தமிழ்நாடு மத்தியப் பல்கலைக்கழகம்

CENTRAL UNIVERSITY OF TAMIL NADU

तमिलनाडु केन्द्रीय विश्वविद्यालय

ESTABLISHED BY AN ACT OF PARLIAMENT IN 2009

DEPARTMENT OF COMPUTER SCIENCE

SCHOOL OF MATHEMATICS AND COMPUTER SCIENCES

B.Tech. Computer Science and Engineering

REGULATIONS (R2026), CURRICULUM AND SYLLABUS

A. OVERVIEW

Central University of Tamil Nadu (CUTN) is an institution of higher education established by an Act of Parliament in 2009. The University aims at the forming of an enlightened society founded on a relentless pursuit of excellence through innovation in teaching-learning process, interdisciplinary studies and research. With a host of diversified integrated postgraduate, postgraduate and doctoral programmes, the University has been keen to stay abreast of the ever-expanding academic frontiers. Within a brief period CUTN has established itself as a frontrunner in the pursuit of excellence.

1. SCHOOL OF MATHEMATICS AND COMPUTER SCIENCES

The School of Mathematics and Computer Sciences aims to be in the forefront of teaching, research, and extension activities. This School presently comprises the department of Mathematics, Computer Science and Statistics & Applied Mathematics.

2. DEPARTMENT OF COMPUTER SCIENCE

The Department of Computer Science is one among the science departments that offer M.Sc. and Ph.D. in computer science. The department was started in the academic year 2016-17. From academic year 2026 – 27, it offers the B.Tech. programme in Computer Science and Engineering. The department is equipped with seven faculty members with doctorates and they are actively involved in research besides teaching.

The curriculum is designed to meet the standards expected from the IT industry and also facilitates to aspire research. The department offers a choice-based credit system. The students are evaluated through a continuous assessment system. The department is equipped with a smart class room and two computer labs with 60 systems that caters the needs of students. The department has a research lab that has a high-end GPU Server, GPU workstations and high-end workstations that caters the needs of faculty and research scholars to pursue quality research.

3. VISION

To develop the department as a global leader in knowledge dissemination and to perform cutting edge research in computer science in compliance with international standards

4. MISSION

M1	**To produce students by inculcating them with state-of-the-art education to make them technically competent in solving real time problems**
M2	**To kindle students as efficient IT professionals, researchers and entrepreneurs**
M3	**To enrich the students as social, ethical and value-based graduates to make significant contribution to the society**

5. PROGRAM SPECIFIC OBJECTIVES

PSO1	**Graduates will be able to design, develop, test and maintain software systems, algorithms and applications by applying core concepts of computer science and modern engineering tools to solve real-time and domain-specific problems.**
PSO2	**Graduates will demonstrate the ability to analyze, interpret and derive insights from data using artificial intelligence, machine learning, data analytics and related emerging technologies to address real-world challenges.**
PSO3	**Graduates will be capable of designing, deploying and managing networks, cloud and distributed systems with due emphasis on cybersecurity principles, ethical considerations and industry standards for ensuring reliable and secure computing environments.**

6. PSO TO MISSION MAPPING

	M1	**M2**	**M3**
PSO1	3	3	2
PSO2	2	3	3
PSO3	1	2	3

7. PROGRAM EDUCATIONAL OBJECTIVES

PEO 1	Graduates will excel as computing and engineering professionals by applying fundamental knowledge of mathematics, science, and computer engineering principles to design, develop and deploy effective solutions in industry, academia, and research environments
PEO 2	Graduates will engage in lifelong learning through higher studies, professional certifications, research, innovation and entrepreneurial initiatives, adapting to emerging technologies and evolving global trends in computing and allied domains
PEO 3	Graduates will demonstrate ethical behaviour, professionalism, teamwork and leadership qualities, contributing responsibly to society by developing sustainable computing solutions and addressing contemporary technological and societal challenges

8. PEO TO MISSION MAPPING

	M1	**M2**	**M3**
PEO1	3	2	1
PEO2	2	3	2
PEO3	1	2	3

9. GRADUATE ATTRIBUTES

G1: Ability to identify a problem, analyze using design thinking techniques, and evolve innovative approaches for solving it

G2: Ability to apply mathematical concepts and techniques in problem solving

G3: Ability to function effectively in multicultural teams to accomplish a common goal

G4: Ability to communicate effectively with a wide range of audience

G5: Ability to self-learn and engage in life-long learning and upgrade technical skills

G6: An understanding of professional and ethical responsibility

G7: Ability to undertake small research tasks and projects

G8: An entrepreneurial mindset for opportunities using technology and innovations

G9: An understanding of impact of solutions on economic, societal, and environment context

G10: Strong emotional intelligence, human and cultural values

10. DISCIPLINE GRADUATE ATTRIBUTES FOR CSE

CS1: Proficiency in writing in at least two dissimilar programming languages programs of modest complexity which are: readable, tested for correctness, efficient, and secure

CS2: Ability to design and apply appropriate algorithms and data structures for evolving efficient computing-based solutions for new problems

CS3: Understanding of computing systems at computer architecture, operating systems, and distributed computing levels, and how they affect the performance of software applications

CS4: Understanding of theoretical foundations, fundamental principles, and limits of computing

CS5: Ability to analyse large volumes of data employing a variety of techniques for learning, better prediction, decision making, etc.

CS6: Ability to design, implement, and evaluate computer-based system or application to meet the desired needs using modern tools and methodologies

CS7: Ability to develop full stack applications using one commonly used tech-stack and modern tools

CS8: Understanding of and ability to use advanced techniques and tools in a few different domain areas

CS9: Exposure to emerging technologies such as Cloud Computing, IoT, etc

11. PROGRAM OBJECTIVES

On successful completion of the program, the students will be able to

P01	**Engineering Knowledge:** Apply mathematical foundations, algorithmic principles, and Computer Science theory in the modelling and design of computer-based systems of varying complexity
P02	**Problem Analysis:** Critically analyse a problem, identify, formulate and solve problems in the field of Computer Science and Engineering, considering current and future trends
P03	**Design/Development of Solutions:** Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability in the field of computer engineering
P04	**Conduct Investigations of Complex Problems:** Perform experiments and organize, analyze, and interpret data
P05	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems
P06	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment
P07	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice
P08	**Individual and Team Work:** Function effectively on teams to accomplish a common goal
P09	**Communication:** Communicate effectively with a range of audiences and prepare technical documents and make effective oral presentations
P010	**Project Management and Finance:** Demonstrate knowledge of engineering and management principles to develop innovative solutions and manage projects effectively, both as a member and a leader in a team
P011	**Life-long Learning:** Recognize the need for and possess an ability to engage in life-long learning, leading to continuing professional development

12. PO to PSO Mapping

	PS01	PS02	PS03
P01	3	3	3
P02	3	3	2
P03	3	3	3
P04	2	3	2
P05	3	3	3
P06	1	2	2
P07	1	2	2
P08	1	2	3
P09	2	2	2
P010	2	2	2
P011	2	2	3

B. REGULATIONS

1. PREAMBLE

The B.Tech. (CSE) programme of Central University of Tamil Nadu is offered under the Choice Based Credit System (CBCS). These regulations guide all academic and administrative processes pertaining to admission, curriculum structure, teaching–learning, assessment, evaluation, and award of the degree.

2. ADMISSION REQUIREMENTS AND SANCTIONED INTAKE

A candidate seeking admission to the B.Tech. Degree Programme shall have passed the Higher Secondary Examination (10+2 pattern) with Physics, Chemistry and Mathematics as mandatory subjects under Part III or any Examination recognized as equivalent, fulfilling eligibility norms of the University and Government of India. Admissions shall be made through ranking obtained by the candidate in national-level examinations such as JEE (Main) or CUET-UG, subject to policy decisions of CUTN. **For the academic year 2026-27, the sanctioned intake is 30+1.**

3. DURATION OF THE PROGRAMME

The programme shall extend over eight semesters (four academic years) with two semesters in each academic year.

4. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all courses, seminars, examinations, laboratory work, and project reports.

5. PROGRAMME STRUCTURE

The curriculum consists of the following categories of courses:

- **Humanities and Social Sciences (HSMC)**
- **Basic Sciences (BSC)**
- **Engineering Sciences (ESC)**
- **Professional Core (PCC)**
- **Professional Electives (PEC)**
- **Lab Courses (LC)**
- **Open Electives (OEC)**

- **Industrial Training / Internship Courses / Certification**
- **MOOCs**
- **Project Work**

5. PROGRAMME STRUCTURE

5.1 CREDIT SYSTEM

The assignment of credits follows standard norms:

- **1 Credit = 1 hour of Lecture/Tutorial per week**
- **1 Credit = 2 hours of Laboratory / Practical work per week**
- **MOOCs / Self-Learning: Credit as per equivalence approved by the BoS.**

5.2 TOTAL CREDITS

To qualify for the award of the B.Tech. CSE degree, a student must earn **170 credits**, as specified in the curriculum.

