GOVERNMENT OF ANDHRA PRADESH

STATE BOARD OF TECHNICAL EDUCATION AND TRAINING

Andhra Pradesh :: Mangalagiri

FUTURE READINESS

INDUSTRY 4.0/ COMPETENCY 5.0

CURRICULUM (C-26)

For Polytechnic Diploma Courses in Andhra Pradesh

Transforming learners into future technologists

DIPLOMA IN ELECTRONICS AND COMMUNICATION ENGINEERING

3 YEARS

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3 YEAR DIPLOMA
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CURRICULUM -2026 (C-26)

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1. PREAMBLE

The world is evolving rapidly, and education must evolve with it. In today's dynamic environment, our approach to learning must equip students not only with knowledge but also with the practical experience in innovation, critical thinking ability and problem-solving mindset required to excel in both academic and professional spheres.

At the heart of the new curriculum, lies the belief that education should be student-centric, fostering curiosity, creativity and a lifelong passion for learning. The State Board of Technical Education and Training (SBTET), Andhra Pradesh aims to create a safe, supportive, and inclusive learning environment where every student is encouraged to reach their fullest potential. This curriculum is designed to provide a strong foundation for lifelong growth and employability, ensuring that learners graduate not only with a diploma but also with the competence and confidence to thrive in a rapidly changing world.

The SBTET, A.P. has consistently strived to meet the aspirations of all stakeholders i.e., students, parents, industries, academia and society at large by keeping its diploma programmes relevant to emerging technologies and industrial advancements. To this end, SBTET, A.P. has regularly reviewed and updated its curricula through a systematic, evidence-based and consultative process.

Building on the success of earlier curriculum and responding to the demands of new-age technologies, SBTET, A.P. resolved to update the Polytechnic C-23 curriculum and introduce the new curriculum (C-26), aligning it with global technological trends, skill-development goals, and industry expectations. The revision process was initiated in November 2024, with comprehensive feedback collected from all stakeholders i.e., students, parents, industry experts, academia, alumni, faculty, heads of sections and principals across the state.

A pivotal meeting was convened under the chairmanship of Sri. Gummala Ganesh Kumar, I.A.S., Director of Technical Education & Chairman, SBTET, A.P. to discuss the revamping of the curriculum with an emphasis on industry relevance, academic flexibility, skill orientation and employability.

Further, Sri. Gummala Ganesh Kumar, I.A.S., reiterated the importance of industrial exposure, project-based learning, and practical training in bridging the gap between

classroom learning and industry requirements. He highlighted the need to make the curriculum more innovative, flexible, and technology-driven to prepare students for emerging fields such as Artificial Intelligence (AI), Machine Learning (ML), Quantum Computing, Internet of Things (IoT), Drone Technology, and Industry 4.0.

To ensure a holistic and futuristic approach, two regional workshops were conducted with industry experts, academic experts from higher-level institutes and subject experts at Tirupati and Visakhapatnam. The Programme-wise expert committees comprising members from industry, higher-education institutions and polytechnic faculty were constituted. In the subsequent workshops conducted, these committees explored strategies to integrate the following key components into the curriculum, with the objective of enhancing employability and industry readiness:

- Internet of Things (IoT) for all programmes
- A balanced ratio of theory and practical components
- Emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), Quantum Computing, and Drone Technology
- Industry 4.0 and 5G Technologies
- Introduction of elective courses to provide flexibility and promote specialization in emerging domains
- Inclusion of audit courses to encourage innovative and holistic development, ethics, environmental awareness, entrepreneurship and lifelong learning beyond the core curriculum
- Adoption of Practicum-based Learning, wherein certain courses are designed to be taught through hands-on, activity-oriented, and experiential methods instead of the conventional lecture mode, enabling students to apply concepts directly through practice and experimentation

A series of workshops, consultations, and validation meetings with subject experts, industrialists, and academicians were conducted to comprehensively review and refine the draft curriculum. The final version was further vetted by industry professionals and academicians from reputed higher-education institutions to ensure academic rigor, practical relevance, and alignment with current and emerging industry needs.

The Curriculum 2026 (C–26) has been developed through the active participation of

polytechnic faculty, industry representatives, and expert committees, following an Outcome-Based Education (OBE) framework in accordance with NBA guidelines.

This new curriculum reflects the collective vision of educators, industry experts, and policymakers to develop competent, innovative, ethical and highly employable diploma graduates. It equips learners with the skills, attitudes and mindset needed to embrace future challenges driven by AI, Quantum Computing, IoT, Industry 4.0, 5G and sustainable technologies.

The C–26 Curriculum has been approved by the Board Members, SBTET, Andhra Pradesh, for implementation from the academic year 2026–27.

2. KEY FEATURES OF THE C-26 CURRICULUM

- The revised C-26 curriculum is enriched in alignment with the National Credit Framework (NCrF), ensuring conformity with updated academic structures and national standards.
- Practicum-based courses integrating theory and practical components are introduced from the first year across the programme to strengthen hands-on skills and improve industry readiness through skill-oriented learning.
- Audit courses are incorporated to broaden students' knowledge base without impacting academic grades.
- Elective courses are included to provide flexibility, enabling students to pursue specialized areas aligned with their interests and career aspirations.
- National-level online learning platforms are integrated as electives, offering access to a wide range of quality courses and promoting self-directed learning.
- Theory and laboratory courses are restructured to accommodate new and emerging subjects that address current and future industrial requirements.
- Emerging technologies in electronics and communication, including artificial intelligence, advanced wireless systems, quantum technologies, edge and cloud computing, advanced semiconductor technologies, and industrial IoT, are introduced through audit components to promote multidisciplinary and globally competitive learning.
- Conventional engineering drawing content is replaced with industry-relevant electronic design tools to enhance skills in circuit design, PCB layout, and simulation.
- Foundational laboratory exposure is strengthened through the introduction of practicum-based electrical and electronics experiments.
- Digital literacy is enhanced by upgrading basic computing laboratories into comprehensive digital skills laboratories with emphasis on practical software proficiency.
- Strong theoretical foundations are established to support advanced signal processing and communication system applications.
- Awareness of emerging interdisciplinary domains such as unmanned aerial systems and drone technologies is introduced through audit learning components.
- Elective options are provided in specialized application domains, including healthcare-related electronics, to highlight real-world engineering applications.
- Advanced analytical and signal processing skills are strengthened through elective offerings aligned with industry expectations.
- Modern programming skills are promoted through elective options supporting applications in automation, artificial intelligence, machine learning, and embedded systems.
- Fundamental concepts of artificial intelligence and intelligent systems are introduced through audit learning without increasing credit load.
- Industrial safety, environmental sustainability, and electronic waste management concepts are integrated to promote responsible engineering practices.
- Automation-oriented skills related to industrial control and monitoring systems are introduced through electives to enhance employability.
- Exposure to advanced engineering tools, systems, and implementation methodologies is strengthened through audit learning in emerging electronics and communication technologies

3. ACKNOWLEDGEMENT

The members of the working group sincerely thank Sri Gummala Ganesh Kumar, I.A.S., Director of Technical Education and Chairman of SBTET, Andhra Pradesh, and Sri Kona Sasidhar, I.A.S., Principal Secretary, Skills Development and Training Department, for their valuable guidance and support during the revision of the C-23 Curriculum and the development of the new C-26 Curriculum.

We are also thankful to SBTET, Andhra Pradesh, Mangalagiri, for organizing a series of workshops at different stages. These workshops brought together faculty from polytechnics, experts from reputed national Institutes, universities, engineering colleges and professionals from industry. Their discussions and feedback helped to review the C-23 Curriculum and design the improved C-26 Curriculum.

We express our gratitude to Sri G.V.V. Satyanarayana Murty, Secretary, SBTET, Andhra Pradesh, Sri V. Padma Rao, Joint Director of Technical Education, Sri A. Ravi Kumar, Joint Secretary (Academic), SBTET, Andhra Pradesh and all officers from the Directorate of Technical Education and State Board of Technical Education and Training, Andhra Pradesh, for their encouragement and continuous support.

Finally, we sincerely thank all faculty members from various polytechnics across the state who contributed to this endeavour. Their ideas, teamwork, and commitment played a key role in shaping the C-26 Curriculum successfully.

