PO2	PO3	PSO1	PSO2	
23CS201.1	Illustrate the role of linear data structures in organizing and accessing data efficiently in algorithms	3	3	2	3	2	L1 – L3
23CS201.2	Analyze linked lists for dynamic data storage, demonstrating understanding of memory allocation.	3	3	2	3	2	L1 – L4
23CS201.3	Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems	3	3	3	3	2	L1 – L3
23CS201.4	Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between deques and priority queues, and apply them appropriately to solve data management challenges	3	3	3	3	2	L1 – L4
23CS201.5	Identify scenarios where hashing is advantageous and develop hash-based solutions for specific problems	3	3	3	3	2	L1 – L4

All the COs are mapped to PO12 as few self-learning topics are inbuilt in syllabus promoting autonomous learning

Unit I: Introduction to Data Structures**9 Hours**

Types of Data Structures, Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Importance of Non-Linear Data Structures, Overview of time and space complexity analysis for linear data structures. Searching Techniques: Linear & Binary Search. Sorting Techniques: Bubble sort, Selection sort, Insertion Sort.

COs: CO1*Self - Learning Topic: Analyze Time Complexity of Binary search***Unit II: Linked Lists****9 Hours**

Singly linked lists: representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists.

COs: CO2*Self - Learning Topic: Swap nodes in a Linked List (without Swapping data)***Unit III: Stacks****9 Hours**

Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, Applications of stacks in expression evaluation, backtracking, reversing list etc.

COs: CO3*Self - Learning Topic: Types of stacks***Unit IV: Queues & Deques****9 Hours**

Queues: Introduction to queues: properties and operations, implementing queues using arrays and linked lists, Applications of queues in breadth-first search, scheduling, etc.

Deques: Introduction to deques (double-ended queues), Operations on deques and their applications.

COs: CO4*Self - Learning Topic: Different types of Queues*

Unit V: Trees, Hashing**9 Hours**

Trees: Introduction to Trees, Binary Search Tree – Insertion, Deletion & Traversals.

Hashing: Brief introduction to hashing and hash functions, Collision resolution techniques: chaining and open addressing, Hash tables: basic implementation and operations, Applications of hashing in unique identifier generation, caching, etc, Applications of Data Structures

COs: CO5*Self - Learning Topics: Types of Binary Trees*

Board of Studies

Computer Science and Engineering

Approved in: BoS No. VI

October 06, 2023

Approved in: ACM No. VIII

October 21, 2023

Expert talk (To be delivered by SMEs from industries)**COs****POs**

1 Graphs

CO4

PO1, PO2, PO3

2 AVL Tree, B Tree, B+ Tree

CO5

PO1, PO2, PO3

Text Books

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2002
2. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2014

Reference Books

1. Kurt Mehlhorn and Peter Sanders, "Algorithms and Data Structures: The Basic Toolbox", Springer, 2008
2. Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft, "Data Structures and Algorithms", 1st Edition, Pearson Education India, 2002
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", PHI Learning Pvt. Ltd., 3rd Edition, 2010
4. Robert Sedgewick, "Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms", Addison-Wesley, 3rd Edition, 2001
5. Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford Publication, 2014

Web References

1. <https://github.com/topics/data-structures-c>
2. <https://www.hackerrank.com/domains/data-structures>
3. <http://cslibrary.stanford.edu/>
4. https://www.tutorialspoint.com/dsa_using_c/dsa_using_c_quick_guide.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	15	15
L2	35	35
L3	40	40
L4	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. List any five operations in single linked list
2. What is the principle of stack?
3. What are the operations of queue?
4. Define single linked list with suitable example
5. List any two linear data structure

L2: Understand

1. Explain the bubble sort and selection sort algorithms with an example
2. Write an algorithm to insert new node at the beginning, at middle position and at the end of a Singly Linked List
3. Explain the queue ADT with an example
4. Write the algorithm to insert new node at the beginning, at middle position and at the end of a Double Linked List with an example
5. Describe insertion sort algorithm and trace the steps of insertion sort for sorting the list -12, 19, 33, 26, 29, 35, 22, and 37. Find the total number of comparisons made