5.3 INTERNSHIP / INDUSTRIAL TRAINING / CERTIFICATION

Every student should undergo industrial training or do an internship in industry, R&D organization or in any recognized institution for a minimum of four to six weeks, normally during the summer vacation. Evaluation will be made in the subsequent semester but credits will be awarded in seventh semester. Credits shall be awarded based on

- Internship report
- Certificate from the organization / institution
- Evaluation by the faculty committee

A student can be permitted to do a certification course instead of internship or industrial training. Ex: Cisco / Google / Microsoft / RedHat / AWS etc. In this case, the certificate will be validated by the faculty committee and the credits will be awarded in the seventh semester.

5.4 NCC / NSS / SPORTS AND YOGA

The activities will include Practical / field activities / Extension lectures and shall be carried out outside class hours. The evaluation of these audit courses will be done as per CUTN norms.

6. ACADEMIC CALENDAR

Each semester shall normally consist of 90 working days. The University shall notify the academic calendar every year, indicating:

- Course registration dates
- Commencement and last date of classes
- Examination dates
- Vacation periods

7. COURSE REGISTRATION

Every student must register for courses at the beginning of each semester.

- A student may register for a maximum number of credits permissible for any semester as dictated in the curriculum.
- Late registration / enrolment will be permitted with a fine as per CUTN norms.

8. FACULTY ADVISOR

To provide guidance on academic matters as well as other related activities, the Head of the Department shall, at the beginning of each academic year, assign a group of first-semester students to a faculty member designated as the Faculty Advisor. The same Faculty Advisor shall continue to mentor the assigned students throughout the duration of the programme, until they complete all degree requirements.

9. CLASS COMMITTEE

A Class Committee shall be constituted for every class in each semester to monitor the academic progress and teaching–learning processes. The Class Committee shall be chaired by a senior faculty member of the department who preferably does not teach the class, and shall include all faculty handling courses for that class. In addition, there will be four student representatives nominated, as per the norms given by the Department, by the students and approved by the Head of the Department. The Class Committee shall meet three times during the semester: once within two weeks of the commencement of the semester to discuss the nature and structure of the internal assessment tests and the overall assessment methodology; the second time two weeks after the first internal assessment test; and the third time two weeks after the second internal assessment test. The meetings are aimed at reviewing student performance and enhancing the teaching–learning process.

10. ASSESSMENT PROCEDURES

Student performance is assessed continuously through internal evaluation and a final end-semester examination.

10.1 THEORY COURSES

In every theory course, the pattern of assessment shall be as follows:

Assignments shall be issued at least one week prior to each cycle test and the end-semester examination. These assignments will include both theoretical and problem-solving components from the portions covered for the respective cycle test.

- **CONTINUOUS INTERNAL ASSESSMENT (CIA): 40 MARKS**
  - 1st Internal Assessment for 30 marks (Mandatory)
  - 2nd Internal Assessment for 30 marks (Mandatory)
  - 3rd Internal Assessment for 60 marks (Optional)*
  - Assignments/Seminar/Quiz etc for 5 marks
  - Attendance for 5 marks

  * Convert the 3rd internal assessment marks from 60 to 30
    - The final continuous internal assessment (CIA) marks shall be computed by taking the average of the best two scores.
    - To provide the marks for the attendance, the following classification has to be adopted:

Attendance Percentage	Above 95%	94% - 90%	89% – 85%	84% - 80%	79% - 75%
Marks	5	4	3	2	1

- **END-SEMESTER EXAMINATION (ESE): 60 MARKS**

10.2 LAB COURSES

The continuous assessment in laboratory courses shall be based on the supervision of the student's performance, the quality of work carried out, their participation in viva-voce examinations and group discussions and other components as prescribed. The end-semester practical examination shall consist of an experiment and/or a written test. For every practical course, the assessment pattern shall be as follows:

- **CONTINUOUS ASSESSMENT: 75%**
- **END-SEMESTER PRACTICAL EXAMINATION: 25%**

10.3 PROJECT WORK

For the project work, the continuous assessment shall be carried out by a committee comprising the Project Coordinator, appointed by the Head of the Department, and the project guide. The assessment shall be based on a minimum of two periodic reviews. If the Project Coordinator or the Head of the Department is also serving as a project guide, the Head of the Department shall nominate another faculty member to participate in the continuous assessment for those students to avoid any conflict of roles.

Upon submission of the project report, the end-semester evaluation shall consist of a detailed project assessment and a viva-voce examination. This evaluation shall be conducted by a panel comprising the Project Coordinator, the project guide, and either a faculty member from a related department or an external examiner from an academic institution or industry.

The distribution of marks between continuous assessment and the end-semester examination shall be as follows:

- Periodic reviews and continuous assessment: 40%
- Final evaluation and viva voce: 60%
  - External Examiner – 30%
  - Project Guide – 30%

10.4 SUPPLEMENTARY EXAMINATIONS

The **Supplementary Examinations** will be conducted as per CUTN norms.

10.5 RETEST

Students who are absent for the cycle tests on genuine grounds (with the condition that the student reports to the Head of the Department within two days of rejoining) or participation in Institute-approved activities with prior permission—may be permitted to appear for a retest. Permission for the retest shall be granted by the Head of the Department. The retest shall not be considered or used as an improvement test under any circumstances.

11. ATTENDANCE REGULATIONS AND ELIGIBILITY CRITERIA FOR APPEARING IN END SEMESTER EXAMINATION

A minimum of **75% attendance** is required in each course to appear for the End-Semester Examination (ESE). Attendance shortage is handled as per CUTN norms.

12. PASSING REQUIREMENTS

A student shall secure at least 50% in the End-Semester Examination and a minimum of 50% overall (CIA + ESE) to pass the course.

13. GRADING SYSTEM

A 10-point letter grading scheme shall be used as follows:

Range of Marks	90 – 100	80 – 89	70 – 79	60 – 69	50 – 59	< 50
Letter Grade	O	A+	A	B+	B	RA
Grade Point	10	9	8	7	6	0

RA → Reappear
AU → Audit Course
FA → Failure due to lack of attendance
AE → Absent in the end semester examination

13.1 CALCULATION OF CGPA

The Semester Grade Point Average (SGPA) for a given semester shall be calculated only for those students who have passed all the courses prescribed in that semester. Likewise, the Cumulative Grade Point Average (CGPA) up to any semester shall be computed only for students who have successfully completed all the courses up to that point.

The SGPA is defined as the ratio of the sum of the products of the credits assigned to each course C_i and the grade points earned in that course GP_i, to the sum of the credits of all courses taken in that semester:

$$\mathbf{SGPA} = \frac{\sum_{i=1}^{n} \mathbf{C_i} \times \mathbf{GP_i}}{\sum_{i=1}^{n} \mathbf{C_i}}$$

where n denotes the total number of courses registered in that semester.

Upon successful completion of the entire programme, the CGPA shall be calculated using the following formula:

$$\mathbf{CGPA} = \frac{\sum_{i=1}^{N} C_i \times GP_i}{\sum_{i=1}^{N} C_i}$$

where C_i represents the credit assigned to the i-th course, GP_i denotes the grade point secured in that course, and N is the total number of courses prescribed for the programme.

Formula for Conversion of CGPA to Percentage is as follows:

$$\%\ \mathbf{of\ marks} = \mathbf{CGPA} \times \mathbf{10}$$

14. ELIGIBILITY FOR THE DEGREE

A candidate shall be eligible for the award of the degree of Bachelor of Technology (B.Tech.) only if he or she satisfies the following conditions:

- The candidate has successfully completed the prescribed programme of study and has earned the minimum number of credits specified in the curriculum of the relevant programme within the maximum permitted duration of eight years.
- The candidate has cleared all dues to the Institution, including those pertaining to the Library, Hostels and any other University facilities.
- No disciplinary proceedings or actions are pending against the candidate at the time of award of the degree.

15. ACADEMIC GOVERNANCE

Academic governance shall be carried out through the:

- Class Committee
- Department Consultative Committee
- Board of Studies (BoS)
- School Board
- Academic Council

These bodies shall oversee curriculum revision, academic audits, student progress, and policy compliance.