4. RULES AND REGULATIONS

4.1 Duration and Pattern of Diploma Programmes

All Diploma Programmes approved by AICTE are of three years duration.

- The first year follows a yearly system.
- The remaining period (two years) follows a semester system.
- A run-through system is followed for all Diploma Programmes, as per eligibility rules.

4.2 Procedure for Admission into the Diploma Programmes:

Selection of candidates is governed by the rules and regulations laid down in this regard from time to time.

a. Candidates who wish to seek admission into any of the Diploma Programmes will have to appear for the Common Entrance Test for admissions into polytechnics (POLYCET) conducted by the State Board of Technical Education and Training, Andhra Pradesh, Mangalagiri. Only the candidates satisfying the following requirements will be eligible to appear for the Common Entrance Test for admissions into polytechnics (POLYCET).

The candidates seeking admission should have passed/appeared for S.S.C. examination, conducted by the Board of Secondary Education, Andhra Pradesh, or equivalent examination thereto, by the time of applying for the Common Entrance Test for admission into polytechnics (POLYCET). In case of candidates whose results of their qualifying examinations are pending, their selection shall be subject to production of proof of their passing the qualifying examination in one attempt or compartmentally at the time of admission.

b. Admissions are made based on the merit obtained in the Common Entrance Test (POLYCET) and the reservation rules stipulated by the Government of Andhra Pradesh from time to time.

c. For admission into Diploma in Pharmacy programme for which entry qualification is 10+2 (MPC/BiPC), candidates need not appear for POLYCET. A separate notification will be issued for admission into this Programme.

4.3 Medium of Instruction

The medium of instruction and examination for all Diploma programmes shall be English

4.4 Permanent Identification Number (PIN)

Every student is given a Permanent Identification Number (PIN) at the time of admission. This number is used to record and maintain the student's academic and examination details throughout the Diploma along with APAAR ID.

4.5 Number of Working Days per Semester/Year:

a) The academic year for all the programmes shall be in accordance with the academic calendar.
b) The working days in a week shall be from Monday to Saturday.
c) There shall be 7 periods of 50 minutes duration each on all working days.
d) The minimum number of working days for each semester/year shall be 90/180 days excluding examination days. If the prescribed minimum is not achieved due to any reason, special arrangements shall be made to conduct classes to complete the syllabus.
e) The timings of the institutions shall be preferably from 9:30 a.m. to 4:30 p.m.

4.6 Eligibility (Attendance to appear for the Summative Assessment)

a) A candidate shall be permitted to appear for the Summative Assessment in all programmes, if he or she has attended a minimum of 75% of working days during the year/semester.
b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester or first year may be granted on medical grounds.
c) A stipulated fee shall be payable towards condonation for shortage of attendance.
d) Candidates having less than 65% attendance shall be detained.
e) Students whose shortage of attendance is not condoned in any semester / year and who have not paid the condonation fee in time are not eligible to take the Summative Assessment of that semester/year and they will be detained. They may seek readmission for that semester/year (when offered) in the next subsequent academic semester/year.
f) For Industrial Training:

i) During Industrial Training, the candidate shall put in a minimum of 90% attendance.

ii) If the student fails to secure 90% attendance during industrial training, the student shall reappear for industrial training at his own expense.

4.7 Readmission Rules

Readmission shall be granted to eligible candidates by the respective Principal/Regional Joint Director/Director of Technical Education.

a) (i) Within 15 days after commencement of class work in any semester.
(ii) For Industrial Training: before commencement of the Industrial Training.

b) Within 30 days after commencement of class work in any year (including D. Pharmacy Programme or first year course work in Engineering and Non-Engineering Diploma streams). Otherwise, such cases shall not be considered for readmission for that year and they are advised to seek readmission in the next eligible academic year.

c) The percentage of attendance of the readmitted candidates shall be calculated from the first day of beginning of the regular class work for that year/semester, as officially announced by CTE but not from the day on which he/she has actually reported to the class work.

d) A candidate detained in any year or semester shall be allowed readmission to the same year/semester only in the subsequent academic year. This provision shall equally apply to the industrial training also.

4.8 Scheme of Evaluation

a) First Year:

Theory Courses: 70 marks for the Summative Assessment (3 hours) + 30 marks for Formative Assessment.

Laboratory/Drawing Courses: 60 or 30 marks for the Summative Assessment (3 hours) + 40 or 20 marks for Formative Assessment as per the allocated marks to that course.

b) III to V Semesters:

Theory Courses: 70 marks for the Summative Assessment (3 hours) + 30 marks for Formative Assessment.

Laboratory/Drawing Courses: 60 or 30 marks for the Summative Assessment + 40 or 20 formative assessment as per the allocated marks to the course.

4.9 Formative Assessment Scheme:

Formative Assessment shall be conducted for awarding marks on the dates specified and it consists of two components namely, Assessment through Unit Tests and Continuous Internal Assessment (CIA).

Total Formative Assessment Marks (30) =Unit Test (20) + CIA (10)

a) **Theory Courses:**

Three-unit tests shall be conducted for I year and two Unit Tests for semesters. Unit test shall be of 90 minutes duration and for a maximum of 40 marks for each test.

S. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment (30 Marks)		
1	Formative Assessment through Unit Tests (UT): 20 Marks		
	Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Unit test shall be conducted for 40 marks and scaled down to 20. Average of all the unit tests will be taken as Unit Test marks
2	Formative Assessment through Continuous Internal Assessment (CIA) :10 Marks		
	1. Assignments	05*	All activities shall be recorded. Relevant records are to be filed and secured for further scrutiny of higher authorities
	2. Dynamic Learning Activities: Project Work/ Seminar /Group Discussion, Quizzes etc.	05**	
	T O T A L	30	

**At least one assignment should be completed for each unit which carries 10 marks. The total assignment marks should be scaled down to 5.*

***At least one dynamic learning activity is to be conducted which carries 10 marks. The total marks should be scaled down to 5.*

b) Practical Courses:

Award of marks for Formative Assessment shall be as follows:

i) Drawing Courses:

Distribution of Marks for the Formative Assessment				
First Year (Total: 40 Marks)			Semesters (Total: 40 Marks)	
Max: 20 Marks	Max: 20 Marks		Max: 20 Marks	Max: 20 Marks
From the average of THREE Unit Tests.	From the average of Assessments of Regular Class work Exercises.		From the average of TWO Unit Tests.	From the average of Assessment of Regular Class work Exercises.

- Each Unit Test will be conducted for a duration of 120 minutes with maximum marks of 40 and scaled down to 20 Marks.

ii) Laboratory Courses:

a) Student's performance in Laboratories / Workshop shall be assessed during the year/ semester of study for 40 marks in each Laboratory Course. The procedure for evaluation for Laboratory Courses, other than Drawing courses:

i. Formative Assessment for Laboratory Course shall be done on the basis of tasks performed by the student in the laboratory.

ii. Question paper for Formative Assessment shall be task-based and shall be designed to assess practical skills, procedures, and application of concepts.

b) Formative Assessment in Laboratory courses shall be done during the course of study and marks shall be awarded by the concerned faculty. Formative Assessment for laboratory courses can be done for 40 marks

Sl. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment: 40 Marks		
1	Formative Assessment through Unit Tests (UT): 20 Marks		
	Practical & Theory evaluation: Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Unit test shall be conducted for 20 Marks. Average of all the Tests will be taken as Unit Test marks
2	Formative Assessment through Continuous Internal Assessment (CIA) :20 Marks		
	Experiment wise observations, individual laboratory performance	20	
	T O T A L	40	

c) For laboratory examinations, there shall be two examiners. External examiner shall be appointed by the Principal in consultation with respective Head of the Section, preferably choosing a qualified person from the list given below in order of preference. Appointment order copy shall be filed and secured.

i) Near by Industries.

ii) Govt./Semi Govt organizations like R & B, PWD, PR, Railways, BSNL, APSRTC, APSEB etc.

iii) Govt./ University Engineering Colleges.

iv) Senior Faculty from nearby Polytechnics.