L3: Apply

1. Convert the given infix Expression $((A+B)*C-(D-E)*(F+G))$ into its Equivalent Prefix and Postfix Notations
2. Write an algorithm for evaluating a postfix expression using stack. Evaluate the following postfix Notation $123*+5-$
3. Illustrate the given infix expression $A+B^*C+(D^*E/F)^*G$ into its postfix expression, and evaluate the same using stack. Here $A=3, B=5, C=2, D=7, E=4, F=1, G=8$

L4: Analyze

1. Inspect single linked list operations to maintain student marks obtained for various courses
2. Write an algorithm and examine it to construct binary search tree with no duplicate values



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Sontyam, Visakhapatnam - 531173

ES 23ESX01 Basics of Electrical and Electronics Engineering**3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PSO1	
23ESX01.1	Understand basic concepts of electrical circuits	3	2	-	1	L1, L2
23ESX01.2	Explain the operation of various machines and instruments	3	1	-	1	L1, L2
23ESX01.3	Understand the operation of different power plants	3	2	2	1	L1, L2
23ESX01.4	Analyze the working of electronic devices	3	-	-	1	L1 – L4
23ESX01.5	Examine the working of electronics circuits and devices	3	-	-	1	L1 – L4
23ESX01.6	Analyze various digital logic gates	3	2	2	1	L1 – L4

All the COs are mapped to PO12 as few self-learned topics are inbuilt in syllabus promoting autonomous learning

Unit I: DC & AC Circuits**9 Hours****DC Circuits:** Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.**AC Circuits:** A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, voltage and current relationship with phasor diagrams in R, L, and C circuits, concept of Impedance, active power, reactive power and apparent power, concept and measurement of power factor (Simple numerical problems).**COs: CO1***Self-Learning Topic: Applications of electrical circuits***Unit II: Machines and Measuring Instruments****9 Hours****Machines:** Construction, principle and operation of (i) DC Motor, (ii) DC Generator (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.**Measuring instruments:** Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge**COs: CO2***Self-Learning Topic: Applications of electrical machines***Unit III: Energy Resources, Electricity Bill & Safety Measures****9 Hours****Energy Resources:** Conventional and non-conventional energy resources; Layout and operation of various power generation systems: Hydrel, Nuclear, Solar & Wind power generation.**Electricity Bill:** Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.**COs: CO3****Equipment Safety Measures:** Working principle of fuse and miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, safety precautions to avoid shock.*Self-Learning Topic: Importance of electrical safety measures***Unit IV: Semiconductor Devices****9 Hours**

Introduction - Evolution of electronics - Vacuum tubes to nano electronics - Characteristics of PN junction Diode - Zener Effect - Zener Diode and its characteristics. Bipolar Junction Transistor - CB, CE, CC configurations and characteristics - Elementary - Treatment of Small Signal Amplifier.

COs: CO4*Self-Learning Topic: Applications of Zener diode***Unit V: Basic Electronic Circuits and Instrumentation****9 Hours****Rectifiers and power supplies:** Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator. **Amplifiers:** Block diagram of

Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system. **COs: CO5**

Self - Learning Topic: Applications of rectifiers and amplifiers

Unit VI: Digital Electronics

9 Hours

Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs). Simple combinational circuits–Half and Full Adders. Introduction to sequential circuits, Flip flops, Registers and counters. **COs: CO6**

Self - Learning Topics: Application of logic gates

Board of Studies	Electrical and Electronics Engineering	
Approved in: BoS No. VI	October 07, 2023	
Approved in ACM: ACM No. VIII	October 21, 2023	
Expert talk (To be delivered by SMEs from industries)	COs	POs
1 Operation of Brush-less DC motor and its applications to industry	CO 2	PO1, PO2, PO3, PSO1
2 Operation of servo motor and its applications to industry	CO 2	PO1, PO2, PO3, PSO1

Text Books

1. Kulshreshtha D. C., "Basic Electrical Engineering", Revised 1st Edition, McGraw Hill, 2021
2. Rajendra Prasad, "Fundamentals of Electrical Engineering", 3rd Edition, PHI Publishers, 2020
3. Kotari D. P. and Nagrath I. J., "Basic Electrical Engineering", 3rd Edition, Tata McGraw Hill, 2020
4. Boylestad R. L., & Louis Nashlesky, "Electronic Devices & Circuit Theory", Pearson Education, 2021