16. STUDENT WELFARE AND CONDUCT

Students shall abide by:

- CUTN Code of Conduct
- Anti-Ragging Regulations
- POSH (Prevention of Sexual Harassment) guidelines
- Guidelines issued by statutory bodies

The University shall provide counselling services and assign faculty advisors for academic guidance.

17. AMENDMENTS TO THE REGULATIONS

The University reserves the right to modify these regulations in part or whole, subject to approval of the Academic Council. Amendments shall be applicable to all students from the date of notification unless specified otherwise.

PROGRAM STRUCTURE

S.No	Course Code	Course Title	Course Type	Credit	Hours per Week	Marks	
						Int.	Ext.
INDUCTION PROGRAMME							
SEMESTER – I							
1	MAT5011	Calculus	BSC	4	4	40	60
2		Engineering Physics	BSC	3	3	40	60
3	ENG5019	English for Technical Communication	HSMC	3	4	40	60
4	MGM5011	Principles of Management	HSMC	3	3	40	60
5	CSC5011	Computer Programming and Problem Solving	ESC	4	4	40	60
6		Engineering Physics Lab	BSC	2	4	100	
7	CSC5012	Computer Programming and Problem Solving Lab	ESC	2	4	100	
8		Indian Constitution	MC	0	2		
TOTAL				**21**	**28**		
SEMESTER – II							
1	MAT5043	Probability and Statistics	BSC	4	4	40	60
2	MSN5021	Basic Engineering	ESC	4	4	40	60
3	MSN5022	Engineering Graphics	ESC	3	3	40	60
4	CSC5021	Data Structures	PCC	3	3	40	60
5	CSC5022	Discrete Mathematics	PCC	3	3	40	60
6	MSN5023	Workshop / Manufacturing Practices	ESC	2	4	100	
7	CSC5023	Data Structures Lab	PCC	2	4	100	
8		NSS / NCC / Sports and Yoga	MC	0	2		
TOTAL				**21**	**27**		
SEMESTER – III							
1	MAT5051	Linear Algebra	BSC	4	4	40	60
2	CSC5031	Digital Logic and Design	ESC	3	3	40	60
3	CSC5032	Computer Organization and Architecture	PCC	3	3	40	60
4	CSC5033	Design and Analysis of Algorithms	PCC	4	4	40	60
5	CSC5034	Operating Systems	PCC	3	3	40	60
7	CSC5035	Python Programming	PCC	3	3	40	60
8	CSC5036	Operating Systems Lab	PCC	2	4	100	
9	CSC5037	Python Programming Lab	PCC	2	4	100	
10	ENSVAC	Environmental Science	MC	0	2		
TOTAL				**24**	**30**		

SEMESTER – IV							
1	CSC5041	Artificial Intelligence and Machine Learning	PCC	3	3	40	60
2	CSC5042	Computer Networks	PCC	3	3	40	60
2	CSC5043	Database Management Systems	PCC	3	3	40	60
3	CSC5044	Software Engineering	PCC	3	3	40	60
4	CSC5045	Theory of Computation and Compiler Design	PCC	4	4	40	60
6	CSC5046	Artificial Intelligence and Machine Learning Lab	PCC	2	4	100	
7	CSC5047	Computer Networks Lab	PCC	2	4	100	
8	CSC5048	Database Management Systems Lab	PCC	2	4	100	
9		Internship – I / Industrial Training / Certification					
TOTAL				**22**	**28**		
SEMESTER – V							
1	MGM5052	Organizational Behaviour	HSMC	4	4	40	60
2	CSC5051	Full Stack Technology	PCC	3	3	40	60
3	CSC5052	IoT Hardware Fundamentals	PCC	3	3	40	60
4	CSC5053	Object Oriented Programming using Java	PCC	3	3	40	60
5	CSCECXX	Professional Elective – I (MOOCS)	PEC	3	3		
6		Open Elective – I	OEC	3	3	40	60
7	CSC5054	Full Stack Technology Lab	PCC	2	4	100	
8	CSC5055	IoT Hardware Fundamentals Lab	PCC	2	4	100	
9	CSC5056	Java Programming Lab	PCC	2	4	100	
TOTAL				**25**	**31**		
SEMESTER – VI							
1		Managerial Economics	HSMC	3	3	40	60
2	CSC5061	Cryptography and Network Security	PCC	3	3	40	60
3	CSC5062	Deep Learning	PCC	3	3	40	60
4	CSC5063	Distributed Systems	PCC	3	3	40	60
5	CSCECXX	Professional Elective – II (MOOCs)	PEC	3	3		
6		Open Elective – II	OEC	3	3	40	60
7	CSC5064	Cryptography and Network Security Lab	PCC	2	4	100	
8	CSC5065	Deep Learning Lab	PCC	2	4	100	
9		Internship – II / Industrial Training / Certification					
TOTAL				**22**	**26**		

SEMESTER – VII							
1		Foreign Language	HSMC	3	3		
2	CSC5071	High Performance Computing	PCC	3	3	40	60
3		Open Elective – III	OEC	3	3	40	60
4	CSC5072	Project Phase – I	PCC	6	12	100	
5	CSC5073	High Performance Computing Lab	PCC	2	4	100	
6	CSC5074	Internship (Internship – I + Internship – II) / Industrial Training / Certification	PCC	4		100	
TOTAL				**21**	**25**		
SEMESTER – VIII							
1	CSCECXX	Professional Elective – III	PEC	3	3	40	60
2	CSCECXX	Professional Elective – IV	PEC	3	3	40	60
3	CSC5081	Seminar / Comprehensive Viva-Voce	PCC	2	0	100	
4	CSC5082	Project Phase – II	PCC	6	12	100	
TOTAL				**14**	**18**		

CREDITS PER SEMESTER									**Total Credits**
Sem#	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
CREDITS	**21**	**21**	**24**	**22**	**25**	**22**	**21**	**14**	**170**

CATEGORY-WISE COURSES

BASIC SCIENCE COURSES (BSC)

S.No.	Sem.	Courses	Credits	Hours
1	1	Calculus	4	4
2	1	Engineering Physics	3	3
3	1	Engineering Physics Lab	2	4
4	2	Probability and Statistics	4	4
5	3	Linear Algebra	4	4
		TOTAL	**17**	

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

S.No.	Sem	Courses	Credits	Hours
1	1	English for Technical Communication	3	4
2	1	Principles of Management	3	3
3	5	Organizational Behaviour	4	4
4	6	Managerial Economics	3	3
5	7	Foreign Language	3	3
		TOTAL	**16**	

ENGINEERING SCIENCE COURSES (ESC)

S.No.	Sem	Courses	Credits	Hours
1	1	Computer Programming and Problem Solving	4	4
2	1	Computer Programming and Problem Solving Lab	2	4
3	2	Basic Engineering	4	4
4	2	Engineering Graphics	3	3
5	2	Workshop / Manufacturing Practices	2	4
6	3	Digital Logic and Design	3	3
		TOTAL	**18**	

MANDATORY COURSES (MC)

S.No.	Sem	Courses	Credits	Hours per week
1	0	Induction Programme (2 weeks)	0	35
2	1	Indian Constitution	0	2
3	2	NSS / NCC / Sports and Yoga	0	2
4	3	Environmental Science	0	2

PROFESSIONAL CORE COURSES (PCC)

S.No.	Sem	Courses	Credits	Hours
1	2	Discrete Mathematics	3	3
2	2	Data Structures	3	3
3	2	Data Structures Lab	2	4
4	3	Computer Organization and Architecture	3	3
5	3	Design and Analysis of Algorithms	4	4
6	3	Operating Systems	3	3
7	3	Python Programming	3	3
8	3	Operating Systems Lab	2	4
9	3	Python Programming Lab	2	4
10	4	Artificial Intelligence and Machine Learning	3	3
11	4	Computer Networks	3	3
12	4	Database Management Systems	3	3
13	4	Software Engineering	3	3
14	4	Theory of Computation	4	4
15	4	Artificial Intelligence and Machine Learning Lab	2	4
16	4	Computer Networks Lab	2	4
17	4	Database Management Systems Lab	2	4
18	5	Full Stack Technology	3	3
19	5	IoT Hardware Fundamentals	3	3
20	5	Object Oriented Programming using Java	3	3
21	5	Full Stack Technology Lab	2	4
22	5	IoT Hardware Fundamentals Lab	2	4
23	5	Java Programming Lab	2	4
24	6	Cryptography and Network Security	3	3
25	6	Deep Learning	3	3
26	6	Distributed Systems	3	3
27	6	Cryptography and Network Security Lab	2	4
28	6	Deep Learning Lab	2	4
29	7	High Performance Computing	3	3
30	7	Project Phase – I	6	12
31	7	Internship (Internship – I + Internship – II) / Industrial Training / Certification	4	0
32	7	High Performance Computing Lab	2	4
33	8	Seminar / Comprehensive Viva-Voce	2	0
34	8	Project Phase – II	6	12
		TOTAL	**98**	