Internal examiner shall be the person concerned with Formative Assessment as mentioned in (b) above. The Summative Assessment shall be held along with all

theory papers in respect of drawing courses.

In case of drawing course earmarked as Practicum (practical course) the Summative Assessment shall be held along with practical papers.

d) Question Paper for Practical Examination: Question paper should cover the experiments / exercise prescribed to test various skills like handling, manipulating, testing, troubleshooting, repair, assembling and dismantling etc. from more than one experiment / exercise

e) Records pertaining to Formative Assessment marks of both theory and practical Courses are to be maintained for official inspection. All the evaluation formats/proformas shall be maintained as per the instructions issued by SBTET, A.P. from time to time

iii) Practicum Theory Courses:

Assessment for Practicum theory courses can be done for 30 marks

Sl. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment (30 Marks)		
1	Formative Assessment through Unit Tests (UT): 20 Marks		
	Theory & Practical evaluation: Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Test shall be conducted for 40 Marks (Theory:30 Marks Practical:10 Marks) and scaled down to 20. Average of all the Tests will be taken as Unit Test marks
2	Formative Assessment through Continuous Internal Assessment (CIA) :10 Marks		
	a) Assignments	05*	All activities shall be recorded. Relevant records are to be filed and secured for further scrutiny of higher authorities
	b) Dynamic Learning Activities: Project Work/ Seminar/Group Discussion, Quizzes etc.	05**	
	TOTAL	30	

**At least one assignment should be completed for each unit which carries 10 marks. The total assignment marks should be scaled down to 5.*

***At least one dynamic learning activity is to be conducted which carries 10 marks. The total marks should be scaled down to 5.*

iv) Practicum Practical Courses:

Assessment for Practicum practical courses can be done for 40 marks

Sl. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment: 40 Marks		
1	Formative Assessment through Unit Tests (UT): 20 Marks		

	Practical & Theory evaluation: Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Test shall be conducted for 40 marks (Theory:10marks Practical:30marks) and scaled down to 20. Average of all the Tests will be taken as Unit Test marks.
2	Formative Assessment through Continuous Internal Assessment (CIA) :10 Marks		
	Experiment wise observations, individual laboratory performance	20	
	T O T A L	40	

v) Activity Periods:

1.	a) Library	All activities shall be duly recorded & the relevant documents shall be filed and securely maintained for scrutiny by higher authorities. 0.5 or 1 Credits shall be awarded to the successful candidates for each semester/year accordingly.
	b) IPSGM/Sports & Games	
	c) Extra-curricular activities (NSS / NCC/ Clean & Green of Campus etc.)	

vi) Industrial Training:

In case of Industrial Training, SOP will be circulated by SBTET, A.P from time to time. The Formative Assessment and Summative Assessment shall be done as illustrated in the following table:

Assessment No	Upon completion of	Conducted by	Based on	Max Marks
Pre-Assessment	15 days to 30 days from the commencement of training	Mentor faculty member visits the industry 15 days to 30 days from the commencement of training and will submit a detailed report to the principal outlining each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment after three months (at	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial	120

	industry)		Training	
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned, 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
TOTAL				300

Each staff member shall be assigned a batch of students 10 to 15 as a mentor faculty for making assessment during industrial training.

vii) Project Work:

The guidelines to be followed for Project work are as follows:

- ✓ The Project Title and Abstract must be approved by a committee comprising the Principal, Head of the Section (HoS) and the concerned faculty members
- ✓ Students should be encouraged to undertake project work with the potential for publication in academic and professional journals

The Formative Assessment consisting of 40% of the total marks shall be distributed as follows:

Assessment	To be conducted	Marks (Evaluated for)
Review-1	After the completion of 4 weeks from the start of the semester	10
Review-2	After the completion of 10 weeks from the start of the semester	15
Review-3	After the completion of 14 weeks from the start of the semester	15

The Summative Assessment consisting of 60% of the total marks shall be distributed as follows:

	To be	Conducted by	Based on	Max

Assessment	conducted			Marks
Summative	After completion of the Project work	1.Project Guide 2.HoS concerned 3.An external examiner	1.Demonstration of skill relevant to the Project	30
			2. Project Report	20
			3. Viva Voce	10
TOTAL				60

4.10 Minimum Pass Marks

a) Theory Courses:

To pass a theory course, a candidate must secure a minimum of 35% in the Summative Assessment (i.e., Min 25 Marks) and a combined minimum of 35% from both the Formative and Summative Assessment marks put together.

b) Practical Courses:

For passing a practical Course, a candidate has to secure a minimum of 50% in Summative Assessment and a combined minimum of 50% of both Formative and Summative Assessment marks put together. In case of D.C.C.P., the pass mark for Typewriting and Shorthand is 45% in the Summative Assessment. There are no marks for formative assessment in case of Typewriting and Shorthand courses in D.C.C.P programme.

c) Industrial Training:

The Industrial training shall carry 300 marks and pass marks is 50% in each assessment at the industry (Mid semester Assessment and second assessment) i.e 120 marks out of 240 and in final summative assessment 30 marks out of 60 marks at institution level put together i.e. 150 marks out of 300 marks.

d)The courses successfully completed shall be awarded the allotted credits and the corresponding grade shall be assigned based on the percentage of marks secured.

4.11 Provision for Improvement

Improvement is allowed only after he / she has completed all the courses from First Year to Final semester of the Diploma.

a) Improvement is allowed in any 4 (Four) courses of the Diploma Programme.

b) The student can avail the improvement chance only once and it must be taken within the two examinations immediately following the completion of their Diploma. However, the duration including Improvement examination shall not exceed FIVE years from the year of first admission.

c) No improvement is allowed in Practical / Lab Courses or Project work or Industrial Training assessment. However, improvement in drawing Course(s) is allowed.

d) If improvement is not achieved, the marks obtained in the previous Examinations hold good.

e) Improvement is not allowed in respect of the candidates who are punished under Mal-Practice in any examination.

f) Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.

g) All the candidates who wish to appear for improvement of performance shall deposit the original Marks Memos of all the years / Semesters including Consolidated Marks Memo(CMM) and also original Diploma Certificate to the Board. If there is improvement in performance of the current examination, the revised Memorandum of marks including CMM and Original Diploma Certificate will be issued, else the submitted originals will be returned.

4.12 Rules of Promotion:

i. A candidate shall be permitted to appear for first year examination provided he / she has 75% attendance (which can be condoned on medical grounds up to 10%) i.e. attendance after condonation on medical grounds should not be less than 65% and has to pay the examination fee.

ii. A candidate shall be promoted to 3rd semester if he/she puts in the required percentage of attendance in the first year and pays the examination fee. A candidate who could not pay the first-year examination fee has to pay the promotion fee as prescribed by State Board of Technical Education and Training, AP from time to time before commencement of 3rd semester.

iii. A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and paid the examination fee. A candidate, who could not pay the 3rd semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training AP from time to time before commencement of 4th semester. A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester and pays the examination fee.

iv A candidate shall be promoted to 5th semester provided he / she puts the required

percentage of attendance in the 4th semester and pays the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5th semester. A candidate is eligible to appear for the 5th semester examination if he/she puts the required percentage of attendance in the 5th semester and pays the examination fee.

v A candidate shall be sent to Industrial Training/6th semester provided he/she puts in the required percentage of attendance in the 5th semester and pays the examination fee /promotion fee as prescribed by SBTET. A candidate is eligible to appear for Industrial Training assessment (Seminar/Viva-Voce) only if he/ she puts the required percentage of attendance, i.e., 90% in the 6th semester Industrial Training and pays the examination fee.

vi Industrial Training shall be treated as the 6th semester, irrespective of whether the training is undertaken during the 5th or 6th semester.

