M.A.M SCHOOL OF ENGINEERING

(Autonomous)

(Accredited by NAAC || Approved by AICTE || Affiliated to Anna University)

Trichy – Chennai Trunk Road, Siruganur, Tiruchirappalli – 621 105

UG CURRICULUM

(I to VIII SEMESTERS)

B.E.MECHATRONICS ENGINEERING

Choice Based Credit System (CBCS)

(For the students admitted in the Academic year 2024 – 25 and onwards)

REGULATIONS 2024

M.A.M SCHOOL OF ENGINEERING

(AUTONOMOUS)

REGULATIONS 2024

CHOICEBASEDCREDITSYSTEM

B.E. MECHATRONICS ENGINEERING

I. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The graduates shall be able

- To impart essential scientific principles for solving complex engineering problems across domains of engineering and technology
- To adopt in successful career as practicing Mechatronics Engineers in interdisciplinary domains contributing to national economy.
- To inculcate ethical values and professional integrity to grow and contribute to the country.

II. PROGRAMOUTCOMES (POs)

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an under standing of the limitations.

PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

III.PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Analyze and realize Mechatronics systems to solve real life problems and develop innovative solutions for social need using automatic control systems.
PSO2	Solve industrial problems related to robotics, industrial automation using fluid power, PLC ladder logic programming and artificial intelligence.
PSO3	Analyze the real world needs and design the mechatronics system using the knowledge on multi domain engineering elements and integrated software tools.

CURRICULUM

M.A.M SCHOOL OF ENGINEERING

DEPARTMENT OF MECHATRONICS ENGINEERING

REGULATIONS 2024

CHOICE BASED CREDITSYSTEM

(Students admitted from the Academic Year 2024 – 25 onwards)

I TO VIII SEMESTERS CURRICULUM

Induction Program (Mandatory)	3 weeks duration
Induction program for students to be offered right at the start of the first year	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

B.E. MECHATRONICS ENGINEERING

SEMESTER I

S.No	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
THEORY COURSES										
1.	24HS101	Communicative English	3	0	0	3	40	60	100	HS
2.	24BS101	Matrices & Calculus	3	1	0	4	40	60	100	BS
3.	24ES101	Problem solving and Python Programming	3	0	0	3	40	60	100	ES
4.	24HS102	Heritage of Tamil	1	0	0	1	40	60	100	HS
THEORY COURSES WITH LABORATORY COMPONENT										
5.	24BS103	Engineering Physics	3	0	2	4	50	50	100	BS
LABORATORY COURSES										
6.	24HS103	Communicative English Laboratory	0	0	2	1	60	40	100	HS
7.	24ES102	Problem solving and Python Programming Laboratory	0	0	4	2	60	40	100	ES
8.	24ES103	Engineering Graphics	0	0	4	2	60	40	100	ES
		TOTAL	13	1	12	20				

SEMESTER II

THEORY COURSES

S.No	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
1.	24BS201	Transforms and Partial Differential Equations	3	1	0	4	40	60	100	BS
2.		Language Elective	2	0	0	2	40	60	100	HS
3.	24ES207	Engineering Mechanics	3	0	0	3	40	60	100	ES
4.	24HS201	Tamils and Technology	1	0	0	1	40	60	100	HS
5	24ES201	Design Thinking	2	0	0	2	40	60	100	ES
THEORY COURSES WITH LABORATORY COMPONENT										
6.	24BS203	Engineering Chemistry	3	0	2	4	50	50	100	BS
7.	24ES213	Basic Electrical and Electronics Engineering	3	0	2	4	50	50	100	ES
LABORATORY COURSES										
8.	24ES211	Foundation Skills	0	0	4	1	60	40	100	ES
9.	24ES212	Basic Engineering Skills	0	0	4	1	60	40	100	ES
10.	24TP201	Aptitude Skills and Communication skills I	0	0	2	1	100		100	EEC
TOTAL			17	1	14	23				

SEMESTER III

THEORY COURSES

S.No	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
1.	24BS301	Statistics and Numerical Method	3	1	0	4	40	60	100	BS
2.	24MT301	Electrical Drives and Actuators	3	0	0	3	40	60	100	PC
3.	24MT302	Fluid Mechanics and Thermal system	3	0	0	3	40	60	100	PC
4.	24MT303	Manufacturing Process	3	0	0	3	40	60	100	PC
THEORY COURSES WITH LABORATORY COMPONENT										
5.	24MT304	Electronic Circuits and Devices	3	0	2	4	50	50	100	PC
6.	24MT305	Mechanics of Materials	3	0	2	4	50	50	100	PC
LABORATORY COURSES										
7.	24MT306	Manufacturing Technology Lab	0	0	4	2	60	40	100	PC
8.	24MT307	Design and Modelling Laboratory	0	0	4	2	60	40	100	PC
9.	24TPS301	Aptitude Skills and Communication skills II	0	0	2	1	100	-	100	EEC
TOTAL			18	1	14	26				

SEMESTER IV

THEORY COURSES

S.No	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
1.	24MT401	Sensors and Measurements	3	0	0	3	40	60	100	PC
2.	24MT402	Linear Integrated Circuits	3	0	0	3	40	60	100	PC
3.	24MC401	Environmental Science	3	0	0	0	40	60	100	MC
THEORY COURSES WITH LABORATORY COMPONENT										
4.	24MT403	Kinematics and Dynamics of Machines	3	0	2	4	40	60	100	PC
5.	24MT404	Control System	3	0	2	4	50	50	100	PC
6.	24MT405	Digital Logic Circuits	3	0	2	4	50	50	100	PC
LABORATORY COURSES										
7.	24MT406	Sensors and Measurements Lab	0	0	4	2	60	40	100	PC
9.	24TPS401	Aptitude Skills III & Technical Skills I	0	0	2	1	100		100	EEC
		TOTAL	18	0	12	21				

SEMESTER V

THEORY COURSES

S.No	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
1.	24MT501	Industrial Automation	3	0	0	3	40	60	100	PC
2.	24 MT502	Design of Mechatronics System	3	0	0	3	40	60	100	PC
3.		Professional Elective-I	3	0	0	3	40	60	100	PE
4		Professional Elective-II	3	0	0	3	40	60	100	PE
5.		Open Elective-I	3	0	0	3	40	60	100	OE
THEORY COURSE SWITH LABORATORY COMPONENT										
6.	24MT503	Embedded System and IOT	3	0	2	4	50	50	100	PC
LABORATORY COURSES										
7.	24MT504	Mechatronics System Design Laboratory	0	0	4	2	60	40	100	PC
8.	24MT505	Industrial Automation Lab	0	0	4	2	60	40	100	PC
9.	24TPS501	Aptitude Skills IV & Technical Skills II	0	0	2	1	100		100	EEC
		TOTAL	18	0	12	24				

SEMESTER VI										
THEORY COURSES										
S.No	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
1.	24MT601	Robotics and Machine Vision Systems	3	0	0	3	40	60	100	PC
2.	24MT602	Micro Electro Mechanical System	3	0	0	3	40	60	100	PC
3.		Professional Elective-III	3	0	0	3	40	60	100	PE
4.		Professional Elective-IV	3	0	0	3	40	60	100	PE
5.		Open Elective-II	3	0	0	3	40	60	100	OE
THEORY COURSES WITH LABORATORY COMPONENT										
6.	24MT603	Application of Artificial Intelligence in Mechatronics System	3	0	2	4	50	50	100	PC
LABORATORY COURSES										
7.	24MT604	Design and Simulation of a Mechatronics Product	0	0	4	2	60	40	100	PC
8.	24TPS601	Aptitude Skills V & Technical Skills III	0	0	2	1	100		100	EEC
9.	24TPS602	Internship	0	0	4	2	100		100	EEC
		TOTAL	18	0	12	24				

SEMESTER VII										
THEORY COURSES										
S.NO	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
1.	24HS701	Human Values and Ethics	3	0	0	3	40	60	100	HS
2.	24HS701	Quality and Safety Management	3	0	0	3	40	60	100	HS
3.		Professional Elective-V	3	0	0	3	40	60	100	OE
4.		Open Elective-III	3	0	0	3	40	60	100	PE
		TOTAL	12	0	0	12				

SEMESTER VIII										
S.NO	Course Code	Course	L	T	P	C	Maximum Marks			Category
							CA	ES	Total	
LABORATORY COURSES										
1.	24MT801	Project Work	0	0	20	10	60	40	100	EEC
		TOTAL	0	0	20	10	60	40	100	