PROFESSIONAL ELECTIVE COURSES (PEC)

S.No.	Sem	Courses	Credits	Hours
1	5	Professional Elective – I (OR) MOOCs	3	3
2	6	Professional Elective – II (OR) MOOCs	3	3
3	8	Professional Elective – III	3	3
4	8	Professional Elective – IV	3	3
		TOTAL	**12**	

OPEN ELECTIVE COURSES (OEC)

S.No.	Sem	Courses	Credits	Hours
1	5	Open Elective – I	3	3
2	6	Open Elective – II	3	3
3	7	Open Elective – III	3	3
		TOTAL	**9**	

TOTAL DISTRIBUTION

S.No.	Course Category	Credits	Percentage
1	BSC	17	10.00
2	HSMC	16	9.42
3	ESC	18	10.58
4	PCC	98	57.65
5	PEC	12	7.05
6	OEC	9	5.30
7	MC	0	0.00
	TOTAL	**170**	**100**

SEMESTER – I

Semester	Course Code	Course Title	L-T-P-C
I	MAT5011	CALCULUS	4-0-0-4

a. Syllabus

Unit – 1	**12 hrs**
(Review Of Differential Calculus), Related Rate Problems, Implicit Differentiation, Tangent of a Curve (Given In Parametric Form and in Implicit Form), Motion on a Straight Line, Local Extremum, Increasing, Decreasing Functions.	
Unit – 2	**12 hrs**
Envelopes, curvature, circle, radius and centre of curvature, formula for the radius of curvature when the curve is given in Cartesian and polar co-ordinates, cartesian co-ordinates of the centre of curvature, evolute and involute, p-r equations of curves.	
Unit – 3	**12 hrs**
Higher order derivatives, Taylor's series expansion of $\sin x$, $\cos x$, e^x, $\log(1+x)$, $(1+x)^m$(with m is a negative integer or a rational number), Leibnitz theorem and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, and $(ax+b)^n\cos x$, convex and concave functions, curve tracing.	
Unit – 4	**12 hrs**
Review of integral calculus: Area under curves, applications of integrals to find area, reduction formulae for powers of trigonometric functions), differentiation under integral sign by Leibnitz rule, line integrals, double integrals, change of order of integration, double integrals in polar form, Jacobian determinant, change of variables.	
Unit – 5	**12 hrs**
Gamma function and Beta function, relation between beta and gamma integrals.	

Textbook:

1. B. S. Grewal, Higher Engineering Mathematics, Forty fourth Edition, Khanna Publishers, 2017.

References:

1. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Ninth International Edition, Addison Wesley, 2002.
2. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons Inc., 2002.
3. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Ninth International Edition, Addison Wesley, 2002.
4. B. S. Grewal, Higher Engineering Mathematics, Forty fourth Edition, Khanna Publishers, 2017.

5. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley & Sons, Singapore, 2006.
6. G. F. Simmons, Calculus with analytic geometry, Second Edition, The McGraw-Hill Companies Inc., 1996.

b. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Understand the concepts of derivatives and integration	Remember / Understand
CO2	Solve problems on differentiation and integration in two and three dimensional spaces	Apply
CO3	Examine the local extremum, concavity, convexity of functions and the order of integration	Analyze
CO4	Determine tangent of a curve, area, arc length, volume and, evaluate double and triple integrals	Evaluate
CO5	Compile the application of derivatives, Beta and Gamma functions	Create

Semester	Course Code	Course Title	L-T-P-C
I		ENGINEERING PHYSICS	3-0-0-3

a. Course Objectives

1.	Provide a fundamental understanding of heat, thermodynamics, and their engineering applications.
2.	Develop knowledge of wave optics phenomena such as interference and diffraction, and introduce principles and applications of lasers and optical fibers.
3.	Build a strong foundation in electricity and magnetism by explaining electric and magnetic fields, electromagnetic waves, and the laws governing them.
4.	Introduce the basic concepts of quantum mechanics and enable students to apply quantum principles to simple physical systems.
5.	Familiarize students with the essential concepts of solid-state physics, including semiconductors, dielectrics, conductors, and magnetic materials, with relevance to modern electronic and communication systems.

b. Syllabus

Unit–1	HEAT & THERMODYNAMICS	9 hrs
Thermodynamic Equilibrium, Concept of Temperature, Concept of Work and Heat, State Functions, Laws of Thermodynamics, Internal Energy, Information Entropy, Thermodynamics processes, Isothermal, Adiabatic, Isobaric, and Isochoric processes, General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes. Conversion of Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine and its efficiency, information engine.		
Unit–2	**LASER & OPTICS**	**9 hrs**
Interference: Air wedge, Newton's ring, Diffraction: Single slit diffraction, resolution of Imaging, Fiber optics: Structure of a fiber, Numerical Aperture of a Fiber, Lasers: Population Inversion, Ruby laser, Nd:YAGlaser, He-Ne laser, CO2 laser (construction, functioning and applications).		
Unit–3	**ELECTRICITY & MAGNETISM**	**9 hrs**
Coulomb's law, Electric Field and potentials, Gauss Law and its application, Magnetic field, Magnetic force on a current, Magnetic Induction and Biot–Savart Law, Magnetic Field at a point along the axis of a circular coil, Lorentz Force, Maxwell's equations, wave equation, plane electromagnetic waves, Poynting vector.		
Unit–4	**QUANTUM MECHANICS**	**9 hrs**
Inadequacy of classical mechanics, black body radiation, photoelectric effect wave and particle duality of radiation, de Broglie concept of matter waves, electron diffraction, Heisenberg's uncertainty principle, Schrodinger's wave equation, eigenvalues and eigen functions, superposition principle, interpretation of wave function, particle in a box.		

Unit–5	SOLID STATE PHYSICS	9 hrs
Intrinsic and extrinsic semiconductors, p-n junction diode, Dielectric materials, electric polarization, Clausius-Mossotti relation, Conductors: Lorentz –Drude theory, electrical Conductivity, classification of magnetic materials: dia, para, and ferromagnetic.		

Text/Reference Books:

1. Engineering Physics – R. K. Gaur & S. L. Gupta
2. Engineering Physics – H. K. Malik & A. K. Singh
3. University Physics – Sears & Zemansky
4. Heat and Thermodynamics – Mark W. Zemansky & Richard H. Dittman
5. Thermodynamics: An Engineering Approach – Yunus A. Çengel & Michael A. Boles
6. Optics – Ajoy Ghatak
7. Optics – Eugene Hecht
8. Lasers and Nonlinear Optics – B. B. Laud
9. Introduction to Electrodynamics – David J. Griffiths
10. Electricity and Magnetism – Edward M. Purcell & David J. Morin
11. Concepts of Modern Physics – Arthur Beiser
12. Quantum Physics – Eisberg & Resnick
13. Solid State Physics – S. O. Pillai
14. Introduction to Solid State Physics – Charles Kittel

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Understand and apply the laws of thermodynamics, heat engines, and thermal processes.	Understand
CO2	Explain the principles of interference, diffraction, fiber optics, and laser operation.	Explain
CO3	Analyze electric and magnetic fields, Maxwell's equations, and electromagnetic waves.	Analyse
CO4	Apply concepts of quantum mechanics such as wave–particle duality, Schrödinger equation, and quantum states.	Apply
CO5	Understand fundamental concepts of solid-state physics including semiconductors, dielectrics, conductors, and magnetic materials.	Understand/Apply

Semester	Course Code	Course Title	L-T-P-C
I	ENG5019	ENGLISH FOR TECHNICAL COMMUNICATION	2-0-2-3

a. Course Objectives

1.	Understand and apply foundational principles of clarity, accuracy, audience awareness, and ethical responsibility in technical communication.
2.	Analyze communication contexts and select appropriate structures, styles, and formats for various technical documents
3.	Produce well-organized technical documents—including short messages, instructional materials, reports, and proposals—using effective language and document design.
4.	Demonstrate effective oral communication in technical settings, including explanations, presentations, and participation in professional meetings.
5.	Evaluate and apply ethical standards related to accuracy, safety communication, confidentiality, and intellectual property in technical documentation and interaction.

b. Syllabus

Unit – 1	FOUNDATIONS OF TECHNICAL COMMUNICATION	6 hrs

Core Qualities of Effective Technical Communication: Clarity, brevity, accuracy; Objectivity and neutrality; Formality and consistency; Plain language principles.