For IVC & ITI Lateral Entry students:

i) A candidate shall be permitted to appear for Third semester examination provided he/she puts in 75% attendance (which can be condoned on medical grounds up to 10%) and pays the examination fee for third semester.

ii) A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pays the examination fee. A candidate who could not pay the 3rd semester exam fee, has to pay the promotion fee as prescribed by SBTET, A.P from time to time before commencement of 4th semester. A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester and pays the examination fee.

iii) A candidate shall be promoted to 5th semester provided he / she put the required percentage of attendance in the 4th semester and pays the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5th semester. A candidate is eligible to appear for the 5th semester examination if he/she puts the required percentage of attendance in the 5th semester and pays the examination fee.

iv) A candidate shall be sent to Industrial Training/VI semester provided he/she puts in the required percentage of attendance in the 5th semester and pays the

examination fee /promotion fee as prescribed by SBTET. A candidate is eligible to appear for Industrial Training assessment (Seminar/Viva-Voce) only if he / she puts the required percentage of attendance, i.e., 90% in the 6th semester Industrial Training and pays the examination fee.

4.13 Student Performance Evaluation

Successful candidates shall be awarded the Diploma under the following CGPA.

CGPA secured	Division
CGPA ≥ 7.5	First Class with Distinction (who completed Diploma within 3 years)
7.5 > CGPA ≥ 6	First Class
CGPA < 6	Second Class

Note: Candidate should acquire 120 credits to award diploma**.**

Awarding Grade and Grade Points

Students will be awarded Grades and Grade Points considering their Percentage of Marks Evaluated in each Theory and Practical Courses and the Conversion of Percentage of Marks obtained in the Examinations to the Grade Points and Awarding Grades for Every Course is tabulated as shown below:

For Theory Courses		
Percentage of Marks	**Grade Points (GP) (10)**	**Grade Awarded**
Above 90	10	A+
From 81 to 90	09	A
From 71 to 80	08	B+
From 61 to 70	07	B
From 51 to 60	06	C+
From 41 to 50	05	C
From 35 to 40	04	D
Below 35	0	F (FAIL)

For Practical Courses		
Percentage of Marks	**Grade Points (GP) (10)**	**Grade Awarded**
Above 90	10	A+
From 81 to 90	09	A
From 71 to 80	08	B+
From 61 to 70	07	B
From 51 to 60	06	C+
Equal to 50	05	C
Below 50	0	F (FAIL)

The merit level of a student would be indicated by

1. "Semester Grade Point Average (SGPA) " for the Year or for a Semester.
2. "Cumulative Grade Point Average (CGPA)" for awarding Diploma.

Conversion Formula, EP = Equivalent Percentage = [CGPA Obtained] x 10

4.14 Examination Fee Schedule

Examination fees are as per the notifications issued by the State Board of Technical Education and Training (SBTET), Andhra Pradesh, from time to time.

4.15 Structure of Examination Question Paper

I. Formative Assessment:

a) Theory Courses

For First Year: Three Unit Tests.

For semesters: Two Unit Tests.

Each test shall be of 90 minutes duration, carrying a maximum of 40 marks and will consist of Part A and Part B

Part A (16 Marks):

1. Objective Type Questions:

Multiple Choice Questions / True or False / Fill in the Blanks-

4 × 1 marks = 4 marks

2. Short Answer Questions:

Four questions - 4 × 3 marks = 12 marks

Part B (24 Marks):

Essay-Type Questions: (Attempt any 3 out of 4)

3 × 8 marks = 24 marks

Total Marks:4 + 12 + 24 = 40 marks

Computation of Marks

First Year: Average of 3 tests

Semester System: Average of 2 tests

The marks obtained out of 40 shall be scaled down to 20 and treated as the Unit Test marks for each course.

b) Drawing Courses (both Conventional/Hybrid) :

First Year:

Three-unit tests shall be conducted for 40 marks. The duration of each test is 120 minutes

The question paper pattern is as follows:

Part A: Answer all 4 question, 4 X 5M =20M.

Part B: Answer any 2 questions out of 4, 2 X 10M =20M.

Semesters:

Two-unit tests shall be conducted for 40 marks. The duration of each test is 120 minutes

The question paper pattern is as follows:

Part A: Answer all 4 questions, 4 X 5M =20M.

Part B: Answer one question out of two 1 X 20M =20M.

The marks obtained for 40 shall be scaled down to 20 marks and the average of 3tests/2tests shall be taken as final Unit test marks for the course. Remaining 20 marks are given by the faculty based on the performance of the student during regular class work of that course.

c) Laboratory/Workshops:

Fifty percent of the total marks shall be allotted to continuous assessment in labs/workshops and the remaining fifty percent shall be derived from two tests

d) Assessment of Practicum Courses:

i)Practicum Theory Course (out of 30 Marks)

Theory and Practical Assessment: 20 Marks

Continuous Internal Assessment: 10 Marks

Total Marks for the course = 20+10= 30 Marks

ii) Practicum Practical Course (out of 40 Marks)

Practical & Theory Assessment: 20 Marks

Continuous Internal Assessment: 20 Marks

Total Marks for the course = 20+20 = 40 Marks

II. Summative Assessment:

The question paper for theory examination is patterned in such a manner that the weightage of periods/marks allotted for each of the topics for a particular course be considered. Summative Assessment paper is of 3 hours duration.

a) Each theory paper has Section A (short answers) and Section B (essay questions).

Section A: Answer 10 out of 12 questions, Total = 10 × 3M = 30M

Section B: Answer 5 out of 8 questions, Total = 5 × 8M = 40M

Total theory marks for Summative Assessment = 70 Marks.

b) Drawing Course:

I year

Section A: 4 questions 4 X 5M = 20 marks (all to be answered).

Section B: answer 4 questions out of 6 questions. 4 × 10M = 40 marks.

Drawing Courses - III Semester to V Semester

As per the weightage of marks given in blueprint of the respective course

c) Practical Examinations:

For practical with total 60 marks: Experiment/exercise = 50 marks; Viva-voce = 10 marks; Total = 60.

For practical with total 30 marks: Experiment/exercise = 25 marks; Viva-voce = 5

marks; Total = 30.

Question papers for practical are drawn by lottery and cover required skills.

Changes to the pattern will be notified in advance.

d) Note on Laboratory Evaluation:

Laboratory teaching shall be task/competency based and the Year/Semester-end question papers should follow SBTET norms.

4.16 Issue of Memorandum of Marks

All candidates who appear for the Summative Assessment will be issued memorandum of marks without any payment of fee. However, candidates who lose the original memorandum of marks have to pay the prescribed fee to the Secretary, State Board of Technical Education and Training, A.P. for each duplicate memo. After successful completion of all courses, Consolidated Memorandum of Marks will be issued.

4.17 Maximum Period for Completion of Diploma

The maximum period to complete a Diploma is twice the duration of the course from the date of first admission (this includes any periods of detention or discontinuation). After this period, students will forfeit the right to complete the Diploma and will not be allowed to appear for exams. This applies to all the Diploma Programmes.

4.18 Eligibility for Award of Diploma

A candidate is eligible for the Diploma if:

i) They have pursued the course for not less than 3 years and not more than 6 years.

ii) Students must complete all the required courses. Those who fail to fulfil the requirements within the maximum permissible period shall forfeit their seat and will not be eligible for readmission

For IVC & ITI Lateral Entry students:

i) They must pursue the course for not less than 2 years and not more than 4 years.

ii)They must complete all required courses. Failure to meet the requirements within the maximum permissible period shall result in forfeiture of the seat, and the student will not be eligible for readmission.

Note: As and when a new curriculum is introduced in future, existing curriculum students under C-26 scheme shall write their backlog courses if any in the new curriculum equivalent courses decided by the SBTET, AP.

4.19 Malpractice Cases:

If any candidate resorts to Malpractice during examinations, he / she shall be booked and the punishment shall be awarded as per SBTET,AP rules and regulations in vogue.

4.20. Discrepancies/ Pleas:

Any Discrepancy /Plea regarding results etc., shall be represented to the SBTET, AP within one month from the date of issue of results. Thereafter, no such cases shall be entertained in any manner.

4.21. General

i. The Board may change or amend the academic rules and regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students, for whom it is intended, with effect from the dates notified by the competent authority.

ii. All legal matters pertaining to the State Board of Technical Education and Training, AP are within the jurisdiction of Mangalagiri, Guntur District Andhra Pradesh only.

iii. In case of any ambiguity in the interpretation of the above rules, the decision of the Secretary, SBTET, A.P., Mangalagiri is final.