PROFESSIONAL ELECTIVE COURSES						
S.No	Course Code	Course	L	T	P	C
VERTICAL I (APPLIED ROBOTICS)						
1.	24MTX1	Robots and Systems in Smart Manufacturing	3	0	0	3
2.	24MTX2	Humanoid Robotics	3	0	0	3
3.	24MTX3	Micro robotics	3	0	0	3
4.	24MTX4	Agricultural Robotics and Automation	3	0	0	3
5.	24MTX5	Collaborative Robotics	3	0	0	3
6.	24MTX6	Robot Operating Systems	3	0	0	3
7.	24MTX7	Medical Robotics	3	0	0	3
8.	24MTX8	Robots and systems in smart manufacturing	3	0	0	3
VERTICAL II (DESIGN AND MANUFACTURING)						
9.	24MTX9	Robot and Machine Elements Design	3	0	0	3
10.	24MTX10	Design for Manufacturing	3	0	0	3
11.	24MTX11	CNC Machine Tools and Programming	3	0	0	3
12.	24MTX12	Computer Integrated Manufacturing	3	0	0	3
13.	24MTX13	Advanced Manufacturing Systems	3	0	0	3
14.	24MTX14	Additive Manufacturing	3	0	0	3
15.	24MTX15	Electronics Manufacturing Technology	3	0	0	3
16.	24MTX16	Computer Aided Inspection and Testing	3	0	0	3

S.No	Course Code	Course	L	T	P	C
		VERTICAL III (SMART MOBILITYSYSTEMS)				
17.	24MTX17	Automobile Engineering	3	0	0	3
18.	24MTX18	Electric and Hybrid Vehicles	3	0	0	3
19.	24MTX19	Automotive Mechatronics	3	0	0	3
20.	24MTX20	Automotive System Modelling and Simulation	3	0	0	3
21.	24MTX21	Vehicle Dynamics and Controls	3	0	0	3
22.	24MTX22	Aircraft Mechatronics	3	0	0	3
23.	24MTX23	Smart mobility and intelligent vehicle	3	0	0	3
24.	24MTX24	Advanced driver assistant systems	3	0	0	3
		VERTICAL IV (AVIONICS AND DRONE TECHNOLOGY)				
25.	24MTX25	Avionics	3	0	0	3
26.	24MTX26	Control Engineering	3	0	0	3
27.	24MTX27	Guidance and Control	3	0	0	3
28.	24MTX28	Navigation and Communication System	3	0	0	3
29.	24MTX29	Design of UAV systems	3	0	0	3
30.	24MTX30	Aerodynamics of Drones	3	0	0	3
31.	24MTX31	Motion control system	3	0	0	3
32.	24MTX32	Applied signal processing	3	0	0	3

		VERTICAL V (DIVERSIFIED GROUP 1)				
33.	24MTX33	Integrated Product Development	3	0	0	3
34.	24MTX34	Big Data and Analytics	3	0	0	3
35.	24MTX35	Medical Mechatronics	3	0	0	3
36.	24MTX36	Process planning and cost estimation	3	0	0	3
37.	24MTX37	Total integrated automation	3	0	0	3

OPEN ELECTIVES						
S.No	Course Code	Course	L	T	P	C
1.	24 MTY 01	Introduction to Industrial Engineering	3	0	0	3
2.	24 MTY 02	Environmental and Social Impact Assessment	3	0	0	3
3.	24 MTY 03	Renewable Energy System	3	0	0	3
4.	24 MTY 04	Introduction to Industrial Instrumentation and Control	3	0	0	3
5.	24 MTY 05	Energy Conservation and Management	3	0	0	3
6.	24 MTY 06	Introduction to Control Engineering	3	0	0	3
7.	24 MTY 07	Robotic Process Automation	3	0	0	3
8.	24 MTY 08	Electric Vehicle technology	3	0	0	3
9.	24 MTY 09	Mechatronics	3	0	0	3
10.	24 MTY 10	Industrial Management	3	0	0	3
11.	24 MTY 11	Applied Design Thinking	3	0	0	3
12.	24 MTY 12	Reverse Engineering	3	0	0	3
13.	24 MTY 13	Industrial Management	3	0	0	3
14.	24 MTY 14	Quality Engineering	3	0	0	3
15.	24 MTY 15	Fire Safety Engineering	3	0	0	3

S.No.	Category	Credits Per Semester								Total Credit	Credits in%
		I	II	III	IV	V	VI	VII	VIII		
1	HS	5	3					6		14	8.02
2	BS	8	8	4						20	12.3
3	ES	7	11							18	12.3
5	PC			21	20	14	12			67	40.7
6	PE					6	6	3		15	92.5
7	OE					3	3	3		9	5.5
8	EEC		1	1	1	1	3		10	17	11.7
Total		**20**	**23**	**26**	**21**	**24**	**24**	**12**	**10**	**160**	**100**

HS–Humanities and Social Science

BS–Basic Science

ES–Engineering Science

PC–Professional Core

PE –Professional Elective

OE–Open Elective

EEC–Employability Enhancement Course

MC–Mandatory course

CA–Continuous Assessment

ES–End Semester Examination

R 2024	SCIENCE &HUMANITIES					SEMESTER: I
24HS101	COMMUNICATIVE ENGLISH - I	L	T	P	C	HS
		3	0	0	3	

COMMON TO: ALL PROGRAMS

COURSE OBJECTIVES:

The objectives of learning this course are to:

- Enable learners to use words appropriately in their communication.
- Enhance learners' grammatical accuracy in communication.
- Develop learners ability to read and listen to texts in English.
- Strengthen the communication skills of the learners.
- Help learners write appropriately in professional contexts

COURSE OUTCOMES:

At the end of this course, students are able to

CO1: Understand the basic grammatical structures and apply them in right context

CO2: Identify and report cause and effects in events, industrial processes through technical texts.

CO3: Apply appropriate words in a professional context.

CO4: Interpret information presented in tables, charts and other graphic forms.

CO5: Draft effective resumes in the context of job search.

UNIT: I	BASICS OF LANGUAGE	9

Reading - Reading brochures (technical context), telephone messages advertisements, user manuals. **Writing** - Sequential Writing – connecting ideas using transitional words (Jumbled Sentences), **Grammar** – basics; parts of speech, Simple Tenses – Form, Function and Meaning;
Vocabulary - Synonyms; One word substitution

Pedagogical Tools	Black board, chalk, group discussion, role play, youtube videos, NPTEL videos

UNIT: II	INTRODUCTION TO FUNDAMENTALS OFCOMMUNICATION	9

Reading - Reading biographies, travelogues, newspaper reports, **Writing** -Cause and Effect Essays, **Grammar**: Continuous Tenses, Subject-Verb Agreement, Idioms; **Vocabulary:** Antonyms,
Language puzzles.

Pedagogical Tools	Black board, chalk, group discussion, role play, youtube videos, NPTEL videos

UNIT: III	NARRATION AND SUMMATION	9

Reading – Reading advertisements, Case Studies, **Writing**- Check-list, Instructions. **Grammar**:
Perfect Tenses, Imperatives; Adjectives, **Vocabulary:** Language Games/ Group Discussion.

Pedagogical Tools:	Black board, chalk, group discussion, role play, youtube videos, NPTEL videos

UNIT: IV	REPORTING OF EVENTS AND RESEARCH	9

Reading –Newspaper articles; **Writing** – Recommendations, Transcoding **Grammar** – Reported Speech, Pronouns - Possessive & Relative pronouns, **Vocabulary:** Oral Presentation.

Pedagogical Tools	Black board, chalk, group discussion, role play, youtube videos, NPTEL videos

UNIT: V	THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY	9

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; **Writing** – Job / Internship application – Cover letter & Resume; **Grammar** – Numerical adjectives, Relative Clauses. Degrees of comparison, Phrasal Verbs; **Vocabulary:** Informal Vocabulary and Formal Substitutes.

Pedagogical Tools	Black board, chalk, group discussion, role play, youtube videos, NPTEL videos

Total Periods :45

TEXT BOOKS:				
Sl.No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	Raymond, Murphy	English Grammar in Use (5th Edition)	Cambridge Press: New York	2019
2	Dr. KN. Shoba, and Dr. Lourdes Joevani	English for Science & Technology	Cambridge University Press	2021

REFERENCE BOOKS:				
Sl.No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	Meenakshi Raman & Sangeeta Sharma	Technical Communication Principles And Practices	Oxford Univ. Press	2016
2	Lakshmi Narayanan	A Course Book on Technical English	Scitech Publications (India) Pvt. Ltd.	2017
3	Kulbhusan Kumar	Effective Communication Skill	R S Salaria, Khanna Publishing House.	2018

WEB LEARNING RESOURCES:
1 https://store.acolad.com/products/english-for-engineering
2https://www.cambridge.es/en/catalogue/business-english/other-titles/cambridge-english-for/engineering
3 https://shipcon.eu.com/english-for-engineers/
4 https://www.udemy.com/course/english-for-engineers/
5 https://store.acolad.com/products/english-for-engineering

CO – PO – PSO MAPPING															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	-	-	-	-	-	1	1	-	-	-	-	3	-	-	-
CO2	-	3	-	-	-	-	3	3	-	3	-	3	-	-	-
CO3	-	-	-	-	2	-	2	-	-	3	-	3	-	-	-
CO4	-	-	-	-	-	3	-	1	2	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-
AVG	-	3	-	-	2	2	2	2	2	3	3	3	-	-	-

R 2024	SCIENCE & HUMANITIES					SEMESTER: I
24BS101	MATRICES AND CALCULUS	L	T	P	C	BS
		3	1	0	4	

COMMON TO: ALL PROGRAMS

COURSE OBJECTIVES:

The objectives of learning this course are to:

- Develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- Familiarize the student with functions of several variables. this is needed in many branches of engineering.
- Make the students understand various techniques of integration.
- Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
- Make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.