Reference Books

1. Mehta V. K. & Rohit Mehta, "Principles of Electrical Machines", 4th Edition, S. Chand Publications, 2019
2. Sedha R. S., "A Text Book of Electronic Devices and Circuits", 3rd Edition, S. Chand & Co., 2014
3. Madhu Sahu K. B., "Basic Electrical Engineering", 4th Edition, Scitech Publications (India) Pvt. Ltd., 2019
4. Paynter R. T., "Introductory Electronic Devices & Circuits – Conventional Flow Version", 2nd Edition, Pearson Education, 2009

Web References

1. <https://www.classcentral.com/course/swayam-electrical-machines-iitd-14030>
2. https://onlinecourses.nptel.ac.in/noc20_ee60/preview
3. https://onlinecourses.swayam2.ac.in/noc22_ec03/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	70	30
L3	-	30
L4	-	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

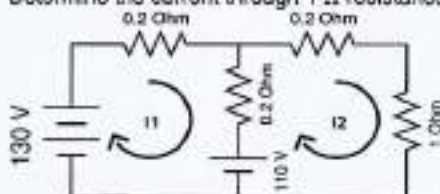
1. What is ohm's law?
2. Define RMS and peak values
3. What is form factor?
4. List any 2 types of rectifiers
5. List any 4 applications of operational amplifiers

L2: Understand

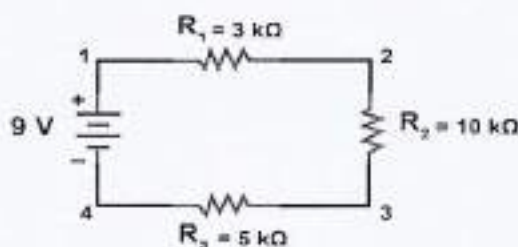
1. Explain in detail about Kirchhoff's current and voltage Law
2. Explain working principle of DC shunt generator
3. Explain the operation of single phase transformer

L3: Apply

1. Determine the current through $1\ \Omega$ resistance by using Kirchhoff's voltage law / Mesh analysis



2. By applying Kirchhoff's voltage law find current through R_3



L4: Analyze

1. Capacitors can be used for the filtering of ripples at the output of a rectifier. Suggest some other device which can work as a better filter
 - a. Design the filter circuit
 - b. Find the filter coefficients
 - c. Analyse the form factor and ripple factor values of the rectifier by comparing them with the values of a rectifier which uses a capacitor for filtering
2. After completing the design and fabrication of an SSI-based digital system, a designer finds that one more inverter is required. However, the only spare gates in the system are a 2 input OR, a 3 input AND, and 2 input XNOR. How should the designer realize the inverter function without adding another IC?
3. For the manufacturing of a p-n junction diode we use either Germanium or Silicon semiconducting materials. Analyse the behaviour of a diode if it is made of a compound form of semiconducting materials like GaAs
 - a. What change do you observe in the doping levels during the formation of p-region and n-region?
 - b. What change do you observe in the V-I characteristics when compared with the characteristics of a conventional diode?


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BS 23BSX22 Chemistry Lab

0 0 2 1

At the end of the course, students will be able to


Code	Course Outcomes	Mapping with POs	
		PO1	PO4
23BSX22.1	Determine the physical properties like surface tension, adsorption and viscosity	3	3
23BSX22.2	Estimate the Iron and Calcium in cement	3	3
23BSX22.3	Explain advanced polymer materials	3	3
23BSX22.4	Compare the total hardness for different water samples	3	3
23BSX22.5	Illustrate the functioning of the instruments such as pH and Potentiometric meters	3	3

List of Experiments

1. Determination of Mn using standard oxalic acid solution (Redox titration)	COs: CO1,CO2
2. Determination of temporary and permanent hardness of water using standard EDTA solution	COs: CO1,CO3
3. Determination of strength of an acid in Pb-Acid battery	COs: CO1,CO2
4. Preparation of a polymer (Bakelite)	COs: CO3
5. Determination of percentage of Iron in cement sample by colorimetry	COs: CO1,CO2
6. Preparation of nanomaterials by precipitation method	COs: CO1,CO2
7. Adsorption of acetic acid by charcoal	COs: CO1,CO2
8. Determination of percentage moisture content in a coal sample	COs: CO1,CO2
9. Determination of the concentration of acetic acid using sodium hydroxide (pH-Metry method)	COs: CO1,CO5
10. Determination of viscosity of lubricating oil by Redwood Viscometer 1	COs: CO1
11. Determination of viscosity of lubricating oil by Redwood Viscometer 2	COs: CO1
12. Determination of calorific value of gases by Junker's gas calorimeter	COs: CO1