VISION

To develop globally competent Electronics and Communication Engineering professionals equipped with emerging technology skills, innovation mindset, ethical values, and lifelong learning abilities to contribute effectively to society, industry, and sustainable development.

MISSION

M1	To provide competitive learning environment through a need-based curriculum enriched with emerging technologies such as AI, IoT, Quantum Computing, 5G, and Semiconductor Technologies to impart strong technical and practical competencies.
M2	To make students globally competent by enhancing ethical values, leadership qualities, communication and professional skills
M3	To Promote innovative, creative, entrepreneurship, and research oriented thinking through activity based, project based, and experiential learning approaches.
M4	To collaborate with industry, higher education institutions, and stakeholders to enhance employability, sustainability, and societal contribution.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Diploma in Electronics and Communication Engineering programme is steadfast to transform students in to competent professionals with qualities of good human values and responsible citizens. On completion of the Diploma programme, the students should have acquired the following characteristics

PEO1	To apply core ECE knowledge along with hands on skills in modern tools like IoT, AI, 5G, and other emerging technologies to solve technical challenges sustainably
PEO2	To pursue lifelong learning through continuous skill upgradation using digital platforms (SWAYAM) and adapt to rapidly evolving technological environments.
PEO3	To demonstrate strong communication, teamwork, leadership, and entrepreneurial abilities to contribute effectively in multidisciplinary and global work environments.
PEO4	To uphold ethics, environmental responsibility, industrial safety, and quality standards in all professional practices

PROGRAMME OUTCOMES(POs)

1. **Basic and discipline specific knowledge**: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem analysis**: Identify and analyse well-defined engineering problems using codified standard methods
3. **Design/Development of solutions**: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs
4. **Engineering tools, Experimentation and Testing**: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
5. **Engineering practices for society, sustainability and environment**: Apply appropriate technology in context of society, sustainability, environment and ethical practices.
6. **Project Management**: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well defined engineering activities.
7. **Life-long learning**: Ability to analyse individual needs and engaging updating in the context of technological changes.

PROGRAMME SPECIFIC OUTCOMES(PSOs)

1. An ability to understand the concepts of basic Electronics & Communication Engineering and to apply them to various areas like Signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices, etc.

2. An ability to solve complex Electronics and Communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.

3. Wisdom of social and environmental awareness along with ethical responsibility to have a successful career in the field of Electronics and Communication Engineering and to sustain passion and zeal for real-world applications in the field of Electronics using optimal resources as an entrepreneur.

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
First Year

Course Code	Course Title	No. of Periods /Week		Practicum (Y/N)	Total No. of Periods /Year	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC101T	English Essentials	3	-	N	90	4	3	30	70	100
26EC102T	Engineering Mathematics - I	6	-	N	180	6	3	30	70	100
26EC103T	Engineering Physics	3	-	N	90	4	3	30	70	100
26EC104T	Engineering Chemistry and Environmental Studies	3	-	N	90	4	3	30	70	100
26EC105T	Basic Electronics	6	-	N	180	6	3	30	70	100
AUDIT COURSE										
26EC106A	Electronic CAD	2	-		60					
PRACTICAL COURSES										
26EC107L	Electric Circuit Analysis		6	Y	180	5	3	40	60	100
26EC108L	Basic Electronics Lab		4	N	120	4	3	40	60	100
26EC109L	Physics Lab		3	N	90	1.5	3	20	30	50
26EC110L	Chemistry Lab			N		1.5	3	20	30	50
26EC111L	Computer and Digital Skills		3	N	90	3	3	40	60	100
26EC112C	Student Centric Activities		3	-	90	1	-	-	-	-
	TOTAL	**23**	**19**		**1260**	**40**		**310**	**590**	**900**

Note 1: 1 credit will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

* **Note 2**: For the Physics laboratory half of the first-year students of each programme will attend, while the remaining half will attend the chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the three-hour lab session.

Note 3: 26EC101T, 26EC102T, 26EC103T, 26EC104T, 26EC109L, 26EC110L, and 26EC111L are common to all programmes. All first year courses are common with ECII.

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
III SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC301T	Electronic Circuits	6	-	N	90	4	3	30	70	100
26EC302T	Analog and Digital Communication Systems	6	-	N	90	4	3	30	70	100
26EC303T	Digital Electronics	6	-	Y	90	4	3	30	70	100
ELECTIVE COURSES										
26EC304E	Engineering Mathematics-II	3	-	N	45	2	3	30	70	100
26EC305E	Signals and Systems									
26EC306E	Computer Hardware and Servicing									
AUDIT COURSE										
26EC307A	Basics of Drone Technology	2	-	N	30					
PRACTICAL COURSES										
26EC308L	Electronic Circuits Lab		6	N	90	2	3	40	60	100
26EC309L	Analog and Digital Communication Systems Lab		4	N	60	1.5	3	40	60	100
26EC310L	Programming in C and MATLAB		6	Y	90	2	3	40	60	100
26EC311C	Student Centric Activities		3	-	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26EC304E is common elective to all programmes. All third semester courses are common with ECII.

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
IV SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC401T	Microcontrollers and Interfacing	6	-	Y	90	4	3	30	70	100
26EC402T	Microwave and Satellite Communication	6	-	N	90	4	3	30	70	100
26EC403T	Industrial Electronics	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EC404E	Medical Electronics	3	-	N	45	2	3	30	70	100
26EC405E	Python Programming									
26EC406E	Swayam Course in Emerging Technologies with 2 Credits	-			-		-	-	-	-
AUDIT COURSE										
26EC407A	Artificial Intelligence	2	-	N	30					
PRACTICAL COURSES										
26EC408L	Communication and Employability Skills		4	Y	60	2	3	40	60	100
26EC409L	Industrial Electronics Lab		6	N	90	2	3	40	60	100
26EC410L	IOT and Sensors Lab		6	N	90	1.5	3	40	60	100
26EC411C	Student Centric Activities		3	-	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26EC408L is common laboratory to all programmes.

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
V SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC501T	Industrial Management and Entrepreneurship	6	-	N	90	4	3	30	70	100
26EC502T	Optical and Mobile Communications	6	-	Y	90	4	3	30	70	100
26EC503T	Data Communication and Computer Networks	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EC504E	PLC & SCADA	3	-	N	45	2	3	30	70	100
26EC505E	Embedded Systems									
26EC506E	Digital Signal Processing									
AUDIT COURSE										
26EC507A	Emerging Technologies in Electronics and Communication Engineering	2	-	N	30					
PRACTICAL COURSES										
26EC508L	Data Communication and Computer Networks Lab		6	N	90	2	3	40	60	100
26EC509L	DLD Through Verilog HDL		6	Y	90	2	3	40	60	100
26EC510P	PROJECT WORK		4	N	60	1.5	3	40	60	100
26EC511C	Student Centric Activities		3	-	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note: 0.5 credits will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
VI Semester

INDUSTRIAL TRAINING

Course Code	Course Title	Duration	Credits	Marks for FA	Marks for SA
26EC601I	Industrial Training	Semester	20	240	60

Assessment No	Upon completion of	Conducted by	Based on	Max Marks
Pre-Assessment	15 days to 30 days from the commencement of training	Mentor faculty member visits the industry 15 days to 30 days from the commencement of training and will submit a detailed report to the principal outlining each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment (after three months at industry)	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
TOTAL				300

The Industrial Training shall carry maximum 300 marks. Pass mark is 50% in first and second assessment put together and also 50% in final summative assessment at the institution level.

FIRST YEAR

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
FIRST YEAR

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Year	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC101T	English Essentials	3	-	N	90	4	3	30	70	100
26EC102T	Engineering Mathematics - I	6	-	N	180	6	3	30	70	100
26EC103T	Engineering Physics	3	-	N	90	4	3	30	70	100
26EC104T	Engineering Chemistry and Environmental Studies	3	-	N	90	4	3	30	70	100
26EC105T	Basic Electronics	6	-	N	180	6	3	30	70	100
AUDIT COURSE										
26EC106A	Electronic CAD	2	-		60					
PRACTICAL COURSES										
26EC107L	Electric Circuit Analysis		6	Y	180	5	3	40	60	100
26EC108L	Basic Electronics Lab		4	N	120	4	3	40	60	100
26EC109L	Physics Lab		3	N	90	1.5	3	20	30	50
26EC110L	Chemistry Lab			N		1.5	3	20	30	50
26EC111L	Computer and Digital Skills		3	N	90	3	3	40	60	100
26EC112C	Student Centric Activities		3	-	90	1	-	-	-	-
	TOTAL	**23**	**19**		**1260**	**40**		**310**	**590**	**900**

Note: One credit will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

* **Note 2**: For the Physics laboratory half of the first-year students of each programme will attend, while the remaining half will attend the chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the three-hour lab session.