Audience and Context Analysis: Identifying primary vs. secondary audiences; User needs and expectations; Cultural and contextual considerations; Reader-centered communication.

Language and Style in Technical English: Technical vocabulary and terminology, Jargon: appropriate vs. excessive use; Active vs. passive voice; Tone management: formal, neutral, directive.

Unit – 2	INFORMATION STRUCTURES AND TECHNICAL DOCUMENT TYPES	6 hrs

Information Organization: Linear vs. non-linear organization; Chunking and modular writing; Logical sequencing (general-to-specific, cause-effect, comparison).

Short Technical Documents: Technical emails (structure, etiquette, clarity); Memos; Meeting minutes; Notices and announcements.

Instructional and Procedural Writing: Standard Operating Procedures (SOPs); Process descriptions; Instruction sets and user guides; Safety instructions and warnings (signal words, hazard levels).

Unit – 3	EXTENDED TECHNICAL DOCUMENTS: REPORTS & PROPOSALS	6 hrs

Technical Reports: Types: informational, analytical, progress, incident; Standard report structure: title page, TOC, introduction, body, conclusions, recommendations; Descriptive vs. analytical content.

Data-Based Reporting: Summarizing numerical and graphical data; Verbalizing trends and comparisons.

Technical Proposals: Problem definition and needs assessment; Objectives and deliverables; Methods, work plans, schedules; Budget and resource requirements.

Unit – 4	LISTENING AND SPEAKING IN TECHNICAL CONTEXTS	6 hrs

Speaking: Explanation and Clarification: Structuring oral explanations (definition → description → example → application); Using verbal signposting ("first… next… therefore…"); Managing precision while avoiding unnecessary jargon; Clarifying misunderstandings and checking listener comprehension; Using qualifiers (approximately, likely, within tolerance).

Participating in Meetings: Common meeting formats: stand-ups, reviews, debriefs, planning meetings; Formulating technical questions and responses effectively; Polite disagreement and evidence-based argumentation; Summarizing meeting decisions and next steps verbally.

Oral Presentation in Professional Contexts: Describing visuals: charts, models, diagrams, prototypes; Demonstrating equipment or processes orally; Pitching technical proposals or product concepts; Managing time, pacing, and clarity in spoken delivery.

Unit – 5	ETHICS IN TECHNICAL COMMUNICATION	6 hrs

Accuracy, Honesty, and Transparency: Avoiding distortion, omission, or exaggeration of data; Communicating limitations, risks, and uncertainties clearly; Integrity in reporting results and project progress.

Safety, Responsibility, and User Protection: Ethical obligation to design clear, complete, and usable instructions; Communicating hazards and warnings effectively (signal words, severity levels); Consequences of ambiguous or incomplete safety information; Ensuring accessibility of information for diverse users.

Confidentiality, Attribution, and Professional Conduct: Protecting proprietary information, sensitive data, and client material; Ethical citation and intellectual property practices; Avoiding plagiarism in technical descriptions, diagrams, and reports.

Text / Reference Books:

1. Markel, M., & Selber, S. *Technical Communication.* (Bedford/St. Martin's)
2. Alred, G. J., Brusaw, C. T., & Oliu, W. E. *The Handbook of Technical Communication.* (Pearson)
3. Gerson, S. J., & Gerson, S. M. *Technical Communication: Process and Product.* (Pearson)
4. Tebeaux, E., & Dragga, S. *The Essentials of Technical Communication.* (Oxford University Press)
5. IEEE Editorial Style Manual (for discipline-specific formatting and ethics guidance

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Create clear, concise, and audience-centered technical documents that demonstrate correct use of technical vocabulary, tone, style, and formatting.	Create
CO2	Organize information logically and coherently, using appropriate structures for emails, memos, instructions, reports, and proposals.	Apply & Analyze
CO3	Interpret, summarize, and integrate numerical or graphical data into written and oral communication with accuracy and clarity.	Analyze
CO4	Communicate technical information orally, including structured explanations, meeting contributions, and professional presentations supported by visuals.	Apply
CO5	Apply ethical principles by maintaining accuracy, ensuring user safety, citing sources properly, and protecting confidential or proprietary information in all communication tasks.	Apply

d. Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								✓	✓		
CO2								✓	✓		
CO3								✓	✓		
CO4								✓	✓		
CO5						✓	✓				

Semester	Course Code	Course Title	L-T-P-C
I	MGM5011	PRINCIPLES OF MANAGEMENT	3-0-0-3

a. Syllabus

Unit – 1	INTRODUCTION	9 hrs

Scope of management; Functions of a manager; Evolution of management thought - Contributions made by Taylor, Gantt, Gilbreth, Fayol, Weber, Elton Mayo, Chester Bernard, Rensi Likert; Approaches to Management- Operations Research/Mathematical School/ Decision Theory approach, Systems Approach, McKinsey's 7-S Approach.

Unit – 2	PLANNING	6 hrs

Planning -Types of plans; steps in planning and process of planning; Setting objectives; Concept and process of Managing by Objectives; Nature and purpose of strategies and policies; Strategic planning process; SWOT analysis; Organization culture and Environment Current trends and issues in Management.

Unit – 3	ORGANIZING	9 hrs

Organizing - Process of organizing; Bases of departmentation; Authority & power - concept & distinction, Line & Staff Authority, Delegation and Decentralization, Span of Management - factors determining effective span-situational approach.Staffing - Position requirements and Job design, Recruitment and selection strategies, Skills and Personal characteristics needed in managers.

Unit – 4	DIRECTING	9 hrs

Foundations of individual and group behavior — motivation — motivation theories — motivational techniques — job satisfaction — job enrichment — leadership — types and theories of leadership –communication — process of communication — barrier in communication — effective communication –communication and IT.

Unit – 5	CONTROLLING	12 hrs

Control – control process; Benchmarking; Dimensions or Types of Control - Feed forward control, Concurrent Control (Real Time Information &Control), Feedback Control; Techniques of Control - Brief review of Traditional Techniques & Modern Techniques of Control. Case Studies.

Text / Reference Books:

1. Harold Koontz & Heinz Weihrich. (2010). Essentials of Management (8th edition.). New Delhi: Tata McGraw Hill.
2. Robbins, S.P. & Decenzo, D. A. (2014). Fundamentals of Management: Essential Concepts and Applications. New Delhi: Pearson Education.
3. Stoner, Freeman and Gilbert Jr. (1995). Management (6th edition.). New Delhi Prentice Hall of India. Stephen Robbins and Coulter Mary (2005). Management (8th edition.)

New Delhi, Prentice Hall
4. Terry& Franklin. (2009), Fundamentals of Management. (8th edition) Pearson Education Asia.
5. Lesikar. (2010), Lesikar's Basic Business Communication, (12th edition), New Delhi, Tata McGraw Hill
6. Sharma, Mohan. (2007), Business Communication and Report Writing, (3rd edition), New Delhi, Tata McGraw Hill.

b. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Understanding the evolution and contributions of management thought	Understand
CO2	Outlining the evolving concepts in managerial planning and scientific decision making	Apply
CO3	Analyzing the role of organizing with other managerial functions	Analyze
CO4	Learn the application of overall control for effective management and creating healthy working environment.	Create
CO5	Apply communication skills in business practices	Skill

Semester	Course Code	Course Title	L-T-P-C
I	CSE5011	COMPUTER PROGRAMMING AND PROBLEM SOLVING	3-1-0-4

a. Course Objectives

1.	To introduce the fundamentals of computers, programming environments, and other number systems
2.	To develop algorithmic thinking
3.	To strengthen students' ability to model, analyse, and solve problems logically
4.	To teach structured programming concepts using C language
5.	To enable students to write, debug and test C programs for real-world problems

b. Syllabus

Unit – 1	BASICS OF COMPUTERS AND PROBLEM SOLVING FUNDAMENTALS	10 hrs

Basics of Computers: Types of Computers, Characteristics, CPU, Memory, I/O, Bus Structure, System Software, Application Software, Operating System basics, Program Development Steps, Compilers, Interpreters, Number Systems and Conversions, ASCII and UNICODE representations. Problem Solving Fundamentals: Understanding the problem-solution framework, Problem definition and specification, Steps in defining a solution, Patterns of reasoning, Algorithmic thinking, Flowcharts and Pseudocode.

Unit – 2	PROBLEM CATEGORIES AND ALGORITHMIC STRATEGIES	10 hrs

Problem Classification, Simple numerical problems, Ratio-proportion and average problems, Problems involving Max/Min, Counting and Summation, rearranging data, searching and sequencing. String processing problems, Algorithmic Design Strategies: Decomposition, Generalization, Transformation and Iterative refinement.