COURSE OUTCOMES:

At the end of this course, students are able to

CO1: Apply the knowledge of matrices with the concepts of eigenvalues to study their problems in core areas
CO2: Apply the basic techniques and theorems function of several variables in other areas of mathematics
CO3: Apply different methods of integration in solving practical problems.
CO4: Apply multiple integral ideas in solving areas, volumes and other practical problems.
CO5: Solve basic application problems described by second and higher order linear differential equations with constant coefficients.

UNIT: I	MATRICES	9+3
Eigen values and Eigenvectors of a real matrix - Properties of Eigen values and Eigenvectors (without proof) - Statement and applications of Cayley- Hamilton theorem (without proof) - Diagonalization of matrices- Reduction of a quadratic form to canonical form by orthogonal transformation-Nature of quadratic forms.		
Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion	

UNIT: II	FUNCTIONS OF SEVERAL VARIABLES	9+3
Partial derivatives - Total derivative - Jacobian and properties - Taylor's series expansion for function of two variables - Extreme values of functions of two variables - Lagrange multipliers method.		
Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion	

UNIT: III	INTEGRAL CALCULUS	9+3
Definite and indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by Partial fraction, Integration of irrational functions		
Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion	

UNIT: IV	MULTIPLE INTEGRALS	9+3
Double integrals - Change of order of integration - Double integrals in polar coordinates - Triple integrals - Applications in area and volume (exceptspherical , cylindrical coordinates)		
Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion	

UNIT: V	ORDINARY DIFFERENTIAL EQUATIONS	9+3
Second and higher order linear differential equations with constant coefficients - Variable coefficients - Euler Cauchy equation - method of variation parameters.		
Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion	

Total Periods :60

TEXT BOOKS:

Sl. No	Authors	Title of the Book	Publisher	Year of publication
1	Kreyszig.E	Advanced Engineering Mathematics	John Wiley and sons, New Delhi	2016
2	Grewal B.S	Higher Engineering Mathematics	Khanna Publishers, New Delhi	2018
3	James Stewart	Calculus : Early Transcendentals	Cengage Learning, New Delhi	2015

REFERENCE BOOKS:

Sl. No	Authors	Title of the Book	Publisher	Year of Publication
1	Bali.N, M.Goyal And Watkins.C	Advanced Engineering Mathematics	Lakshmi Publications, New Delhi	2015
2	Ramana B.V	Higher Engineering Mathematics	McGraw Hill Education, New Delhi	2016
3	Narayanan.S, ManicavasagamPillai .T.K	Calculus	S.Vishwanathan Publishers, Chennai	2009

WEB LEARNING RESOURCES:

1https://nptel.ac.in/courses/111108157
2https://nptel.ac.in/courses/111104125
3https://nptel.ac.in/courses/111105121
4https://nptel.ac.in/courses/111104085
5https://nptel.ac.in/courses/111104521
6https://www.brainkart.com/subject/Matrices-and-Calculus_454/
7https://youtu.be/i8FukKfMKCI
8https://youtu.be/wRR715lkK-E
9https://youtu.be/iGJxxlyqrRM
10https://youtu.be/yyc4yhlFATk
11https://youtu.be/Ziu0y2kWTCM

CO – PO – PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	1	1	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	1	1	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	1	1	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	1	1	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	-	-	-
AVG	3	3	1	1	-	-	-	-	-	-	-	3	-	-	-

R 2024	COMPUTER SCIENCE AND ENGINEERING					SEMESTER:I
24ES101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C	ES
		3	0	0	3	

COMMON TO: AERONUATICAL ENGINEERING, BME, ECE, EEE , MECHANICAL AND MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The objectives of learning this course are:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python

COURSE OUTCOMES:

At the end of this course, students able to

CO1: Develop algorithmic solutions to simple computational problems and execute simple Python programs.

CO2: Write simple Python programs using conditionals and loops for solving problems.

CO3: Decompose a Python program into functions.

CO4: Represent compound data using Python lists, tuples, dictionaries etc.

CO5: Read and write data from/to files in Python programs.

UNIT: I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, controlflow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: Flowchart to find minimum in a list, Flowchart to insert a card in a list of sorted cards, Pseudo code to find an integer number in a range, Pseudo code to find the position of the largest element in an list of n numbers, Towers of Hanoi.

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: II	DATA TYPES, EXPRESSIONS, STATEMENTS	9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, packing and unpacking arguments, precedence of operators, comments; Illustrative programs: swap the values of two variables, circulate the values of n variables, distance between two points, reverse the string.

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: III	CONTROL FLOW, FUNCTIONS, STRINGS	9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, factorial, fibonacci series, palindrome, linear search, binary search.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, YoutubeVideos,Nptel videos.	
UNIT: IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: Bubble sorting, Insertion, selection, merge sort, histogram, Add Two Matrices, Transpose a Matrix, Students marks statement, Retail bill preparation.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, YoutubeVideos,Nptel videos.	
UNIT: V	**FILES, MODULES, PACKAGES**	**9**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules (numpy, pandas, scipy, matplotlib, statmodels), packages; Illustrative programs: word count, copy file, check voting eligibility, count the number of each vowel in a string, random number generation, time series analysis, Marks range validation (0-100).		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, YoutubeVideos,Nptel videos.	
		Total Periods : 45

TEXT BOOKS:

Sl. No	Authors	Title of the Book	Publisher	Year of publication
1	Allen B. Downey	Think Python: How to Think like a Computer Scientist	O'Reilly Publishers	2016
2	Karl Beecher	Computational Thinking: A Beginner's Guide to Problem Solving and Programming	BCS Learning & Development Limited	2017

REFERENCE BOOKS:

Sl. No	Authors	Title of the Book	Publisher	Year of publication
1	Paul Deitel and Harvey Deitel	Python for Programmers	Pearson Education	2021
2	G Venkatesh and Madhavan Mukund	Computational Thinking: A Primer for Programmers and Data Scientists	Notion Press	2021
3	John V Guttag	Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data	MIT Press	2021

WEB LEARNING RESOURCES:
1. https://www.python.org/
2. https://www.geeksforgeeks.org/python-programming-language-tutorial/
3. https://www.w3schools.com/python/

CO PO PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
CO3	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
CO4	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-
CO5	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
AVG	2	2	2	2	2	-	-	-	-	-	1	2	3	1	-

R 2024	SCIENCE & HUMANITIES					SEMESTER: I
24HS102	தமிழர்மரபு / HERITAGE OF TAMIL	L	T	P	C	HS
		1	0	0	1	

COMMON TO: ALL PROGRAMS

COURSE OBJECTIVES:

The objectives of learning this course are to

- Learn the Extensive literature of classical tamil
- Review the fine arts heritage of tamil culture
- Realize the contribution of tamil in Indian freedom struggle

COURSE OUTCOMES:

At the end of this course, students are able to

CO1: Understand the weaving and ceramic technology of ancient tamil people nature.

CO2: Understand the construction technology, building materials in sangam period and case studies.

CO3: Infer the metal process, coin and beads manufacturing with relevant archaeological evidence.

CO4: Realize the agriculture methods, irrigation technology and pearl diving.

CO5: Apply the knowledge of scientific tamil and tamil computing.

UNIT: I	LANGUAGE AND LITERATURE	3

Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan

Pedagogical Tools	Board & Chalk, PPT, NPTEL video, you tube video, Group Discussion

UNIT: II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion

UNIT: III	FOLK AND MARTIAL ARTS	3

Therukoothu, Karakattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather Puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Role Play

UNIT: IV	THINAI CONCEPT OF TAMILS	3

Flora and Fauna of Tamils & Agam and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age -Export and Import during Sangam Age - Overseas Conquest of Cholas.

Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion

UNIT: V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Pedagogical Tools	Chalk & Board, PPT, NPTEL video, you tube video, Group Discussion

Total Periods :15

TEXT CUM REFERENCE BOOKS:				
Sl. No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	Dr.K.K.Pillay	tamilnadu history people and culture	Tamilnadu Textbook and Education works Corporation	2019
2	EL Sundaram	Computer Tamil	Vikatanprasuram	2016
3	Dr.S.Singaravelu	Social Life of the Tamils - The Classical Period	International Institute of Tamil Studies.	2001
4	Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu	Historical Heritage of the Tamils	International Institute of Tamil Studies	2010
5	Dr.M.Valarmathi	The Contributions of the Tamils to Indian Culture	International Institute of Tamil Studies	2001
6		Keeladi - 'Sangam City Civilization on the banks of river Vaigai'	Department of Archaeology& Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu	2019
7	Dr. K. K. Pillay	Studies in the History of India with Special Reference to Tamil Nadu	The Author	1979
8		Porunai Civilization	Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu	2019
9	R.Balakrishnan	Journey of Civilization Indus to Vaigai	RMRL	2019
10	Dr.K.K.Pillay	Social Life of Tamils	A joint publication of TNTB & ESC and RMRL	1975

WEB LEARNING RESOURCES:
https://youtu.be/8J3UJXu4JZ0?si=ekqrc_x3J79C_MwI
https://www.youtube.com/live/WbnNQM2LNQA?si=S5YS3vXjIotIuDxp
https://www.youtube.com/live/10Z7NdBPAYU?si=Xbvjmr9wzfQBCHH6
https://www.youtube.com/live/xkrRTmvPsbY?si=Xdj6zDOA-WI7Vu9j
https://youtu.be/ByHvsH0I080?si=O2HnEcVubA8tb5h8

CO – PO – PSO MAPPING															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
AVG	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-

R 2024	SCIENCE & HUMANITIES					SEMESTER: I
24BS204	ENGINEERING PHYSICS	L	T	P	C	BS
		3	0	2	4	

COMMON TO: BME, EEE, AERONAUTICAL, MECHANICAL and MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The objectives of learning this course are to:

- ✓ Achieve an understanding of rotational dynamics of multi-particles
- ✓ Acquire the knowledge of transfer of heat in conductors and insulators
- ✓ Introduce the basics of oscillations, optics and lasers
- ✓ Equip the students to understand the importance of quantum physics
- ✓ Introduce and classify crystal structures of materials

COURSE OUTCOMES:

At the end of this course, students can able to

CO1: Understand and analyze the rotational dynamics of multi-particles
CO2: Apply the concepts of heat transfer in various applications.
CO3: Demonstrate a strong foundational knowledge in oscillations, optics and lasers
CO4: Recognize the basics of quantum physics.
CO5: Differentiate crystal structures of materials

UNIT: I	MECHANICS	9

Multi-particle dynamics: Center of mass (C.M) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

Pedagogical Tools	Chalk & board, PPT, NPTEL videos, Youtube videos, Role Play

UNIT: II	THERMAL PHYSICS	9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation –rectilinear heat flow – thermal conductivity - Forbe's and Lee's disc method: theory and experiment-conduction through compound media (series and parallel)–thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

Pedagogical Tools	Chalk & board, PPT, NPTEL videos, Youtube videos, Group Discussion

UNIT: III	OSCILLATIONS, OPTICS AND LASERS	9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer – Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

Pedagogical Tools	Chalk & board, PPT, NPTEL videos, Youtube videos, Group Discussion

UNIT: IV	BASIC QUANTUM MECHANICS	9

Photons and light waves - Electrons and matter waves – Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle

Pedagogical Tools	Chalk & board, PPT, NPTEL videos and Youtube videos, Group Discussion

UNIT: V	CRYSTAL STRUCTURE	9

Introduction – Classification of solids –Space lattice –Basis-Lattice parameter – Unit cell – Crystal system –Miller indices –d-spacing in cubic lattice - Calculation of number of atoms per unit cell – Atomic radius-Coordination number – Packing factor for SC, BCC, FCC and HCP structures – crystal imperfection – Burger vector.

Pedagogical Tools	Chalk & board, PPT, NPTEL videos, Youtube videos, Role Play

Total Periods: 45

Practical Exercises: (Any six experiments to be conducted)	**Total Periods: 30**
1. Non-uniform bending - Determination of Young's modulus	
2. Uniform bending – Determination of Young's modulus	
3. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.	
4. Laser- Determination of the wave length of the laser using grating	
5. Optical fibre -Determination of numerical aperture (NA) and acceptance angle (AA)	
6. Air wedge - Determination of thickness of a thin sheet/wire	
7. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids	
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.	
9. Simple harmonic oscillations of cantilever.	
	Total Periods: 75

TEXT BOOKS:

Sl.No	Authors	Title of the Book	Publisher	Year of publication
1	D. Kleppner and R. Kolenkow	An Introduction to Mechanics	McGraw Hill Education (Indian Edition)	2017
2	Gaur, R.K. and Gupta,S.L	Engineering Physics	DhanpatRai Publishers	2018
3	D. Halliday, R. Resnick and J. Walker	Principles of Physics	Wiley (Indian Edition)	2015
4	Arthur Beiser, Shobhit Mahajan, S. RaiChoudhury	Concepts of Modern Physics	McGraw-Hill (Indian Edition)	2017
5	M.Arumugam	Engineering Physics	Anuradha publications	2010
6	Gaur,R.K.andGupta,S.L	Engineering Physics	DhanpatRai Publishers	2018

REFERENCE BOOKS:

Sl.No	Authors	Title of the Book	Publisher	Year of publication
1	R.Wolfson	Essential University Physics. Volume 1 & 2	Pearson Education (Indian Edition)	2020
2	K.Thyagarajan and A.Ghatak	Lasers: Fundamentals and Applications	Laxmi Publications, (Indian Edition)	2019
3	R.K.Rajput	Thermal Engineering	Laxmi Publications,	2011
4	S.O.Pillai,	Solid State Physics	New Age International, (Multicolour Edition)	2018

WEB LEARNING RESOURCES:

1. https://youtu.be/fDJeVR0o__w?list=PLyQSN7X0ro203puVhQsmCj9qhlFQ-As8e (Rotating Objects, Moment of Inertia, Rotational KE)
2. https://archive.nptel.ac.in/courses/104/104/104104085/ (Lasers)
3. https://www.youtube.com/playlist?list=PL1gyM10tgL1hK9666oGndGlWDQdpQzkY9 (NPTEL: Heat transfer lectures by Dr.Gangesh A. Viswanathan, IITB)
4. https://archive.nptel.ac.in/courses/115/101/115101107/ (Quantum mechanics)
5. https://youtu.be/5EiZjZjG-IY(NPTEL lectures: Crystal Structure - 2 (Unit Cell, Lattice, Crystal)
6. https://www.youtube.com/watch?v=mx2P1_M-7UA&list=PLFE3074A4CB751B2B&index=9 (Rotations, Part I: Dynamics of Rigid Bodies)
7. https://www.youtube.com/watch?v=UzrZxpup3rc&list=PLFE3074A4CB751B2B&index=10 (Rotations, Part II: Parallel Axis Theorem)
8. https://youtu.be/7Bj3N1E7vZk?list=PLZOZfX_TaWAHZOgn8CRjpqRElp5Dd-GaY (Introduction to heat transfer, conduction, convection, and radiation)
9. https://youtu.be/dRpyfm66GxM(Particle in an Infinite Potential Well ,QUANTUM MECHANICS)

CO – PO – PSO MAPPING															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	1	1	-	-	-	-	-	-	-	-	-
CO2	3	-	1	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	3	2	1	2	1	-	-	-	-	-	-	-	-	-
CO4	3	3	1	1	2	1	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-		-	-	-	-	-
AVG	3	3	2	1	2	1						1			

R 2024	SCIENCE & HUMANITIES					SEMESTER: I
24HS103	COMMUNICATIVE ENGLISH LABORATORY	L	T	P	C	BS
		0	0	2	2	

COMMON TO: ALL PROGRAMS

COURSE OBJECTIVES:

The objectives of learning this course are to:

- ✓ Improve the communicative competence of learners
- ✓ Help learners use language effectively in academic /work contexts
- ✓ Develop various listening strategies to comprehend various types of audio materials like
- ✓ Build on students' English language skills by engaging them in listening, speaking
- ✓ Use language efficiently in expressing their opinions via various media.

COURSE OUTCOMES:

At the end of this course, students are able to

CO1: Identify varied group discussion skills and apply them to take part in effective

CO2: Listen to and understand different points of view in a discussion

CO3: Speak fluently and accurately in formal and informal communicative contexts

CO4: Describe products and processes and explain their uses and purposes clearly and accurately

CO5: Express their opinions effectively in both formal and informal discussions

LIST OF EXPERIMENTS

1. Write about a self introduction for your future job opportunities
2. Write a telephonic conversation between a father and a son on "career"
3. Write a product description for a fire extinguisher
4. Give any one product user manual
5. Prepare a TED talk about artificial intelligence
6. Describe a famous person's inspirational you heard before in your life
7. Write about panel discussion
8. Write your view and opinion the solve the water scarcity

Total Periods :30

CO – PO – PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	-	-	-	-	3	-	-	-
CO2	-	3	-	-	-	-	3	3	-	3	-	3	-	-	-
CO3	-	-	-	-	2	-	2	-	-	3	-	3	-	-	-
CO4	-	-	-	-	-	3	-	1	2	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-
AVG	-	3	-	-	-	1	-	1	1	-	3	3	-	-	-

R 2024	COMPUTER SCIENCE AND ENGINEERING					SEMESTER: I
24ES102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C	ES
		0	0	4	2	

COMMON TO: AERONUATICAL ENGINEERING, BME, ECE, EEE , MECHANICAL AND MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The objectives of learning this course are:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

COURSE OUTCOMES:

At the end of this course, students able to
CO1: Develop algorithmic solutions to simple computational problems
CO2: Implement programs in Python using conditionals and loops for solving problems.
CO3: Deploy functions to decompose a Python program.
CO4: Process compound data using Python data structures.
CO5: Utilize Python packages in developing software applications.