Note 3: 26EC101T, 26EC102T, 26EC103T, 26EC104T, 26EC109L, 26EC110L, and 26EC111L are common to all programmes. All first year courses are common with ECII.

ENGLISH ESSENTIALS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC101T	English Essentials	3	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Questions
1	Exploring English	10	14	2	1
2	The Better You!	10	11	3	1
3	Drive to Destiny!	10	14		1
4	Renew, Rewire & Resolve!	10	17	2	1
5	Brains & Bots	10		1	
6	The Blue Planet: Mend or End	10	11	1	1
7	One World One Dream	10	11	1	1
8	The Net Norms	10	11	1	1
9	Managing Moods & Moments	10	11	1	1
	Total	**90**	**100**	**12**	**8**

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	inculcate knowledge of functional English and enrich vocabulary

(ii)	impart effective listening, speaking, reading, and writing skills
(iii)	sensitise the students on themes related to personality, technological advancements, sustainability, and human values

COURSE OUTCOMES

CO1	EC101.1	Learn and apply various English grammatical concepts to communicate in academic, professional, personal, and social contexts
CO2	EC101.2	Use appropriate vocabulary in academic, professional, and in business correspondence and on social media platforms
CO3	EC101.3	Listen and understand, read and comprehend different forms of academic, professional, and general listening and reading materials
CO4	EC101.4	Communicate effectively and fluently in oral and written forms in various life situations
CO5	EC101.5	Display scientific temper and universal human values technology for holistic development and harmonious living through demeanour and communication

LEARNING OUTCOMES

1.0 EXPLORING ENGLISH

1.1 To read and comprehend simple sentences in a short passage.

1.2 To apply certain rules of spelling, correct the misspelt words and use dictionary to enrich vocabulary

1.3 To identify various parts of speech suitable to context and use articles & prepositions accurately.

1.4 To describe a given situation/ picture using simple sentences.

1.5 To value the importance of English for employability.

2.0 THE BETTER YOU!

2.1 To read and comprehend formal and informal conversations.

2.2 To use words suitable to the context in spoken and written communication.

2.3 To use the appropriate forms of verbs.

2.4 To engage in conversations in both formal and informal contexts.

2.5 To demonstrate positive attitude in personal and academic spheres.

3.0 DRIVE TO DESTINY

3.1 To read and comprehend paragraphs for specific and general information, and distinguish different types of paragraphs

3.2 To distinguish word pairs and use them contextually.

3.3 To frame sentences with proper subject-verb agreement.
3.4 To describe actions using appropriate tense.
3.5 To set and achieve academic and personal goals.

4.0 RENEW, REWIRE & RESOLVE

4.1 To read and comprehend the content and structure of e-mails for different purposes.
4.2 To recognize the root words and use appropriate affixes contextually.
4.3 To use various kinds of sentences for different communicative situations.
4.4 To draft E-mails for academic and professional purposes.
4.5 To apply the skills of critical thinking and creativity in solving problems.

5.0 BRAINS & BOTS

5.1 To read and comprehend the description of a process with sequence markers.
5.2 To communicate using phrasal verbs intelligibly.
5.3 To use active and passive voice appropriately.
5.4 To describe processes and procedures using appropriate sentence forms.
5.5. To appraise the importance and use of robotics and artificial intelligence in human life.

6.0 THE BLUE PLANET: MEND OR END!

6.1 To read and comprehend the content, structure and purpose of formal and informal letters.
6.2 To describe using appropriate forms of adjectives
6.3 To substitute phrases or clauses with a single word.
6.4 To draft personal and professional letters.
6.5 To realise the importance of environmental protection and ensure sustainability.

7.0 ONE WORLD - ONE DREAM

7.1 To read and comprehend essay and analyse its features
7.2 To identify and create shortened forms of words or phrases.
7.3 To report the expressions of the speaker to a third person with necessary grammatical changes.
7.4 To draft well-organized essays for academic and professional purposes.
7.5 To appraise the importance of inclusivity in the society.

8.0 THE NET NORMS

8.1 To comprehend and analyse the given text for making notes and summarising.
8.2 To use contemporary language in informal communication.
8.3 To split or combine ideas using conjunctions for effective communication.
8.4 To make notes of textual information and summarize the information.
8.5 To demonstrate ideal behaviour on the internet.

9.0 MANAGING MOODS & MOMENTS

9.1 To read and comprehend different types of reports.

9.2 To analyse and evaluate grammatical errors.

9.3 To use words and phrases in sentences of your own.

9.4 To draft organized and comprehensive reports on experiments, events, visits and incidents.

9.5 To assess the reasons and manage stress and manage time effectively.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO1	POs 1 to 4 are not directly applicable for English course. However, activities that use content from science and technology relevant to the Programme taken up by the student shall be exploited for communication in the Course.					3	2	Programme Specific Outcomes are Branch specific with technical aspects which are not directly applicable to English Language course.		
CO2						3	2			
CO3						3	2			
CO4						3	2			
CO5					2		2			
Average					2	3	2			

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 Exploring English

Reading – Roleplay – Picture Interpretation – Sounds and Spellings – Parts of Speech – Articles and Prepositions

2.0 The Better You!

Reading – Dialogue Writing – Synonyms and Antonyms – Word order – Verbs

3.0 Drive To Destiny

Reading – Paragraph Writing – Homophones, Homonyms, Homographs – Concord – Tenses

4.0 Renew, Rewire & Resolve

Reading – E-mail Writing – Roots, Affixes – Kinds of Sentences

5.0 Brains & Bots

Reading – Describing Process – Phrasal Verbs – Voice

6.0 The Blue Planet: Mend Or End!

Reading – Letter Writing – One-word Substitutes – Degrees of Comparison

7.0 One World - One Dream

Reading – Essay Writing – Abbreviations & Acronyms – Reported Speech

8.0 The Net Norms

Reading – Note making & Summarising – Gen-Z Vocabulary – Synthesis of Sentences

9.0 Managing Moods & Moments

Reading – Report Writing – Usage – Error Analysis

The text book "English Essentials" (A Textbook of English for I Year Engineering Diploma Courses - by SBTET, AP) is the prescribed text for this course. It comprises various language inputs and activities addressing the Learning outcomes specified in each unit. Every unit will have six major components: Listening, Speaking, Reading, Writing, Vocabulary, Grammar. The activities will be designed as Individual, Pair and Group activities to facilitate self and peer learning.

REFERENCES

1. M. Hewing's, *Advanced Grammar in Use*. Cambridge: Cambridge University Press.
2. R. Murphy, *English Grammar in Use*. Cambridge: Cambridge University Press.
3. S. Greenbaum, *Oxford English Grammar*. Oxford: Oxford University Press.
4. P. C. Wren and H. Martin, *English Grammar and Composition*, revised by N. D. V. Prasad Rao. New Delhi: Blackie ELT Books, S. Chand & Co.
5. S. Freeman, *Strengthen Your Writing*. London: Macmillan.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From 1.1 to 3.5
Unit Test – II	From 4.1 to. 6.5
Unit Test – III	From 7.1 to 9.5

ENGINEERING MATHEMATICS-I

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC102T	Engineering Mathematics - I	6	180	6	30	70