References

- Mendham J., Denney R. C., Barnes J. D., Thomas M. and Siva Sankar B. Vogel's "Quantitative Chemical Analysis" 6th Edition, Pearson Publishers, 2000
- Lab Manual for Chemistry, Department of Basic Science and Humanities, NSRIT, 2023


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HS 23HSX02 Communicative English Lab

0 0 2 1

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO10	PO9
23HSX02.1	Recognize the various facets of English language ability, with a focus on LSRW abilities	3	1
23HSX02.2	Use numerous activities for language learners to practice communication skills	3	1
23HSX02.3	To improve listening and speaking comprehension, analyze the sounds, stress, rhythm, intonation, and syllable division of English speech	3	1
23HSX02.4	Assess your professionalism when taking part in group discussions and debating	3	1
23HSX02.5	Develop compelling messaging and get ready for upcoming interviews	3	1

List of Experiments

1. Vowels & Consonants	COs: CO1,CO2
2. Neutralization/Accent Rules	COs: CO1,CO2
3. Communication Skills & JAM	COs: CO3,CO4
4. Role Play or Conversational Practice	COs: CO3,CO4
5. E-mail Writing	COs: CO4,CO5
6. Resume Writing, Cover letter, SOP	COs: CO4,CO5
7. Group Discussions-methods & practice	COs: CO4,CO5
8. Debates- Methods & Practice	COs: CO4,CO5
9. PPT Presentations/ Poster Presentation	COs: CO4,CO5
10. Interviews Skills	COs: CO4,CO5

Reference Books

1. Meenakshi Raman, Sangeeta-Sharma, 4th Edition, Technical Communication, Oxford Press, 2022
2. Grant Taylor; English Conversation Practice, 1st Edition, Tata McGraw-Hill Education India, 2001
3. Hewing's, Martin, Cambridge Academic English (B2), Cambridge University Press, 2012
4. Balasubramanyam T., A Text Book of English Phonetics for Indian Students, 3rd Edition, Trinity, 2022

Suggested Software

- Walden Infotech
- Young India Films

Web Resources

Spoken English

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. <https://www.britishcouncil.in/english/online>
5. <http://www.letstalkpodcast.com/>
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. <https://www.youtube.com/c/AmelsEverydayEnglish/featured>
8. <https://www.youtube.com/c/engvidAdam/featured>
9. <https://www.youtube.com/c/EnglishClass101/featured>
10. <https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists>
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent

12. <https://www.youtube.com/user/letstalkaccent/videos>
13. <https://www.youtube.com/c/EngLanguageClub/featured>
14. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
15. https://www.youtube.com/channel/UCNfm92h83W2i2jc5Xwp_IA


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ES 23ESX04 Electrical and Electronics Engineering Workshop

0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		
		PO1	PO2	PO4
23ESX04.1	Verify Kirchhoff's laws and theorems	3	2	3
23ESX04.2	Determine various parameters of electrical measuring instruments	3	2	3
23ESX04.3	Determine the basic characteristics of electrical machines	3	2	3
23ESX04.4	Illustrate the characteristics of various electron devices	3	2	3
23ESX04.5	Examine the operation of a logical circuit	3	2	3

List of Experiments**Part-A: Basic Electrical Engineering Lab**

1. Verification of KCL and KVL	COs: CO1
2. Verification of superposition theorem	COs: CO1
3. Measurement of resistance using Wheat Stone bridge	COs: CO2
4. Magnetization characteristics of DC shunt generator	COs: CO3
5. Conduct brake test on DC shunt motor	COs: CO3
6. Speed control of DC shunt motor by field and armature control	COs: CO3
7. Perform Swinburne's test on DC machine	COs: CO3
8. Measurement of power and power factor using single - phase wattmeter	COs: CO2
9. Measurement of earth resistance using Megger	COs: CO2
10. Calculation of electrical energy for domestic premises	COs: CO2

Part-B: Basic Electronics Engineering Lab

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias	COs: CO4
2. Plot V-I characteristics of Zener diode and its application as voltage regulator	COs: CO4
3. Implementation of half wave and full wave rectifiers	COs: CO4
4. Plot input & output characteristics of BJT in CE and CB configurations	COs: CO4
5. Frequency response of CE amplifier	COs: CO4
6. Simulation of RC coupled amplifier with the design supplied	COs: CO5
7. Verification of truth table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs	COs: CO5
8. Verification of truth tables of S-R, J-K& D flip flops using respective ICs	COs: CO5