Unit – 3	INTRODUCTION TO C PROGRAMMING	10 hrs

Structure of a C program, Header files, compiling, linking and executing programs, variables, data types and constants, operators and expressions: arithmetic, relational, logical and bit-wise, Input and Output Statements, Simple C programs.

Unit – 4	CONTROL STRUCTURES, ARRAYS, FUNCTIONS AND STRINGS	15 hrs

Control Structures: Selection: If, If-else, Nested If, Switch. Iteration: for, while, do-while. Break and continue. Functions: Function declaration and definition, Call by value, Call by reference, Recursion (factorial, gcd, towers of Hanoi). Arrays and Strings: 1D & 2D arrays, Searching and Sorting, Strings and library functions.

Unit – 5	POINTERS, STRUCTURES, FILE HANDLING AND MODULAR PROBLEM SOLVING	15 hrs

Pointers: Basics, pointer arithmetic, pointers with arrays and strings, dynamic memory allocation. Structures and Unions: Definition, Array of structures, Nested structures. File Handling: Text and binary files, fopen, fclose, fgets, fputs, fprintf, fscanf, fread, fwrite functions. Modular Problem Solving: Modular design, refining large programs into modules, handling complexity, case studies.

Text / Reference Books:

1. R.G. Dromey, How to Solve it by Computer, Pearson India, 2007.
2. B.W. Kerninghan and Dennis M. Ritchie, The C Programming Language, 2nd Edition, Pearson Education India, 2015
3. E. Balaguruswamy, Programming in ANSI C, McGrawHill, 9th Edition, 2024
4. Yashvant Kanetkar, Let Us C, BPB Publications, 2026th Edition, 2025.

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Explain the basics of computers, software components, and number systems.	K1, K2
CO2	Apply problem solving strategies to analyse, design and model computational solutions	K2, K3, K4
CO3	Construct algorithms and flowcharts for various categories of problems	K3, K4
CO4	Write C programs using control structures, arrays, functions, strings and pointers	K3
CO5	Solve moderately complex problems using modular programming, structures and file handling in C	K3, K4, K6

d. Mapping of Course Outcomes to Program Outcomes

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

Semester	Course Code	Course Title	L-T-P-C
I		ENGINEERING PHYSICS LAB	0-0-2-2

a. Course Objectives

1.	To familiarize students with experimental methods in physics and enable them to perform measurements of fundamental physical quantities with accuracy.
2.	To develop the ability to apply theoretical physics concepts—such as optics, thermodynamics, electricity, magnetism, quantum effects, and semiconductor physics—to laboratory experiments.
3.	To train students in the proper handling, calibration, and operation of laboratory instruments such as optical benches, potentiometers, laser setups, fiber-optic kits, magnetometers, and semiconductor devices.
4.	To enhance skills in collecting, analyzing, and interpreting experimental data, and to develop the ability to compare experimental results with theoretical predictions.
5.	To cultivate scientific reasoning, teamwork, communication, and ethical laboratory practices essential for experimental physics and engineering applications.

b. Syllabus

1. Newton's law of cooling
2. Specific heat by method of mixtures
3. Determination of Earth’s magnetic moment and induction
4. Newtons rings
5. Air-wedge experiment
6. PN junction diode – I-V characteristics
7. Potentiometer- comaparison of emf
8. Photoelectric effect
9. Fiber-optics characteristic
10. Study of dia-, para-, and ferromagnetic materials
11. Single-slit diffraction

Text / Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Publication.

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Perform experiments related to heat, optics, electricity, and magnetism and interpret experimental results accurately	Apply
CO2	Apply scientific principles to determine physical parameters such as specific heat, magnetic induction, diode characteristics, etc.	Apply
CO3	Develop skills in using laboratory instruments and experimental setups (optical bench, potentiometer, fiber optics, etc.).	Analyse
CO4	Analyze experimental data, draw valid conclusions, and compare with theoretical predictions.	Analyse
CO5	Demonstrate practical understanding of modern physics phenomena such as photoelectric effect, semiconductors, and magnetism.	Apply

d. Mapping of Course Outcomes to Program Outcomes

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

Semester	Course Code	Course Title	L-T-P-C
I	CSE5012	COMPUTER PROGRAMMING AND PROBLEM SOLVING LAB	0-0-4-2

a. Course Objectives

1.	To introduce the fundamentals of computers, programming environments, and other number systems
2.	To develop algorithmic thinking
3.	To strengthen students' ability to model, analyse, and solve problems logically
4.	To teach structured programming concepts using C language
5.	To enable students to write, debug and test C programs for real-world problems

b. Syllabus

Programs should include but not be limited to:

Lab – 1: Basic I/O programs (temperature conversion, area and perimeter of shapes etc.)
Lab – 2: Problem Solving exercises (sum of digits of a number etc.)
Lab – 3: Conditional Statements (even or odd, roots of a quadratic equation etc.)
Lab – 4: Looping Constructs (factorial, gcd, multiplication table, etc.)
Lab – 5: Functions and Recursion (user defined functions, recursive functions, etc.)
Lab – 6: 1-D Arrays (sum / average, linear search, binary search, bubble sort, etc.)
Lab – 7: 2-D Arrays (matrix addition, multiplication, transpose of a matrix etc.)
Lab – 8: Strings (length, concatenation, palindrome, reverse, substring checking etc.)
Lab – 9: Pointers (address and referencing, pointers to arrays, dynamic memory allocation etc.)
Lab – 10: Structures and Unions
Lab – 11: File Handling
Lab – 12: Mini Project

Text / Reference Books:

1. R.G. Dromey, How to Solve it by Computer, Pearson India, 2007.
2. B.W. Kerninghan and Dennis M. Ritchie, The C Programming Language, 2nd Edition, Pearson Education India, 2015
3. E. Balaguruswamy, Programming in ANSI C, McGrawHill, 9th Edition, 2024
4. Yashvant Kanetkar, Let Us C, BPB Publications, 2026th Edition, 2025.

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Explain the basics of computers, software components, and number systems.	K1, K2
CO2	Apply problem solving strategies to analyse, design and model computational solutions	K2, K3, K4
CO3	Construct algorithms and flowcharts for various categories of problems	K3, K4
CO4	Write C programs using control structures, arrays, functions, strings and pointers	K3
CO5	Solve moderately complex problems using modular programming, structures and file handling in C	K3, K4, K6

d. Mapping of Course Outcomes to Program Outcomes

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

Semester	Course Code	Course Title	L-T-P-C
I		INDIAN CONSTITUTION	2-0-0-0

a. Syllabus

Unit – 1	INTRODUCTION TO THE INDIAN CONSTITUTION	9 hrs
Constitution – meaning and need for a constitution –formation and composition of constituent assembly – values and principles in the Indian constitution – origin and development – basic features of the Indian constitution - constitutionalism.		
Unit – 2	**FUNDAMENTALS OF THE INDIAN CONSTITUTION**	**6 hrs**
Preamble – Fundamental Rights – Right to equality – right to life and personal Liberty-freedom of speech and expression – expansion of the freedom of speech and expression - reasonable restrictions.		
Unit – 3	**DIRECTIVE PRINCIPLES AND FUNDAMENTAL DUTIES**	**9 hrs**
Nature of DPSP- Separation of Powers -Equal Justice and Free Legal Aid - 42nd Amendment Act - Swaran Singh Committee Report -Importance of abiding by the constitution – Protection of the environment.		
Unit – 4	**PARLIAMENTARY SYSTEM AND THE INDIAN CONSTITUTION**	**9 hrs**
Parliamentary system of the government - Structure and composition of the Parliament- Lok Sabha and Rajya Sabha - Functions of the Parliament – legislative, executive and financial functions – procedure for making law.		
Unit – 5	**FEDERALISM UNDER THE INDIAN CONSTITUTION**	**12 hrs**
Division of Powers – division of power v separation of Powers – seventh schedule of the Indian Constitution - 42nd Amendment Act – Centre State Relation – Local self-Government.		