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs mapped
Unit - I: Algebra						
1	Partial Fractions	6	4	0	1/2	CO1
2	Matrices and Determinants	25	18	2	1&1/2	CO1
Unit - II: Trigonometry						
3	Trigonometric Ratios	4	0	0	0	CO2
4	Compound Angles	8	3	1	0	CO2
5	Multiple and Sub-multiple angles	8	3	1	0	CO2
6	Transformations	9	4	0	1/2	CO2
7	Inverse Trigonometric Functions	8	4	0	1/2	CO2
8	Trigonometric Equations	8	4	0	1/2	CO2
9	Properties of triangles	8	4	0	1/2	CO2
10	Complex Numbers	8	3	1	0	CO2
11	Hyperbolic functions	2	0	0	0	CO2
Unit III: Co-ordinate Geometry						
12	Straight Lines	8	3	1	0	CO3
13	Circles	8	4	0	1/2	CO3
14	Conic Sections	10	4	0	1/2	CO3
Unit – IV: Differential Calculus						
15	Limits and Continuity	6	3	1	0	CO4

16	Differentiation	28	17	3	1	CO4
Unit – V: Integral Calculus						
17	Indefinite integration	18	11	1	1	CO5
18	Definite integration	8	11	1	1	CO5
	Total	**180**	**100**	**12**	**8**	
			Marks	36	64	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	apply the principles of Algebra, Trigonometry and Co-ordinate Geometry to real-time problems in engineering
(ii)	build the concepts of indefinite integrals and definite integrals

COURSE OUTCOMES

CO1	EC102.1	Resolve partial fractions and solve problems on matrices and determinants
CO2	EC102.2	Use the concept of trigonometric functions, their inverses and complex numbers
CO3	EC102.3	Find the equations and properties of straight lines, circles and conic sections in coordinate system
CO4	EC102.4	Evaluate the limits and derivatives of various functions and apply to engineering problems
CO5	EC102.5	Integrate various functions using different methods and evaluate definite integrals

LEARNING OUTCOMES

1.0 Resolve partial fractions and solve problems on matrices and determinants.

1.1 Define rational, proper and improper fractions of polynomials.

1.2 Explain the procedure of resolving proper fractions of the type $\frac{f(x)}{(ax+b)(cx+d)}$

1.3 Define a matrix and order of a matrix.

1.4 State various types of matrices with examples (emphasis on 3rd order square matrices).

1.5 Compute sum, difference, scalar multiplication and product of matrices. Illustrate the properties of these operations such as commutative, associative and distributive properties with examples and counter examples.

1.6 Define the transpose of a matrix and state its properties – examples.

1.7 Define symmetric and skew-symmetric matrices with examples. Resolve a square matrix into a sum of symmetric and skew-symmetric matrices with examples.

1.8 Define determinant of a square matrix; minor, co-factor of an element of a 3x3 square matrix with examples. Expand the determinant of a 3x3 matrix using Laplace expansion formula. State and apply the properties of determinants to solve simple problems.

1.9 Distinguish singular and non-singular matrices. Define multiplicative inverse of a matrix and list properties of adjoint and inverse. Compute adjoint and multiplicative inverse of a square matrix.

1.10 Solve a system of three linear equations in three unknowns using Cramer's rule.

2.0 Solve problems using the concept of trigonometric functions, their inverses and complex numbers.

2.1 Recall the trigonometric ratios and their values at specified angles.

2.2 Draw graphs of trigonometric functions - Explain periodicity of trigonometric functions.

2.3 Define compound angles and state the formulae of sin(A±B), cos(A±B), tan(A±B) and cot(A±B).

2.4 Give simple examples on compound angles to derive the values of $\sin 15^0$, $\cos 15^0$, $\sin 75^0$, $\cos 75^0$, $\tan 15^0$, $\tan 75^0$ etc.

2.5 Derive identities like $\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B$ etc.

2.6 Solve simple problems using the identities on compound angles.

2.7 Derive the formulae of multiple angles 2A, 3A etc., and sub-multiple angle A/2 in terms of angle A of trigonometric functions.

2.8 Derive useful allied formulae like $\sin^2 A = (1 - \cos 2A)/2$ etc.

2.9 Solve simple problems using the multiple and sub-multiple formulae.

2.10 Derive the formulae on transforming sum or difference of two trigonometric ratios into a product and vice versa - examples on these formulae.

2.11 Solve problems by applying these formulae to sum or difference or product of two terms.

2.12 Explain the concept of inverse of a trigonometric function by selecting an appropriate domain and range.

2.13 Define inverses of six trigonometric functions along with their domains and ranges.

2.14 Derive relations between inverse trigonometric functions so that the given inverse trigonometric function can be expressed in terms of other inverse trigonometric functions with examples.

2.15 State various properties of inverse trigonometric functions and identities like $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$ etc.

2.16 Apply formulae like $\tan^{-1} x + \tan^{-1} y = \tan^{-1}\left(\frac{x+y}{1-xy}\right),\ where\ x \geq 0, y \geq 0, xy < 1$ etc., to solve simple problems.

2.17 Explain what is meant by solution of trigonometric equations and find the general solutions of $\sin x = k$, $\cos x = k$ and $\tan x = k$ with appropriate examples.

2.18 Solve models of the type $a\sin^2 x + b\sin x + c = 0$ and $a\sin x + b\cos x = c$.

2.19 State sine rule, cosine rule, tangent rule and projection rule and solve a triangle using these formulae.

2.20 List various formulae for area of a triangle with examples.

2.21 Define a complex number, its modulus, conjugate, amplitude and list their properties.

2.22 Define arithmetic operations on complex numbers with examples.

2.23 Represent the complex number in various forms like modulus-amplitude (polar) form and Exponential (Euler) form with examples.

2.24 Explain the concept of hyperbolic trigonometric functions and list appropriate formulae.

3.0 Find the equations and properties of straight lines, circles and conic sections in coordinate system.

3.1 Write different forms of a straight line – general form, point-slope form, slope- intercept form, two-point form, intercept form and normal form or perpendicular form.
3.2 Find distance of a point from a line, acute angle between two lines, intersection of two non-parallel lines and distance between two parallel lines.
3.3 Define locus of a point and circle.
3.4 Write the general equation of a circle and find its centre and radius.
3.5 Find the equation of a circle, given (i) centre and radius, (ii)two ends of the diameter(iii) three non collinear points of type (0,0) (a,0), (0, b).
3.6 Define a conic - Explain the terms focus, directrix, eccentricity, axes and latus-rectum of a conic.
3.7 Find the equation of a conic when focus, directrix and eccentricity are given.
3.8 Describe the properties of Parabola $y^2 = 4ax$.

4 Evaluate the limits and derivatives of various functions.

4.1 Explain the concept of limit and meaning of $\lim_{x\to a} f(x)=l$ and state the properties of limits.
4.2 Evaluate the limits of the type $\lim_{x\to a}\frac{f(x)}{g(x)}$
4.3 State the Standard limits $\lim_{x\to a}\frac{x^n-a^n}{x-a}$, $\lim_{x\to 0}\frac{\sin x}{x}$, $\lim_{x\to 0}\frac{\tan x}{x}$, $\lim_{x\to 0}\frac{a^x-1}{x}$, $\lim_{x\to 0}\frac{e^x-1}{x}$, (without proof) and solve simple problems using these standard limits.
4.4 Explain the concept of continuity of a function at a point and on an interval
4.5 State the concept of derivative of a function y = f(x) – definition, first principle as $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ and also write standard notations to denote the derivative of a function.
4.6 Explain the significance of derivative in scientific and engineering applications.
4.7 Find the derivatives of standard algebraic, logarithmic, exponential and trigonometric functions using the first principle.
4.8 Find the derivatives of hyperbolic and inverse hyperbolic functions.
4.9 State the rules of differentiation of sum, difference, scalar multiplication, product and quotient of functions with simple illustrative examples.
4.10 Explain the method of differentiation of a function of a function (Chain rule) with illustrative examples.
4.11 Explain the method of differentiation of parametric functions with examples.
4.12 Explain the procedure for finding the derivatives of implicit functions with examples.
4.13 Explain the need of taking logarithms for differentiating some functions of $[f(x)]^{g(x)}$ type – examples on logarithmic differentiation.
4.14 Explain the concept of finding the second order derivatives with examples.
4.15 Define maximum and minimum values of a function and find the maximum and minimum values for quadratic polynomials.
4.16 Explain the concept of functions of several variables, finding partial derivatives and difference between the ordinary and partial derivatives with simple examples.