Web References

1. <https://www.vlab.co.in/broad-area-electrical-engineering>

References

1. Kulshreshtha D. C., "Basic Electrical Engineering", Revised 1st Edition, McGraw Hill, 2021
2. Sedha R. S., "A Text Book of Electronic Devices and Circuits", 3rd Edition, S. Chand & Co, 2014
3. Lab Manual for "Electrical and Electronics Engineering Workshop", Department of Electrical and Electronics Engineering & Department of Electronics and Communication Engineering, NSRIT

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PC 23CS202 Data Structures Lab**0 0 3 1.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs / PSOs						
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
23CS202.1	Implement linear data structures in organizing and accessing data efficiently in algorithms	3	3	3	2	2	3	3
23CS202.2	Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation	3	3	3	3	2	3	3
23CS202.3	Implement small scale programming challenges involving data structures such as stacks, trees	3	3	3	3	2	3	3
23CS202.4	Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between dequeues and priority queues, and apply them appropriately to solve data management challenges	3	3	3	3	2	3	3
23CS202.5	Recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems	3	3	3	3	2	3	3

List of Experiments

1.	Write C programs to implement Array Manipulation	COs: CO1
2.	Write C programs to implement operations on Linked List	COs: CO2
3.	Write C programs to implement Linked List Applications	COs: CO2
4.	Write C programs to implement operations on Double Linked List	COs: CO2
5.	Write C programs to implement operations on Stack	COs: CO3
6.	Write C programs to implement operations on Queue	COs: CO4
7.	Write C programs to implement Stack Applications	COs: CO3
8.	Write C programs to implement Queue Applications	COs: CO4
9.	Write C programs to implement operations on Binary Search Tree	COs: CO5
10.	Write C programs to implement Hashing	COs: CO5

Exercise Problems

- Write a program to reverse an array
- Write C programs to implement the searching techniques – linear & binary search
- Write C programs to implement sorting techniques – bubble, selection and insertion sort
- Implement a singly linked list and perform insertion and deletion operations
- Develop a program to reverse a linked list iteratively and recursively
- Solve problems involving linked list traversal and manipulation
- Create a program to detect and remove duplicates from a linked list
- Implement a linked list to represent polynomials and perform addition
- Implement a double-ended queue (deque) with essential operations
- Implement a doubly linked list and perform various operations to understand its properties and applications
- Implement a circular linked list and perform insertion, deletion and traversal
- Implement a stack using arrays and linked lists
- Write a program to evaluate a postfix expression using a stack
- Implement a program to check for balanced parentheses using a stack

15. Implement a queue using arrays and linked lists
16. Develop a program to simulate a simple printer queue system
17. Solve problems involving circular queues
18. Use a stack to evaluate an infix expression and convert it to postfix
19. Create a program to determine whether a given string is a palindrome or not
20. Implement a stack or queue to perform comparison and check for symmetry
21. Implement BST using linked list
22. Implement traversing of BST
23. Implement a hash table with collision resolution techniques
24. Write a program to implement a simple cache using hashing

References

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson, 2002
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Silicon Press, 2008
3. Lab Manual for Data Structures, Department of Computer Science & Engineering, NSRIT



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CSP 23CSP01 NSS /NCC /Scouts & Guides /Community Service Project**0 0 1 0.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		
		PO7	PO8	PO12
23CSP01.1	Understand the importance of discipline, character and service motto	3	1	1
23CSP01.2	Outline the needs and problems of the community	3	1	1
23CSP01.3	Solve some societal issues by applying acquired knowledge, facts, and techniques	3	2	1
23CSP01.4	Explore human relationships by analyzing social problems	2	1	1
23CSP01.5	Determine to extend their help for the fellow beings and downtrodden people	2	2	1

Unit I: Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

3 Hours**Activities:**

- Conducting –ice breaking sessions–expectations from the course–knowing personal talents and skills
- Conducting orientations programs for the students –future plans–activities–releasing road map etc.
- Displaying success stories–motivational biopics– award winning movies on societal issues etc.
- Conducting talent show in singing patriotic songs–paintings– any other contribution.