Text / Reference Books:

1. Introduction to the Constitution of India, D.D Basu (27th edition, 2024)
2. Indian Polity, M. Laxmikanth (8th edition, 2025)
3. Constitutional Law of India , H.M Seervai (4th edition , 2023)
4. Our Constitution – Subhash C Kashyap (5th edition 2025)
5. Constitution of India Bare Act (EBC) (2025)
6. The Constitution of India ,PM Bakshi (20th edition, 2025)
7. The Framing of India's Constitution, B. Shiva Rao (reprint in 2025)
8. Constitutional Interpretation: Principles , P Ishwara Bhat (1st edition , 2026)
9. You Must Know Your Constitution , Fali S Nariman (1st edition , 2023)
10. Supreme Court on Fundamental Rights , V.K.Dewan (1st edition, 2021)
11. Fundamentals of the Indian Constitution Mukesh Kumar Suman (2nd edition, 2025)

12. The Indian Constitution: Cornerstone of a Nation , Granville Austin (1966)
13. Indian Constitutional Law, M.P. Jain (9th edition, 2025)
14. Constitution of India, V.N Shukla (14th edition, 2022)
15. Shorter Constitution of India, D.D. Basu (16th edition, 2021)
16. Why the Constitution Matters, D.Y Chandrachud (1st edition, 2025)

SEMESTER – II

Semester	Course Code	Course Title	L-T-P-C
I	MAT5043	PROBABILITY AND STATISTICS	4-0-0-4

a. Syllabus

Unit – 1	**9 hrs**
Arithmetic mean, geometric mean, harmonic mean, median, mode, standard deviation, quartile deviation, percentiles, expectation, variance, covariance, correlation, regression, properties of correlation, regression coefficients.	
Unit – 2	**6 hrs**
Probability, random experiment, sample point, event and probability, rules of probability, conditional probability, independence of events, Bayes' rule, applications.	
Unit – 3	**9 hrs**
Discrete random variables: Definition, sum and linear composite of random variables, mean, variance, Bernoulli, binomial, geometric and negative binomial distributions, hypergeometric distribution, Poisson distribution, applications.	
Unit – 4	**9 hrs**
Continuous random variables: Definition, uniform and exponential distributions, normal distribution and its properties, standard normal distribution, transformation from a general normal distribution to standard normal, checking for normality of data, applications.	
Unit – 5	**12 hrs**
Hypothesis testing: Hypothesis, simple and composite, null and alternative, test of hypothesis, type I and type II errors, level and power of a test, p-value, tests for mean and standard deviation, test for proportion, one tail or two tails, applications.	

Text / Reference Books:

1. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics (A Modern Approach), Tenth Edition, Sultan Chand and Sons, 2000. (Unit I)
2. R. E. Walpole, R. H. Myers, S. L. Myers and K.Ye, Probability & Statistics for Engineers & Scientists, Ninth Edition, Prentice Hall, 2012. (Units II-V)
3. Douglas C. Montgomery Arizona State University George C. Runger, Applied Statistics and Probability for Engineers, Fifth Edition, John Wiley & Sons, 2011.
4. A.D. Aczel, and J. Sounderpandian Complete Business Statistics, Seventh Edition, McGraw-Hill, Irwin, 2008.
5. M.L. Samuels, and J.A. Witmer, Statistics for the life sciences, 23rd Edition, Prentice Hall, 2003.

6. H.E. Van Emden, Statistics for terrified Biologists, Blackwell Publishing, 2008.
7. R. Barlow, Statistics - A guide to the use of statistical methods in the Physical Sciences, Wiley, 1999.

b. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Quantify the uncertainness in various real-life situations using the knowledge of probability Remember / Understand	Remember / Understand
CO2	Model and predict various events as discrete random variables	Apply
CO3	Model and predict various events as continuous random variables	Analyze
CO4	Estimate the basic statistics in a practical situation and to give a conclusive inference from the available resources	Evaluate
CO5	Test different hypothesis and to establish the validity of the proposed hypothesis with statistical evidence	Create

Semester	Course Code	Course Title	L-T-P-C
II	MSN5021	BASIC ENGINEERING	4-0-0-4

a. Syllabus

Unit – 1	**12 hrs**
Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Build-up area, Floor space index – Types of buildings: Residential buildings, Industrial buildings.	
Unit – 2	**12 hrs**
Overview of Mechanical Engineering – Mechanical Engineering Contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering – Interdisciplinary concepts in Mechanical Engineering.	
Unit – 3	**12 hrs**
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law – Kirchhoff's Laws - Nodal Analysis, Mesh analysis Introduction to AC Circuits – Steady state analysis of RLC circuits. Electrical machines: DC Separately and Self excited Generators, Types and Applications; DC motors, Types and Applications. Construction, working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.	
Unit – 4	**12 hrs**
Analog electronics: Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters.	
Unit – 5	**12 hrs**
Digital Electronics: Review of number systems and Boolean algebra, Logic Gates and Truth Tables, Simplification of Boolean functions using Karnaugh map (upto 4 variable K-maps), Implementation of Simple combinational circuits (Adder, Code Converters, 7-Segment Drivers, Comparators, Priority Encoders, etc) T and D flip-flops, counters and registers using D flip flops.	

Text / Reference Books:

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
2. N.Mittle "Basic Electrical Engineering". Tata McGraw Hill Edition, New Delhi, 1990.
3. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
4. 4S. Jacob Millman and Christos C-Halkias, "Electronic Devices and Circuits", Tata McGraw Hill

b. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	To provide the students an illustration of the significance of the Civil Mechanical Engineering Profession in satisfying the societal needs.	Analyze
CO2	To help students acquire knowledge in the basics of surveying and the materials used for construction and manufacturing.	Understand
CO3	Students will gain knowledge regarding the various laws and principles associated with electrical systems	Understand
CO4	Students will gain knowledge of Analog electronics.	Understand
CO5	Students will gain knowledge on Digital electronic systems.	Remember

Semester	Course Code	Course Title	L-T-P-C
II	MSN5022	ENGINEERING GRAPHICS	3-0-0-3

a. Syllabus

Unit – 1	**9 hrs**
Introduction; drawing instruments and their uses; lines, lettering and dimensioning; geometrical construction; constructions of plain, diagonal and Vernier scales; orthographic projection—first and third angle projections;	
Unit – 2	**9 hrs**
Orthographic projection of points on principal, profile, and auxiliary planes. Orthographic projection of straight line in simple and oblique positions; application of orthographic projection of line;	
Unit – 3	**9 hrs**
Orthographic projection of planes in simple and oblique position on principal and profile planes; orthographic projection of lines and planes on auxiliary planes.	
Unit – 4	**9 hrs**
Orthographic projection of solids in simple and oblique positions on principal and profile planes; orthographic projections of solids in oblique position using auxiliary plane method; orthographic projection of spheres;	
Unit – 5	**9 hrs**
Orthographic projection of solids in section; development of surfaces of solids; method of isometric projection.	

Text / Reference Books:

1. N. D. Bhatt, Engineering Drawing, 53rd ed. Anand, India: Charotar Publishing House, 2016.
2. Basant Agrawal and C M Agrawal, Engineering Drawing, 2nd ed. New Delhi, India: McGraw Hill Education (India), 2014.

b. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Prepare drawings as per standards (BIS).	Analyze
CO2	Solve specific geometrical problems involving points and lines.	Understand
CO3	Solve specific geometrical problems in plane geometry involving plane figures.	Understand
CO4	Produce orthographic projection of engineering components working from pictorial drawings	Understand
CO5	Understand the basic AUTOCAD commands	Remember

Semester	Course Code	Course Title	L-T-P-C
II	CSC5021	DATA STRUCTURES	3-0-0-3

a. Course Objectives

1.	To build fundamental understanding of data structures, dynamic memory concepts, and algorithmic problem-solving
2.	To develop the ability to select and use appropriate data structures for modeling and solving computational problems efficiently
3.	To acquire skills in implementing linear and non-linear data structures using suitable programming techniques
4.	To enhance the ability to design, analyze, and evaluate algorithms with respect to time and space complexity
5.	To prepare learners to apply data structures and algorithmic techniques in real-world applications and modern engineering practice

b. Syllabus

Unit – 1	INTRODUCTION AND OVERVIEW OF DATA STRUCTURES	6 hrs

Concept of data type, definition and brief description of various data structures, operations on data structures, ADT, algorithm complexity and time space trade-off, Asymptotic notation, recursion, some illustrative examples of recursive functions. Review of Pointers and Dynamic Memory Management: Understanding pointers, usage of pointers, memory management functions. Arrays: Linear and multi-dimensional arrays and their representation, operations on arrays.

Unit – 2	LISTS, STACKS AND QUEUES	12 hrs

Linked Lists: Linear linked list, operations on linear linked list, doubly and circularly linked list, operations on doubly and circularly linked list, application of linked lists. Stacks: Sequential and linked representations, operations on stacks, application of stacks such as parenthesis checker, evaluation of postfix expressions, conversion from infix to postfix representation, evaluation of an expression, implementing recursive functions. Queues: Sequential representation of queue, linear queue, circular queue, operations on linear and circular queue, linked representation of a queue and operations on it, priority queues, applications of queues.