PRACTICAL EXERCISES:

1.Identification and solving of simple real life or scientific or technical problems, and developing flowcharts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)

2.Python programming using simple statements and expressions (exchange the values of twovariables, circulate the values of n variables, distance between two points).

3.Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns,pyramid pattern)

4.Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)

5.Implementing real-time/technical applications using Sets, Dictionaries. (Language, components ofan automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)

6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)

7. Implementing programs using Strings. (reverse, palindrome, character count, replacingcharacters)

8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy.Matplotlib, scipy)

9. Implementing real-time/technical applications using File handling. (copy from one file to another,word count,
longest word)

10.Implementing real-time/technical applications using Exception handling. (divide by zero error,voter's age validity, student mark range validation)

11.Exploring Pygame tool.

12.Mini Project - Developing a game activity using Pygame like bouncing ball, car race, Cricketalerts etc.

Total Periods : 60

CO PO PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	2	2	2	1	2	1	1	1	2	-	3	2	2	2	-
CO2	2	3	2	1	2	1	1	1	2	-	3	2	2	2	-
CO3	3	2	2	1	3	1	1	1	2	-	3	3	2	2	-
CO4	2	3	3	1	2	1	2	1	2	-	3	2	2	3	-
CO5	2	3	3	1	2	1	-	-	2	1	2	2	2	2	-
AVG	2	3	2	1	2	1	1	1	2	1	3	2	2	2	-

R 2024	MECHANICAL ENGINEERING					SEMESTER: I
24 ES103	ENGINEERING GRAPHICS	L	T	P	C	PC
		0	0	4	2	

COMMON TO: AERONAUTICAL, MECHANICAL and MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The main objectives of this course are to:

- To learn conventions and use of drawing tools in making engineering drawings
- To draw orthographic projection of points and lines
- To understand the projection of planes and simple solids
- To teach the section of solids and obtain the development of surfaces of given solids
- To deliver how to draw isometric and perspective projections of the given solids

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Recognize the conventions and construct basic engineering curves.

CO2: Draw the projection of points and lines.

CO3: Sketch the projection of planes and simple solids.

CO4: Produce the projection section of solids and development of surfaces of given solids

CO5: Develop the isometric projection and Perspective projections of the given objects

PRACTICAL EXERCISES:

1. Fundamental of drawing: Importance of graphics in engineering applications–Use of drafting instruments–BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. (Not for examination)
2. Fundamental of drawing: Importance of graphics in engineering applications–Use of drafting instruments–BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. (Not for examination)
3. Projection of straight lines (only First angle projection) inclined to both the principal planes - Determination of true l lengths and true inclinations by rotating line method.
4. Projection of polygonal plane surface inclined to both the principal planes by rotating object method (Pentagonal and Hexagonal plane surface)
5. Projection of Circular plane inclined to both the principal planes by rotating object method.
6. Projection of simple prisms (Hexagon and pentagon) when the axis is inclined to one of the principal planes.
   Note: One problem has to be drawn using CAD software.
7. Projection of simple prisms (Hexagon and pentagon) when the axis is inclined to one of the principal planes.
   Note: One problem has to be drawn using CAD software.
8. Projection of simple pyramids (Hexagon and pentagon), cylinder and cone when the axis is inclined to one of the principal planes.
   Note: One problem has to be drawn using CAD software.
9. Projection of cylinder and cone when the axis is inclined to one of the principal planes.
   Note: One problem has to be drawn using CAD software.
10. Projection of sectioned solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section (Prism or Pyramid)
    Note: One problem has to be drawn using CAD software.

11. Development of lateral surfaces of simple and sectioned solids (Prism or Pyramid) Note: One problem has to be drawn using CAD software.

12. Draw the isometric view of frustum of solids like Prism or Pyramid of pentagonal or hexagonal base.

Note: One problem has to be drawn using CAD software.

13. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Note: One problem has to be drawn using CAD software.

Total Periods : 60

CO PO PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	3	3	3	2	-	-	-	-	3	-	2	1	3	2
CO2	3	3	3	3	2	-	-	-	-	3	-	2	1	3	2
CO3	3	3	3	3	2	-	-	-	-	3	-	2	1	3	2
CO4	3	3	3	2	2	-	-	-	-	3	-	2	1	3	2
CO5	3	3	3	2	2	-	-	-	-	3	-	2	1	3	2
AVG	3	3	3	2	2	-	-	-	-	3	-	2	1	3	2

R 2024	SCIENCE & HUMANITIES					SEMESTER: II
24BS201	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C	BS
		3	1	0	4	

COMMON TO: BME, ECE, EEE, AERONAUTICAL, MECHANICAL & MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The objectives of learning this course are:

- ✓ Introduce the basic concepts of PDE for solving standard partial differential equations.
- ✓ Make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- ✓ Introduce fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- ✓ Acquaint the student with fourier transform techniques used in wide variety of situations.
- ✓ To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z-Transform techniques for discrete time systems.

COURSE OUTCOMES:

At the end of this course, students are able to :

CO1: understand how to solve the given standard partial differential equations.

CO2: apply Laplace transform techniques in solving linear differential equations.

CO3: apply Fourier series techniques in engineering applications.

CO4: use the Fourier transforms techniques in solving engineering problems.

CO5: use the Z-Transforms techniques in solving difference equations.

UNIT: I	**PARTIAL DIFFERENTIAL EQUATIONS**	**9+3**
Formation of partial differential equations –Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Homogeneous Linear partial differential equations of second and higher order with constant coefficients		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos, Nptel videos.	
UNIT: II	**LAPLACE TRANSFORMS**	**9+3**
Existence theorem - Transform of standard functions – Transform of Unit step function and Dirac delta function – Basic properties - Shifting theorems - Transforms of derivatives and integrals – Transform of periodic functions - Inverse Laplace Transforms- Convolution theorem (without proof) – Solving differential equations using Laplace Transform techniques.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos, Nptel videos.	
UNIT: III	**FOURIER SERIES**	**9+3**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos, Nptel videos.	
UNIT: IV	**FOURIER TRANSFORMS**	**9+3**
Fourier integral theorem – Fourier transform pair - Fourier sine and cosine transforms – Properties – Transform of elementary functions - Convolution theorem (without proof) – Parsevals's identity.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.	
UNIT: V	**Z – TRANSFORMS**	**9+3**
Z-transforms - Elementary properties – Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.	
		Total Periods :60

(Recommended by Ist BOS held on 05.09.24 & Approved by Ist Academic Council held on 25.11.24)

TEXT BOOKS:				
Sl.No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	Kreyszig.E	Advanced Engineering Mathematics	John Wiley and sons, New Delhi	2016
2	Grewal B.S	Higher Engineering Mathematics	Khanna Publishers, New Delhi	2018
REFERENCE BOOKS:				
Sl.No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	Bali.N, M.Goyal	A text book of Engineering Mathematics	Lakshmi Publications, Reprint,New Delhi	2015
2	Jain R.K. and Iyengar S.R.K.	Advanced Engineering Mathematics	Narosa Publications, New Delhi , 3rd Edition	2017
3	Ramana B.V.	Higher Engineering Mathematics	Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi	2010
5	Peter V. O'Neil	Advanced Engineering Mathematics	Cengage Learning India Pvt., Ltd,7th Edition, New Delhi	2012

WEB LEARNING RESOURCES:
1 https://www.brainkart.com/subject/Transforms-and-Partial-Differential-Equations_93/
2 https://nptel.ac.in/courses/111105093
3 https://nptel.ac.in/courses/111102129
4 https://nptel.ac.in/courses/111105123
5 https://nptel.ac.in/courses/111106046
6 https://nptel.ac.in/courses/111103021
7 https://nptel.ac.in/courses/111105035
8 https://nptel.ac.in/courses/111106111
9 https://nptel.ac.in/courses/111106139
10https://youtu.be/Sb6qrdMPRPE?si=2kqgDNOyQYkh1UJC
11https://youtu.be/l4pFAAR5km8?si=wcPssWizT66RCYiP
12https://youtu.be/NNTJ5VinRPU?si=dOq5vs2VbpJx0cOo
13https://youtu.be/PG_-ax_HmS0?si=bCbVoOtY68o0uZC0
14https://youtu.be/kum70H2NcqU?si=WelThJwV8X_ysdDa

CO – PO – PSO MAPPING															
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
Avg	3	2	3									3			

R 2024	SCIENCE & HUMANITIES					SEMESTER: II
24HS201	Tamils and Technology	L	T	P	C	HS
		1	0	0	1	

COMMON TO: ALL PROGRAMS

COURSE OBJECTIVES:

The objectives of learning this course are to:

- ✓ Learn weaving, ceramic and construction technology of Tamil.
- ✓ Understand the agriculture, irrigation and manufacturing technology of tamil.
- ✓ Realize the development of scientific Tamil and computing.

COURSE OUTCOMES:

At the end of this course, students can able to :

CO1: Understand the weaving and ceramic technology of ancient Tamil people nature.