COs: CO1**Unit II: Nature & Care****Activities:**

- Best out of waste competition.
- Poster and signs making competition to spread environmental awareness.
- Recycling and environmental pollution article writing competition.
- Organising Zero-waste day.
- Digital Environmental awareness activity via various social media platforms.
- Virtual demonstration of different eco-friendly approaches for sustainable living.

Write a summary on any book related to environmental issues

**3 Hours
COs: CO2****Unit III: Community Service****3 Hours****Activities:**

- Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.
- Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
- Conducting consumer Awareness. Explaining various legal provisions etc.
- Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
- Any other programmes in collaboration with local charities, NGOs, etc.

COs: CO3

General Guidelines

1. Institutes must assign slots in the Timetable for the activities
2. Institutes are required to provide instructor to mentor the students

Assessment Pattern

1. Evaluated for a total of 100 marks
2. A student can select 8 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks
3. A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject



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SOC 23SOC07 Plumbing

0 0 0 2

At the end of the course, students will be able to

Code	Course Outcomes
23SOC07.1	Demonstrate the principles of designing plumbing systems for different types of fluids, including gas, air, steam, sewage and water
23SOC07.2	Demonstrate competency in the use of specialized tools and equipment essential for professional pipe installation
23SOC07.3	Diagnose and troubleshoot common plumbing problems in residential, commercial and industrial settings

Min. 60 Hours

Plumbing tools, levelling instruments, valves and meters, soft soldering, rigging and hoisting, Pipe Materials & Joining Methods, Plumbing Fixture, Distribution Piping, Drain, Waste & Vent System, Water Heating / Fuel Storage Equipment, Site & Drain Design, installing water supply piping, septic systems, storm ater and sumps, reaping water supply systems, supporting and testing pipe.



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Sriharipuram, Visakhapatnam - 531173

SOC 23SOC08 Refrigeration and Air Conditioning

0 0 0 2

At the end of the course, students will be able to

Code	Course Outcomes
23SOC08.1	Develop the knowledge and practical skills required to install, troubleshoot, and repair a wide range of R&AC systems, including heating, ventilation, air conditioning, furnaces, and water heaters
23SOC08.2	Demonstrate the procedures for conducting warranty services, including documenting issues, ordering replacement parts, and completing repairs within warranty coverage
23SOC08.3	Learn to assess and identify maintenance issues in refrigeration and air condition equipment, as well as recommend preventive measures to improve system longevity and performance

Min. 60 Hours

Refrigeration and Air Conditioning: Types of refrigerants, study of refrigeration cycles, Vapour absorption system, Vapour compression refrigeration test rig, study of compressors, valves, types of air conditioning, Summer and winter air conditioning, Fitting and Welding, Thermal Insulation, Commercial RAC Plants & Car Air Conditioner, Commercial Compressor & Capacity Control, Water Softening Plants & Chiller, three fluid refrigeration



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SOC 23SOC09 Mobile Troubleshooting**0 0 0 2**

At the end of the course, students will be able to

Code	Course Outcomes
23SOC09.1	Demonstrate the Basic electronics concepts and Basics of mobile communications and different mobile technologies.
23SOC09.2	Gain proficiency in various components of PCB and different Sections on Motherboard and Different ICs used in MotherBoard.
23SOC09.3	Gain proficiency in Hardware and Software tools and trouble Shootings.

Min. 60 Hours

Basic Electronics - Current, Voltage, AC Current & DC Current, Resistor, Transistor, Capacitor, Diode, Inductor / Coil, Transformer, Integrated Circuit, Study of Digital Electronics, Study of Various components inside the mobile phone, Assembling and disassembling of various models of mobile phones, Study of various tools and equipment used in mobile phone repairs, Using a multi-meter, Use of DC Power Supply, Introduction and study of Printed Circuit Board (Motherboard), Details of various components on the PCB, Circuits and Different Sections on Motherboard: Power Circuit, Charging Circuit, SIM Circuit, Display Circuit, Keypad Circuit, Touch Screen Circuit, Audio Circuit, Memory card Circuit, Speaker and Microphone Circuit, Network Circuit, Bluetooth Circuit, Wi-fi Circuit, Testing of various parts and components, Study of different ICs (chips) used on the motherboard, How to recognize various ICs, Soldering & de-soldering of components by using a soldering iron, Soldering & de-soldering of components by using a rework station, Reheating and mounting of various BGA and SMD chips. Use of various secret codes. Fault finding, troubleshooting and repairing of various faults, Common repair procedure for hardware related faults, Common repair procedure for software related faults, Water damaged repair techniques, Circuit tracing, jumper techniques and solutions, Troubleshooting through schematic diagrams, Advanced troubleshooting techniques.