Unit – 3	SORTING AND SEARCHING	9 hrs

Sorting arrays using bubble sort, selection sort, insertion sort, quick sort, merge sort, heap sort, shell sort, tree sort, radix sort, etc., searching an element using linear search and binary search techniques. Heaps: Representing a heap in memory, operations on heaps, application of heap in implementing priority queue and heapsort algorithm.

Unit – 4	TREES AND GRAPHS	12 hrs
Trees: Basic terminology, array and linked representations of trees, traversing a binary tree using recursive and non-recursive procedures, BST - inserting a new node, deleting a node, finding height, threaded binary trees, AVL trees and B-trees. Graphs: Basic terminology, representation of graphs (adjacency matrix, adjacency list), traversal of a graph (breadth first search and depth-first search), applications of graphs in problems such as finding shortest paths, obtaining minimum cost spanning tree, etc.		
Unit – 5	**HASHING**	**6 hrs**
Comparing direct address tables with hash tables, hash functions, concept of collision and its resolution using open addressing and separate chaining, double hashing, rehashing.		

Text / Reference Books:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson, 2nd Edition, 2003.
2. Ellis Horrowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Computer Science Press, 2nd Edition , 2008.
3. E. Balagurusamy, "Data Structures using C", Tata McGraw Hill, 2013.
4. Debasis Samanta, "Classic Data Structures", Prentice Hall of India, 2nd Edition, 2009.
5. Reema Thareja, "Data Strcutures using C", Oxford University Press, 2nd Edition, 2011.
6. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, "Data Structures using C and C++", Pearson, 2nd Edition, 2015.

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Explain abstract data types, algorithm complexity, recursion, pointers, and array representations	K2
CO2	Implement linked lists, stacks, and queues using sequential and linked representations	K3
CO3	Analyze and apply suitable sorting and searching techniques for computational problems	K4
CO4	Develop tree and graph-based solutions using appropriate traversal and processing techniques	K3
CO5	Apply hashing techniques and collision resolution methods for efficient data storage and retrieval	K3

d. Mapping of Course Outcomes to Program Outcomes

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

Semester	Course Code	Course Title	L-T-P-C
II	CSC5022	DISCRETE MATHEMATICS	3-0-0-3

a. Course Objectives

1.	To develop Mathematical Reasoning
2.	To work with Logics, Sets, Functions, and Relations
3.	To understand Probability, Mathematical Induction and Computational Thinking
4.	To apply Group theory, Combinatorics and Counting Principles Study Graphs and Trees
5.	To solve Real-World and Computational Problems

b. Syllabus

Unit – 1	SETS – RELATIONS – FUNCTIONS – BOOLEAN ALGEBRA	9 hrs
Set Operations – Representation and Properties of Relations – Equivalence Relations – Partially Ordering. Functions – one-one – onto – Injective – Surjective - Bijective – composition of relations and functions – inverse functions. Boolean Algebra and Boolean Functions and its representations – Simplifications of Boolean Functions.		
Unit – 2	**MATHEMATICAL LOGIC**	**9 hrs**
Propositional Logic: Logical Connectives – Truth Tables – Tautology – Contradiction. Predicate Logic: Quantifiers – Inference Rules. Methods of Proof: Direct Proof – Indirect Proof – Contradiction – Contrapositive.		
Unit – 3	**COUNTING AND MATHEMATICAL INDUCTION**	**9 hrs**
Basics of Counting – Pigeonhole Principle – Permutations and Combinations – Inclusion-Exclusion Principle – Mathematical Induction.		
Unit – 4	**GROUP THEORY**	**9 hrs**
Groups – Subgroups – Semi Groups – Product and Quotients of Algebraic Structures – Isomorphism – Homomorphism – Automorphism – Rings - Integral Domains – Fields – Applications of Group Theory. – Polya's theory of counting – Introduction to Error-Correcting Codes.		
Unit – 5	**GRAPH THEORY**	**9 hrs**
Simple Graph – Multigraph – Weighted Graph – Paths and Circuits – Shortest Paths in Weighted Graphs – Eulerian Paths and Circuits – Hamiltonian Paths and Circuits – Planner graph – Graph Coloring –Bipartite Graphs.		

Text / Reference Books:

1. Rosen, K.H. and Kamala Krithivasan, Discrete Mathematics and its Applications, McGraw Hill, 8th Edition 2021.
2. Norman L. Biggs, Discrete Mathematics, (2nd ed. 2002), Oxford University Press
3. Tremblay, J.P. and Manohar.R, Discrete Mathematical Structures with Applications to ComputerScience, McGraw Hill Education, First edition, 2017
4. Grimaldi, R.P. , Discrete and Combinatorial Mathematics: An Applied Introduction, Pearson, Fifthedition, 2013
5. Lipschutz, S. and Mark Lipson, Discrete Mathematics (Schaum's Outlines), McGraw Hill Education,Revised Third edition, 2017

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Understand the concepts of Sets, relations, functions and Boolean algebra with applications	K2
CO2	Apply propositional and predicate logic techniques to solve logical and mathematical problems	K3
CO3	Solve counting and combinatorial problems using counting principles and mathematical induction	K3
CO4	Analyze algebraic structures such as groups, rings, and fields and their applications	K4
CO5	Apply graph theoretic concepts and algorithms to solve computational problems	K3

d. Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	1	1	1	2	2
CO2	3	3	3	3	3	3	2	1	2	2	2
CO3	3	3	3	3	3	3	2	1	1	1	2
CO4	3	3	3	3	3	3	2	2	1	1	3
CO5	3	3	3	3	3	3	2	2	1	2	2

Semester	Course Code	Course Title	L-T-P-C
II	MSN5023	WORKSHOP / MANUFACTURING PRACTICES	0-0-4-2

a. Syllabus

List of experiments include but not limited to

1. Foundry
   Preparation of sand mould for the Flange, Hand Wheel
2. Welding
   Exercise in arc welding for making Butt joint and Lap joint
3. Fitting
   Preparation of Joints, Markings, Cutting and filling for making
   a) Semicircle Part
   b) Dovetail Part
4. Wiring and Plumping
   Exercise in electrical Wiring/House wiring/Plumping
5. Sheet metal / Carpentry experiments - if facility is available

Semester	Course Code	Course Title	L-T-P-C
II	CSC5023	DATA STRUCTURES LAB	0-0-4-2

a. Course Objectives

1.	To build fundamental understanding of data structures, dynamic memory concepts, and algorithmic problem-solving
2.	To develop the ability to select and use appropriate data structures for modeling and solving computational problems efficiently
3.	To acquire skills in implementing linear and non-linear data structures using suitable programming techniques
4.	To enhance the ability to design, analyze, and evaluate algorithms with respect to time and space complexity
5.	To prepare learners to apply data structures and algorithmic techniques in real-world applications and modern engineering practice

b. Syllabus

Programs should include but not limited to:

Implementation of

i. Operations on Arrays
ii. Operations on Singly Linked List i) Creation ii) Insertion iii) Deletion iv) Traversal
iii. Operations on Doubly Linked List i) Creation ii) Insertion iii) Deletion iv) Traversal
iv. Stacks using Arrays and Linked List
v. Applications of Stack
vi. Queues using Arrays and Linked List
vii. Linear Search and Binary Search
viii. Sorting Algorithms
ix. Heaps
x. Tree Traversal Algorithms
xi. Binary Search Tree ADT
xii. AVL Trees
xiii. Graph Traversal Algorithms
xiv. Shortest Path Algorithms
xv. Minimum Spanning Tree Algorithms
xvi. Hashing

Text / Reference Books:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson, 2nd Edition, 2003.
2. Ellis Horrowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", Computer Science Press, 2nd Edition , 2008.
3. E. Balagurusamy, "Data Structures using C", Tata McGraw Hill, 2013.
4. Debasis Samanta, "Classic Data Structures", Prentice Hall of India, 2nd Edition, 2009.
5. Reema Thareja, "Data Strcutures using C", Oxford University Press, 2nd Edition, 2011.
6. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, "Data Structures using C and C++", Pearson, 2nd Edition, 2015.

c. Course Outcomes

On successful completion of the course, the student will be able to

	Course Outcome	Bloom's Level
CO1	Understand and explain fundamental concepts of data structures, algorithms, dynamic memory management, and asymptotic notation.	K2
CO2	Apply linear data structures and associated algorithms to solve defined computational problems.	K3
CO3	Design and implement nonlinear data structures such as trees, heaps, hash tables, and graphs for solving engineering problems.	K3 / K4
CO4	Analyze and compare the performance of searching, sorting, and hashing algorithms using time and space complexity measures.	K4
CO5	Select and integrate suitable data structures and algorithms to model and solve complex computational problems using modern programming tools.	K5

d. Mapping of Course Outcomes to Program Outcomes

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