CO2: Understand the construction technology, building materials in sangam period and case studies.

CO3: Infer the metal process, coin and beads manufacturing with relevant archaeological evidence.

CO4: Realize the agriculture methods, irrigation technology and pearl diving.

CO5: Apply the knowledge of scientific Tamil and Tamil computing.

UNIT: I	WEAVING AND CERAMIC TECHNOLOGY	3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos .	
UNIT: II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silapathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study Madurai Meenakshi Temple)- ThirumalaiNayakarMahal - Chettinad Houses, Indo - Saracenic architecture at Madras during British Period		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos .	
UNIT: III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gemstone types described in Silapathikaram Therukoothu, Karakattam, VilluPattu, Kaniyan Koothu, Oyilattam, Leather Puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos .	
UNIT: IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Flora and Fauna of Tamils &Agam and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos .	
UNIT: V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sekai Project.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.	
		Total Periods :15

(Recommended by Ist BOS held on 05.09.24 & Approved by Ist Academic Council held on 25.11.24)

TEXT CUM REFERENCE BOOKS:				
Sl.No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	Dr.K.K.Pillay	Tamilnadu history people and culture	Tamilnadu Textbook and Education works Corporation	2019
2	EL Sundaram	Computer Tamil	Vikatanprasuram	2016
3	Dr.S.Singaravelu	Social Life of the Tamils - The Classical Period	International Institute of Tamil Studies.	2001
4	Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu	Historical Heritage of the Tamils	International Institute of Tamil Studies	2010
5	Dr.M.Valarmathi	The Contributions of the Tamils to Indian Culture	International Institute of Tamil Studies.	2001
6	Dr. R. Sivanantham	Keeladi - 'Sangam City Civilization on the banks of river Vaigai'	Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu	2019
7	Dr.K.K.Pillay	Studies in the History of India with Special Reference to Tamil Nadu	This Author	1979
8		Porunai Civilization	Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu	2019
9	R.Balakrishnan	Journey of Civilization Indus to Vaigai	RMRL	2019
10	Dr.K.K.Pillay	Social Life of Tamils	A joint publication of TNTB & ESC and RMRL	1975

WEB LEARNING RESOURCES:
1 https://youtu.be/jteRvnNiD6w?si=HmAS7a_gng6hYcL_
2 https://youtu.be/WZwdo20QgP8?si=2oTevNPCiGzTPi0-
3 https://youtu.be/05e3v0xGA9k?si=SHa2vsQG39RpDPtZ
4 https://youtu.be/bxYdHw4rvec?si=Eryg0PF72BPhbRBH
5 https://youtu.be/MRfbeJvJZ0k?si=YpAYFFEpLdV8FIrX
6 https://youtu.be/BS_BSDZp6HA?si=D_QdZn1Zr6X3C95p

CO – PO – PSO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO2	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
CO5	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-
AVG	-	-	-	-	-	-	3	3	-	2	-	3	-	-	-

R 2024	SCIENCE & HUMANITIES					SEMESTER: II
24HS202	PROFESSIONAL ENGLISH	L	T	P	C	HS
		2	0	0	2	

COMMON TO ALL PROGRAMS

COURSE OBJECTIVES:

The objectives of learning this course are to:

- ✓ Enable learners use words appropriately in their communication.
- ✓ Enhance learners grammatical accuracy in communication.
- ✓ Develop learners ability to read and listen to texts in English.
- ✓ Strengthen the communication skills of the learners.
- ✓ Help learners write appropriately in professional contexts.

COURSE OUTCOMES:

At the end of this course, students are able to:

CO1: Apply their comprehension skills and interpret different contents effortlessly
CO2: Participate effectively in diverse speaking situations
CO3: Apply technical information and knowledge in practical documents.
CO4: Demonstrate appropriate language use in extended discussions.
CO5: Present, discuss and coordinate with their peers in workplace using their language skills.

UNIT: I	BASICS OF LANGUAGE	6
Reading - Intentional Reading - Short Narratives and Passages. **Writing** - Writing emails / letters introducing oneself., **Grammar** – Sentence Patterns, Why/ Yes or No/ and Tags; **Vocabulary** - Word formation – Prefix Suffix		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos	
UNIT: II	**INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION**	**6**
Reading - Excerpts from literature, and travel & technical blogs. **Writing** - Note Making, Note Taking – Paragraph Writing, **Grammar**: Prepositions, Articles, Model verbs; **Vocabulary:** Verbal Analogy / Cloze Exercise.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos	
UNIT: III	**NARRATION AND SUMMATION**	**6**
Reading – Timed Reading, Filling KWL, **Writing**- Writing responses to complaints. **Grammar**: Active Passive Voice transformations, Punctuations. **Vocabulary:** Different forms of the same words.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos Videos	
UNIT: IV	**REPORTING OF EVENTS AND RESEARCH**	**6**
Reading – Extensive reading (Jigsaw Reading, Short Stories, Novels); **Writing** – Problem solution essay / Argumentative Essay **Grammar** – Error correction, Infinitive and Gerunds **Vocabulary :** Compound Words.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos	
UNIT: V	**THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY**	**6**
Reading – Reading editorials; and Opinion Blogs – Reading editorials; and Opinion Blogs; **Writing** – Paragraph writing Short Report on an event (field trip etc.); **Grammar** – Concord, If conditionals ; **Vocabulary:** Dialogue writing.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos .	
		Total Periods :30

(Recommended by Ist BOS held on 05.09.24 & Approved by Ist Academic Council held on 25.11.24)

TEXT BOOKS:				
Sl. No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	M. Ashraf Rizvi	Effective Technical Communication	Orient Blackswan Private Ltd.	2020
2	Dr. KN. Shoba, and Dr. Lourdes Joevani	English for Science & Technology	Cambridge University Press	2021
REFERENCE BOOKS:				
Sl. No	**Authors**	**Title of the Book**	**Publisher**	**Year of publication**
1	Meenakshi Raman &Sangeeta Sharma	Technical Communication – Principles And Practices	Oxford Univ. Press	2016
2	Lakshmi Narayanan	A Course Book on Technical English	Scitech Publications (India) Pvt. Ltd.	2017
3	Kulbhusan Kumar	Effective Communication Skill	R S Salaria, Khanna Publishing House.	2018
WEB LEARNING RESOURCES:				
1	https://store.acolad.com/products/english-for-engineering			
2	https://www.cambridge.es/en/catalogue/business-english/other-titles/cambridge-english-for/engineering			
3	https://shipcon.eu.com/english-for-engineers/			
4	https://www.udemy.com/course/english-for-engineers/			
5	https://store.acolad.com/products/english-for-engineering			

CO – PO – PSO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	3	-	-	-	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-
AVG	-	-	-	-	-	3	-	-	3	3	3	3	-	-	-

R 2024	MECHANICAL ENGINEERING					SEMESTER: II
24ES207	ENGINEERING MECHANICS	L	T	P	C	PC
		3	0	0	3	

COMMON TO : AERONAUTICAL, MECHANICAL and MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The main objectives of this course are to:

- To Learn the use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- To introduce the equilibrium of rigid bodies, vector methods and free body diagram
- To study and understand the distributed forces, surface, loading on beam and intensity.
- To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
- To develop basic dynamics concepts – force, momentum, work and energy

COURSE OUTCOMES:

At the end of this course, students can able to

CO1 Students will understand the concepts of engineering mechanics

CO2 Students will understand the vectorial representation of forces and moments

CO3 Students will gain knowledge regarding center of gravity and moment of inertia and apply them for practical problems.

CO4 Student will gain knowledge on friction on equilibrium and its application.

CO5 Student will gain knowledge in solving problems involving work and energy

UNIT: I	STATICS OF PARTICLES	9

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: II	STATICS OF RIGID BODIES	9

Principle of Transmissibility, Equivalent Forces, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: III	PROPERITIES OF SURFACES AND SOLIDS	9

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus s-Guldinus, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates.