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 N.S. Raju Institute of Technology
 Srikalahasti, Andhra Pradesh - 521102

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SOC 23SOC10 Computer Servicing

0 0 0 2

At the end of the course, students will be able to

Code	Course Outcomes
23SOC10.1	Demonstrate system Assembling and hardware troubleshooting
23SOC10.2	Identify automated backups of your system
23SOC10.3	Build systems to safeguard from various types of user activities
23SOC10.4	Solve and configure Networking related issues

Min. 60 Hours

Identify motherboard components and connections, understand error code for fault troubleshooting, verify components with the configuration of CMOS BIOS set up, Test and understand various beep sounds in case of trouble, Assemble and disassembling a Computer System, Upgrade RAM, HDD and other parts. Test fault finding and troubleshooting techniques, Configuration of camera, mic, WLAN and Bluetooth etc, install any popular antivirus software – View its various options, Explore Firewall options, use various disk cleanup utilities to remove junk files from hard disk, create automated backups, identify various Network devices – Switch, Router, Rack, crimping LAN cables, installing a printer and carrying self-test, Replacement of toner cartridge of laser printers.



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SOC 23SOC11 Digital Marketing

0 0 0 2

At the end of the course, students will be able to

Code	Course Outcomes
23SOC11.1	Identify the Market and the behaviour of the customer and how the digital marketing will be useful
23SOC11.2	Search engines, methods to identify the search engines and their optimization in both on page and off page
23SOC11.3	Exercise on the Social media marketing and Email Marketing and gaining the reputation through online management
23SOC11.4	Demonstrate cognitive knowledge of the skills required in conducting online research and research on online markets

Min. 60 Hours

Introduction to Digital Marketing: Nature and Scope of Digital Marketing, Evolution of Digital Marketing, Traditional versus digital marketing, Integration of Market Place from conventional to the virtual, Social Media and Communication Mix – Benefits & Challenges – social media and Customer Engagement – ROC – New Role of Customers – The Social Business Eco system – REAN, RACE, integrating social media with Overall Market efforts – Developing Social Media Marketing plan. Social Media Business Blocks: Segmenting B2C Market – B2B Markets – managing the cyber social Campaign – Joining the Conversation – Lurking and Listening – Engagement with Audience – Staying Engaged – Engagement on the Social Web – Social Objects – Social graph – Social Applications – leveraging Search Engine Optimization (SEO) for social media – Optimizing social media for Search Engines. Digital Media Mix: Blogs, Podcasts, Vlogs – Blog – Create a Podcast – Producing the Video cast – Measuring Blogging, Podcasting, Vlogging Metrics using any social media like Facebook, Twitter, LinkedIn etc. Measuring the Results – Other Social Media Marketing Sites – Communities.



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SOC 23SOC12 Machining

0 0 0 2

At the end of the course, students will be able to

Code	Course Outcomes
23SOC12.1	Demonstrate the various components and parts of a lathe machine, and to Understand the types of cutting tools, tool holders, and tool materials
23SOC12.2	Develop proficiency in performing fundamental lathe operations, such as turning, facing, drilling, boring, threading, and taper turning
23SOC12.3	Learn and adhere to safety guidelines, including the use of personal protective equipment (PPE), safe work habits, and hazard recognition in a lathe shop environment

Min. 60 Hours

Precision and Non Precision Instruments, Various Lathe Parts, Centering of Job in 4 Jaw and 3 Jaw Chuck, Lathe Operations like Straight Turning, TaperTurning, Facing Operation, Boring, Grooving, Knurling Operation, Metric and SSW Thread Cutting in Right Hand and Left Hand Direction, BSP Thread Cutting on the Pipe and Internal Thread Cutting on the Flange, Tool Grinding on Bench Grinder, Personal Safety and Safe Working Practices


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SOC 23SOC13 Electrical Wiring**0 0 0 2**

At the end of the course, students will be able to

Code	Course Outcomes
23SOC13.1	Examine various tools and know their usage
23SOC13.2	Explain different joints, soldering practice and execute wiring circuits
23SOC13.3	Perform various methods of earthing

Min. 60 Hours

Identify size, shape, purpose, speed and use of electrical wiring tools with respect to screw drivers, pliers, drilling machines, Rawl plug jumpers, Line tester, Splicers, Standard wire gauge, Identify different types of electrical wiring accessories with respect to switches, Ceiling roses, Lamp holders and adapters, Sockets, Plug, Fuses, Identify different types of main switches with respect to SP, DP mains, TP, ICDP, ICTP, SPDT, DPDT, TPDT, Change over-Knife type, Rotary, Micro, Modular switches, 2-pole and 3-pole MCBs. Prepare straight joint/Married joint, T joint, Western union joint, Pig tail joint, Femialirisation to use soldering tools and components and soldering of simple electronic circuits on PCB. Make a circuit with one lamp controlled by one switch with PVC surface conduit system, two lamps controlled by two switches with PVC surface conduit system, Make a circuit with one lamp controlled by one switch and provision of 2/3-pin socket. Make a circuit for stair case wiring, Make a circuit for godown wiring, Control two lamps by series - Parallel connection using one 1-way switch & two 2-way switches with PVC surface conduit system, Control wosub – circuits through energy meter, MCB's and two 1-way switches, Prepare switch board with star delta starter, MCB, Pilot lamps for 3 phase motor, Control and practice the wiring for fluorescent lamp, Connect computer by main switch board with a miniature circuit breaker. Prepare pipe earthing and plate earthing.


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SOC 23SOC14 Masonry**0 0 0 2**

At the end of the course, students will be able to:

Code	Course Outcomes
23SOC14.1	Identify the tools required for various purposes and its working in construction activity
23SOC14.2	Preparing the cement sand mortar mix in appropriate proportions based on the suitability and type of work
23SOC14.3	Undergo the types of openings, floors and need for the slope and ceiling finish as per the drawings and standards

Min. 60 Hours

Introduction to the tools and their usage, materials, properties, ratios of the mix, types masonry, types of bonds in masonry, height and width of rooms based on the purpose, types of partition, materials for partition, openings, requirements of openings, height and width of openings and ventilators, types of materials used as ventilators, provision of grooves in the brick work, finishing materials, thickness of finish, mortar ratio for the finishings, types of shuttering, checking of the level by the Plum bob or liquid levels. Performing the RCC works by rod cutting, bending & placing. Making of the different floors with various materials with determination and formation of slopes, performing the ceilings finishing for the slabs must be done as per the standards and with drawing specifications maintaining the accuracy.



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SOC 23SOC15 Automobile Servicing and Maintenance**0 0 0 2**

At the end of the course, students will be able to

Code	Course Outcomes
23SOC15.1	Identify parts in a diesel and petrol engine of LMV/HMV
23SOC15.2	Observe and report the reading of Tachometer, Odometer, temp. and Fuel gauge under ideal and on load condition
23SOC15.3	Engage in practical exercises to discern variances in the constituents of gasoline and diesel engines, and acquire hands-on experience in disassembling both light and heavy motor vehicle engines following established protocols

Min. 60 Hours

Description of internal & external combustion engines, Classification of IC engines, Principle & working of 2 & 4 - stroke diesel engine (Compression ignition Engine (C.I)), Principle of Spark Ignition Engine(SI), differentiate between 2-stroke and 4 stroke, C.I engine and S.I Engine, Direct injection and Indirect injection, Technical terms used in engine, Engine specification. Study of various gauges/instrument on a dash board of a vehicle- Speedometer, Tachometer, Odometer and Fuel gauge, and indicators such a gearshift position, Seat belt warning light, Parking-brake-engagement warning light and an Engine- malfunction light.

Different type of starting and stopping method of Diesel Engine Procedure for dismantling of diesel engine from a vehicle.

Petrol Engine Basics: 4-stroke spark-ignition engines- Basic 4-stroke principles. Spark-ignition engine components - Basic engine components, Engine cams & camshaft, Engine power transfer, Scavenging, Counter weights, Piston components. Intake & exhaust systems – Electronic fuel injection systems, Exhaust systems. Intake system components, Air cleaners, Carburettor air cleaners, EFI air cleaners, Intake manifolds, Intake air heating.


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