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: IV	FRICTION	9
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.	
UNIT: V	**DYNAMICS OF PARTICLES**	**9**
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.		
Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.	
		Total Periods : 45

TEXT BOOKS:

Sl. No	Authors	Title of the Book	Publisher	Year of publication
1	Vela Murali	Engineering Mechanics-Statics and Dynamics	Oxford University Press	2018

REFERENCE BOOKS:

Sl. No	Authors	Title of the Book	Publisher	Year of publication
1	Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi,	Vector Mechanics for Engineers: Statics and Dynamics	McGraw Higher Education	2019
2	Hibbeller, R.C.	Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics	Prentice Hall,	2013
3	Irving H. Shames, Krishna Mohana Rao G	Engineering Mechanics – Statics and Dynamics	Pearson Education Asia Pvt. Ltd.,	2005
4	Timoshenko S, Young D H, Rao J V and Sukumar Pati	Engineering Mechanics	McGraw Hill Higher Education,	2013

WEB LEARNING RESOURCES:

1. NPTEL - https://www.youtube.com/watch?v=A-3W1EbQ13k&list=PLyqSpQzTE6M_MEUdn1izTMB2yZgP1NLfs

2. MIT-https://www.youtube.com/watch?v=GUvoVvXwoOQ&list=PLUl4u3cNGP62esZEwffjMAsEMW_YArxYC

CO PO PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	2	1	2	-	-	-	-	-	-	2	-	-	-
CO2	3	2	2	1	2	-	-	-	-	-	-	2	-	-	-
CO3	3	2	2	1	2	-	-	-	-	-	-	2	-	-	-
CO4	3	2	2	1	2	-	-	-	-	-	-	2	-	-	-
CO5	3	2	2	1	2	-	-	-	-	-	-	2	-	-	-
AVG	3	2	2	1	2	-	-	-	-	-	-	2	-	-	-

R 2024	ELECTRICAL AND ELECTRONICS ENGINEERING					SEMESTER:II
24ES214	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C	ES
		3	0	2	4	

COMMON TO : AERONAUTICAL, MECHANICAL and MECHATRONICS ENGINEERING Departments

COURSE OBJECTIVES:

The main objectives of this course are to:

- ✓ Equip students with a foundational understanding of electric circuits and analysis.
- ✓ Impart knowledge in the basics of working principles and application of electrical machines.
- ✓ Introduce analog devices and digital electronics and their characteristics.
- ✓ Foster Proficiency in handling the measuring instruments and its working.
- ✓ Clarify the power generation, transmission, distribution and safety.

COURSE OUTCOMES:

At the end of this course, students are able to:

CO1: Compute the electric circuit parameters for simple problems.

CO2: Understand the working principle and applications of electrical machines.

CO3: Analyze the characteristics of analog electronic and digital electronics .

CO4: Know the basic concepts of functional elements and working of measuring instruments

CO5: Realize the concepts of power generation, distribution and safety.

UNIT: I	ELECTRICAL CIRCUITS	9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws ,series and parallel combinations of resistance–voltage and current division .Independent and Dependent Sources – Simple problems-Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Steady state analysis for sinusoidal excitation:(simple Problems only) Introduction –sinusoidal function-sinusoidal steady state analysis – power in sinusoidal steady state – nodal and mesh analysis (Simple problems only)

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: II	ELECTRICAL MACHINES	9

Construction and Working principle of DC motors and D.C. Generators- EMF equation, Torque Equation,Types and Applications, Construction, Working principle and Applications of Transformer Emf equation, Synchronous motor and Three Phase Induction Motor construction and working principle. (Qualitative treatment only)

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos, Nptel videos.

UNIT: III	ANALOG & DIGITAL ELECTRONICS	9

Semiconductor Materials: Silicon & Germanium – PN Junction Diode, Zener Diode –Characteristics , Applications – Bipolar Junction Transistor-Biasing, SCR, I-V Characteristics and Applications, Rectifier (Half wave & Full wave centre tapped, Bridge type) (Qualitative treatment only) Number systems, Binary system,Hexa Decimal system and Octal number system ,Logic Gates and Universal Gates

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: IV	MEASUREMENTS AND INSTRUMENTATION	9

Electrical and electronics instruments, classification of instruments, Types of indicating instruments, Electrodynamometer type instruments, Energy meter, instrument Transformers CT and PT.

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: V	GENERATION, TRANSMISSION AND DISTRIBUTION OF POWER SYSTEM	9

Power system structure -Generation , Transmission and distribution , Various voltage levels, Earthing – Methods of earthing, protective devices- switch fuse unit- Miniature circuit breaker, moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid (Qualitative treatment only)

Pedagogical Tools	Black board, chalk, Group Discussion, Role Play, Youtube Videos,Nptel videos.

Periods : 45

PRACTICAL EXERCISES **Periods : 30**

1. Verification of ohms and Kirchhoff's Laws
2. Load test on DC Shunt Motor.
3. Load test on Single phase Transformer.
4. Load Test on Three phase Induction Motor.
5. Speed control of DC Shunt Motor.
6. Load test on Single Phase Induction motor.

Total Periods : 75

TEXT BOOKS:

Sl.No.	Authors	Title of the Book	Publisher	Year of Publication
1	Kothari D.P. and I.J Nagrath	Basic Electrical and Electronics Engineering	Second edition McGraw Hill Education,	2020
2	S.K. Bhattacharya	Basic Electrical and Electronics Engineering	.Pearson Education, Second Edition,	2017.
3	C.L.Wadhwa	"Generation, Distribution and Utilisation of Electrical Energy",	New Age International pvt.ltd.,	2015

REFERENCE BOOKS:

Sl.No	Authors	Title of the Book	Publisher	Year of publication
1	Thomas L. Floyd,	'Digital Fundamentals11th Edition	Pearson Education	2017
2	H.S. Kalsi	Electronic Instrumentation	Tata McGraw-Hill, New Delhi	2010
3	Albert Malvino, David Bates,	Electronic Principles, 7th edition	McGraw Hill Education	2017.

WEB LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/
2. https://www.khanacademy.org/science/electrical-engineering
2. https://www.coursera.org/browse/physical-science-and-engineering/electrical-engineering

3. https://ethw.org/Category:Engineering_fundamentals?gad_source=1&gclid=Cj0KCQjwtZK1BhDuARIsAAy2VzthS61SRxHUpVR7d7ruGv1_Gz_SIwmTjGusTibTehRbI2z1ZPRCilsaAoM2EALw_wcB
4. https://ethw.org/Category:Engineering_fundamentals?gad_source=1&gclid=Cj0KCQjwtZK1BhDuARIsAAy2Vzv97YRwkx1whxouLZli7v5gQF6lwqAdMDvpdfn_8pbiWvycM68h80MaArogEALw_wcB
5. https://www.wolframalpha.com/examples/science-and-technology/engineering/electrical-engineering/electric-circuits/
6. https://observatorysciences.co.uk/?gad_source=1&gclid=Cj0KCQjwtZK1BhDuARIsAAy2VztpEyy3LCu9y-YRVH0gE492lo6tIEOwTuayBynUOGY1u82Mc51vQcYaAvgoEALw_wcB
7. https://www.circuitlab.com/

CO PO PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO2	3	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO3	3	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO4	3	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO5	3	2	1	-	-	-	-	1	-	-	-	2	-	-	1
AVG	3	2	1	-	-	-	-	1	-	-	-	2	-	-	1

1-Low, 2-Medium, 3-High

R 2024	SCIENCE & HUMANITIES					SEMESTER: II
24BS203	CHEMISTRY FOR ENGINEERS	L	T	P	C	BS
		3	0	2	4	

COMMON TO: BME, EEE, AERONAUTICAL, MECHANICAL and MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The objectives of learning this course are to:

- ✓Inculcate sound understanding of water quality parameters and water treatment techniques.
- ✓Introduce the basic concepts and applications of phase rule and alloys.
- ✓Facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- ✓Familiarize the students with the different energy sources, operating principles, working processes and applications of energy conversion and storage devices.
- ✓Impart knowledge on the basic principles and preparatory methods of nanomaterials.

COURSE OUTCOMES:

At the end of this course, students are able to :

CO1: Understand the quality of water from quality parameter data, analyze and propose the suitable treatment methodologies to treat water.
CO2: Recognize different forms of energy resources and apply them for suitable applications in energy sectors.
CO3: Apply the knowledge of phase rule and alloys for material selection requirements.
CO4: Analyze and recommend suitable fuels for engineering processes and applications.
CO5: Apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials

UNIT: I	WATER TECHNOLOGY	9

Water: Sources, impurities and water quality parameters, Hardness of water – types – expression of hardness – units, Boiler troubles: Scale and sludge, Priming &foaming. Need for water treatment, Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment (Ion exchange or demineralization and zeolite process), Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis.

Pedagogical Tools	Chalk & Board, Group Discussion, Role Play, Youtube Videos,Nptel videos.

UNIT: II	ENERGY SOURCES AND STORAGE DEVICES	9

Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Basic Electrochemical Terminologies, Batteries: Types of batteries, Primary battery (dry cell), Secondary battery (lead acid battery and lithium-ion-battery); Electric vehicles– working principles; Fuel cells: H_2-O_2 fuel cell, Bio Fuel Cell, microbial fuel cell; Super capacitors: Storage principle, types and examples.

Pedagogical Tools	Chalk & Board , Group Discussion, Role Play, Youtube Videos, Nptel videos.

UNIT: III	PHASE RULE AND ALLOYS	9

Phase rule: Introduction, definition of terms with examples. One component system - water system, sulphur system; Reduced phase rule; Construction of a simple eutectic phase diagram – Two component system: lead-silver system-Pattinson's process,$FeCl_2$-H_2O system.

Alloys: Introduction- Definition- properties of alloys- significance of alloying, Alloys-Nichrome and stainless steel (18/8) – heat treatment of steel. Introduction to composites – definition-types-uses.

Pedagogical Tools	Chalk & Board , Group Discussion, Role Play, Youtube Videos, Nptel videos.

UNIT: IV	FUELS AND COMBUSTION	9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate),Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Property - Knocking, Power alcohol and biodiesel (trans-esterification).Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Flue gas analysis-ORSAT Method.CO_2 emission and carbon footprint.

Pedagogical Tools	Chalk & Board , Group Discussion, Role Play, Youtube Videos, Nptel videos.

UNIT: V	NANO TECHNOLOGY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of - nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, laser ablation, chemical vapour deposition, Analytical techniques- SEM, TEM, Applications of nanomaterials

Pedagogical Tools	Chalk & Board , Group Discussion, Role Play, Youtube Videos, Nptel videos.

Total Periods:45

Practical Exercises: (Any six experiments to be conducted) **Total Periods:30**

1. Preparation of Na_2CO_3 as a primary standard and determination of types and amount of alkalinity in water sample
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of chloride content of water sample by Argentometric method.
4. Estimation of sodium /potassium present in water using a flame photometer.
5. Estimation of copper content of the given solution by Iodometry
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer
9. Estimation of Nickel in steel

Total Periods:75

TEXT BOOKS:

Sl.No	Authors	Title of the Book	Publisher	Year of publication
1	P.C.Jain and Monica Jain	Engineering Chemistry	16thEdition,DhanpatRaiPublishingCompany (P)Ltd, New Delhi	2018
2	S.S. Dara	A Text book of Engineering Chemistry	S.Chand Publishing,12thEdition	2018
3	Vairam S, Kalyani P and Suba Ramesh	Engineering Chemistry	2nd Edition, Wiley India Pvt. Ltd., New Delhi	2014
4	J Mendham RC Denn MJK Thomas David J Barnes	Vogel's Text book of Quantitative Chemical Analysis	Pearson Education	2018

REFERENCE BOOKS:

Sl.No	Authors	Title of the Book	Publisher	Year of publication
1	B.S.Murty,P. Shankar, Baldev Raj,B. B.Rath and James Murday	Text book of nano science and nanotechnology	Universities Press-IIM Series in Metallurgy and Materials Science	2018
2	Shikha Agarwal	Engineering Chemistry-Fundamentals and Applications	Cambridge University Press, Delhi, Second Edition	2019
3	O.G. Palanna	Engineering Chemistry	McGraw Hill Education (India) Private Limited, 2ndEdition	2017
4	Prasanta Rath	Engineering Chemistry	Cengage Learning India, Pvt., Ltd., Delhi. 1st Edition	2015

WEB LEARNING RESOURCES:

1	https://nptel.ac.in/courses/105106119 (Unit 1)
2	https://nptel.ac.in/courses/103103206 (Unit 2)
3	https://www.brainkart.com>article phase rule (Unit 3)

4	https://nptel.ac.in/courses/113/104/113104008/ (Unit 4)
5	https://nptel.ac.in/courses/104103019 (Unit 5)
6	https://www.brainkart.com/subject/engineering-chemistry_264/ (All Units)
7	https://www.youtube.com/watch?v=4RDA_B_dRQ0(Reverse Osmosis)
8	https://www.youtube.com/watch?v=XUzpG1-rJLA Bergius Process)
9	https://www.youtube.com/watch?v=2bDf7JSRvf8
10	https://www.youtube.com/watch?v=Pme64aNaE5A (Otto-Hoffmman Method)
11	https://www.youtube.com/watch?v=VxMM4g2Sk8U (Lithium ion Batteries)

CO – PO – PSO MAPPING															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
CO2	3	1	2	1	-			-	-	-	-	2	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
CO5	2	1	1		-	-	-	-	-	-	-	-	-	-	-
AVG	3	1	2	1	-	1	2	-	-	-	-	2	-	-	-

R 2024	MECHANICAL ENGINEERING					SEMESTER: II
24ES211	FOUNDATION SKILLS	L	T	P	C	PC
		0	0	2	1	

COMMON TO: AERONAUTICAL ENGINEERING, MECHANICAL ENGINEERING and MECHATRONICS ENGINEERING

COURSE OBJECTIVES:

The main objectives of this course are to:

- Practice few basic engineering operations in welding, and sheet metal works.
- Make the specified skills in fitting operations.
- Perform few basic operations to produce wooden joints
- Make pipe connections for household applications.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1-Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work

CO2Saw; plan; make joints in wood materials used in common household wood work.

CO3-Weld various joints in steel plates using arc welding work;

CO4-Make a tray out of metal sheet using sheet metal work.

CO5-Prepare metal joints using fitting tools

PRACTICAL EXERCISES:

1. Plumbing Works: Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components for pumping water from sump to overhead tank and pipe connections from overhead tank to bath shower and wash basin.
2. Carpentry using modern tools only: Hands-on-exercise: Wood work, joints such as T, Mortise and Tenon and Dove Tail.
3. Welding: Preparation of butt joints, lap joints and T- joints by Arc welding and Gas welding
4. Sheet Metal Work: Model making – Trays and funnels.
5. Fitting: Preparation of Square fitting and V – fitting models.
6. Machining – Plain turning, Facing and Step turning

Total Periods : 30

CO PO PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
CO5	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
AVG	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

R 2024	ELECTRICA AND ELECTRONICS ENGINEERING					SEMESTER: II
24ES212	BASIC ENGINEERING SKILLS	L	T	P	C	ES
		0	0	2	1	

COMMON TO : AERONAUTICAL, MECHANICAL and MECHATRONICS ENGINEERING Departments

COURSE OBJECTIVES:

The main objectives of this course are to:

- Study the various basic domestic wiring circuits and measure the electrical parameters.
- Impart the Knowledge about the stair case wiring, wiring layout and its connections
- Impart the knowledge of various basic electronic components .
- Know about Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
- Study about the operation of various Boolean operations in electronics.

LCOURSE OUTCOMES:

At the end of this course, students are able to:

CO1:Wire various electrical joints in common household electrical wire work.
CO2:Understand the stair case wiring, wiring layout and its connections
CO3:Measure the electrical quantities using ammeter, voltmeter,wattmeter and energy meter
CO4:Study the construction, working principle and wiring of single phase energy meter.
CO5:Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

LIST OF EXPERIMENTS:

I ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fitting and Installation of household appliances- LED TV,Fan
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.

II ELECTRONIC ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding, Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Verification of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering simple electronic circuits and checking continuity.
5. Assembling and testing electronic components on a small PCB.

Total Periods :30

CO PO PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	-		1	1	1	-	-	-	-	2	2	1	1
CO2	3	2	-		1	1	1	-	-	-	-	2	2	1	1
CO3	3	2	-		1	1	1	-	-	-	-	2	2	1	1
CO4	3	2	-		1	1	1	-	-	-	-	2	2	1	1
CO5	3	2	-		1	1	1	-	-	-	-	2	2	1	1
AVG	3	2	-		1	1	1	-	-	-	-	2	2	1	1

1-Low, 2-Medium, 3-High

R 2024	CAREER DEVELOPMENT AND PLACEMENT CELL M.A.M. SCHOOL OF ENGINEERING					SEMESTER:II
24TP201	APTITUDE AND COMMUNICATION SKILLS - I	L	T	P	C	EEC
		0	0	2	1	

COURSE OBJECTIVES:

The main objectives of this course are to:

- To Learn and Practice Vedic Mathematics Principles and Techniques
- To Understand the Components of Effective Communication
- To understand the components of Presentation Skills and Delivery Techniques that are needed for Individual & Group Presentations.
- To learn about personal grooming, body language and Dress code.

COURSE OUTCOMES:

At the end of this course, students are able to:

CO1: Effectively applying the Vedic Mathematics Techniques to solve the Mathematical Aptitude Questions.

CO2: Learn and Practice the ways of Effective Communication and hence to excel in Public Speaking.

CO3: Present their Ideas in an professional way by learning the Presentation Skills and Delivery Techniques.

CO4: Effectively apply the body language and show case them with better dress code and grooming.

LIST OF ACTIVITIES/EXCERCISES:

1. Squares ending with 5 and 55.
2. Multiplication of Numbers by 5, 25, 50, 125, 9, 99, 999, 9999.
3. Multiplication of Two Numbers where Sum of unit digit is 10
4. Multiplication of Two Numbers where Sum of unit digit is 10, 1000 others digits same
5. Multiplication of Two numbers both having '5' at Unit digits.
6. Multiples of 11, 111 & 22, 33, 44, 55 etc.,
7. Squaring of numbers using Base 10, 100, 1000, 50, 500, 5000.
8. Multiplication of numbers more than or below the Base 10, 100, 1000, 50, 500, 5000.
9. Squares ending with 555.
10. Dividing of 9, 19, 29, 39, 49.
11. Square Root & Cube Root, Decimals, Fractions.
12. Components of Effective Communication and Communication styles of others.
13. Barriers of Communication.
14. Dealing with emotions while communicating
15. Just a Minute (JAM) Session
16. Delivery Techniques & Visual Effects / Individual & Group Presentations
17. SWOT Analysis
18. Personality Enhancement & Body Language.
19. Hand Shaking & Dress Code.
20. Personal Grooming.

Total Periods : 30

CO PO PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	3	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
AVG	-	1	1	-	2	-	-	-	3	3	-	-	-	-	-