5 Integrate various functions using different methods and evaluate definite integrals.

5.1 Explain the concept of Indefinite integral as an anti-derivative.
5.2. State the indefinite integral of standard functions and properties of $\int (u+v)\,dx$ and $\int k\,u\,dx$ where u, v are functions of x and k is constant.

5.3. Solve problems involving standard functions using these properties.

5.4. Evaluate integrals involving simple functions of the following type by the method of substitution.

i) $\int f(ax+b)\,dx$, *where f(x)* is in standard form.

ii) $\int (f(x))^n f'(x)\,dx,\ n \neq -1$

iii) $\int \frac{f'(x)}{f(x)}dx$

5.5. Find the integrals of *tan x, cot x, sec x* and *cosec x* w.r.t. x.

5.6. Evaluate the Standard integrals of the functions of the type :

$i)\ \frac{1}{a^2+x^2}, \frac{1}{a^2-x^2}, \frac{1}{x^2-a^2}$

$ii)\ \frac{1}{\sqrt{a^2+x^2}}, \frac{1}{\sqrt{a^2-x^2}}, \frac{1}{\sqrt{x^2-a^2}}$

$iii)\ \sqrt{a^2+x^2}, \sqrt{a^2-x^2}, \sqrt{x^2-a^2}$

5.7. Evaluate integrals using decomposition method for integrand of the type $\frac{px+q}{(ax+b)(cx+d)}$.

5.8. Solve problems using integration by parts.

5.9 Use Bernoulli's rule to evaluate the integrals of the form $\int u.vdx$.

5.10. State the fundamental theorem of integral calculus.

5.11. Explain the concept of definite integral.

5.12. Solve simple problems on definite integrals.

5.13. State various properties of definite integrals.

5.14. Evaluate simple problems on definite integrals using these properties.

CO/PO – MAPPING MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	3				3	2	2
CO2	3	3	2	2				3	2	2
CO3	3	3	2	2				3	2	2
CO4	3	3	3	3				3	3	3
CO5	3	3	3	3				3	3	3
Average	3	2.8	2.4	2.6				3	2.4	2.4

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO/PO mapping can be met with appropriate activities as follows:

For PO5: Appropriate quiz programmes may be conducted at intervals and duration as decided by concerned faculty.

For PO6: Seminars on applications of mathematics in various engineering disciplines are to be planned and conducted.

For PO7: Plan activities in such a way that students can visit the library to refer standard books on Mathematics and access the latest updates in reputed national and international journals. Additionally, encourage them to attend seminars and learn mathematical software tools.

COURSE CONTENT

Unit-I: Algebra

Partial Fractions: Definitions of rational, proper and improper fractions of polynomials. Resolve rational fractions (proper fractions) of type $\frac{f(x)}{(ax+b)(cx+d)}$ into partial fractions.

Matrices: Definition of a matrix, types of matrices - Algebra of matrices, equality of two matrices, sum, difference, scalar multiplication and product of matrices. Transpose of a matrix, Symmetric, skew-symmetric matrices - Determinant of a square matrix, minor and cofactor of an element, Laplace's expansion, properties of determinants - Singular and non-singular matrices, Adjoint and multiplicative inverse of a square matrix - System of linear equations in 3 variables-Solutions by Cramer's rule.

Unit-II: Trigonometry

Trigonometric ratios: Definition of trigonometric ratios of any angle, values of trigonometric ratios at specified values, draw graphs of trigonometric functions, periodicity of trigonometric functions.

Compound angles: Formulas of sin(A±B), cos(A±B), tan(A±B), cot(A±B), and related identities.

Multiple and sub-multiple angles: Formulae for trigonometric ratios of multiple angles 2A, 3A and sub multiple angle A/2.

Transformations: Transformations of products into sums or differences and vice versa.

Inverse trigonometric functions: Definition, domains and ranges-basic properties.

Trigonometric equations: Concept of a solution, principal value and general solution of trigonometric equations:

Sin x = k, cos x= k, tan x = k, where k is a constant. Solutions of simple quadratic equations and equations of type a sin x + b cos x=c.

Properties of triangles: Relations between sides and angles of a triangle- sine rule, cosine rule, tangent rule and projection rule-area of a triangle.

Complex Numbers: Definition of a complex number, modulus, conjugate and amplitude of a complex number- Arithmetic operations on complex numbers - Modulus-Amplitude (polar) form, Exponential form (Euler form) of a complex number.

Hyperbolic functions: Definition of hyperbolic and inverse hyperbolic trigonometric functions- and list formulae.

UNIT-III: Coordinate geometry

Straight lines: Various forms of a straight line - Angle between two lines, perpendicular distance from a point to the straight line, point of intersection of non-parallel lines and distance between parallel lines.

Circle: Locus of a point, Circle definition - Circle equation given (i) centre and radius, (ii) two ends of a diameter (iii) three non-collinear points of type (0,0), (a,0), (0, b) - General equation of a circle –its centre and radius.

Conic sections: Definition of a conic - Equation of a conic when focus, directrix and eccentricity are given - Properties of parabola in the standard form $y^2 = 4ax$.

UNIT-IV: Differential Calculus

Concept of Limit: Definition and Properties of Limits and Standard Limits -Continuity of a function at a point.

Concept of derivative: Definition (first principle)- different notations- Derivatives of standard algebraic, logarithmic, exponential, trigonometric, inverse trigonometric, hyperbolic and inverse hyperbolic functions - Derivatives of sum, difference, scalar multiplication, product, quotient of functions - Chain rule, derivatives of parametric functions, derivatives of implicit functions, logarithmic differentiation - Second order derivatives – Define maximum and minimum values of a function and find the maximum or minimum values for quadratic polynomial. Functions of several variables, first order partial derivatives.

UNIT-V: Integral Calculus

Indefinite Integration: Integration regarded as an anti-derivative – Indefinite integrals of standard functions. Properties of indefinite integrals. Integration by substitution or change of variable. Integrals of tan x, cot x, sec x and cosec x.

Evaluation of integrals which are of the following forms:

$i)\ \frac{1}{a^2+x^2}, \frac{1}{a^2-x^2}, \frac{1}{x^2-a^2}$

$ii)\ \frac{1}{\sqrt{a^2+x^2}}, \frac{1}{\sqrt{a^2-x^2}}, \frac{1}{\sqrt{x^2-a^2}}$

$iii)\ \sqrt{a^2+x^2}, \sqrt{a^2-x^2}, \sqrt{x^2-a^2}$

Integration by decomposition of the integrand into simple rational, algebraic functions - Integration by parts, Bernoulli's rule.

Definite Integration: Definite integral, fundamental theorem of integral calculus, properties of definite integrals, evaluation of simple definite integrals.

TEXTBOOK

Engineering Mathematics-I, a textbook for first year diploma courses, prepared & prescribed by SBTET, AP.

REFERENCES

1. Shanti Narayan, A Textbook of matrices, S.Chand & Co.
2. Robert E. Moyer & Frank Ayers Jr., Schaum's Outline of Trigonometry, 4th Edition, Schaum's Series.
3. G.B.Thomas, R.L.Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
4. Frank Ayers & Elliott Mendelson, Schaum's Outline of Calculus, Schaum's Series.
5. M.Vygodsky, Mathematical Handbook, Mir Publishers, Moscow.

SUGGESTED E-LEARNING REFERENCES

1. https://www.khanacademy.org/
2. https://www.wolframalpha.com/
3. https://onlinecourses.nptel.ac.in/
4. http://tutorial.math.lamar.edu/

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From 1.1 to 2.11
Unit Test – II	From 2.12 to 3.8
Unit Test – III	From 4.1 to 5.14

ENGINEERING PHYSICS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC103T	Engineering Physics	3	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Units and Measurements	09	06	02	-	CO1
2	Elements of Vectors	11	14	02	01	
3	Mechanics	10	11	01	01	CO2
4	Fundamentals of Astrodynamics	13	19	01	02	
5	Energy and Thermal Physics	12	11	01	01	CO3
6	Concepts of Acoustics	12	14	02	01	
7	Electricity and Magnetism	13	14	02	01	CO4
8	Modern Physics	10	11	01	01	
	Total	**90**	**100**	**12**	**08**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	understand the basic concepts of physics for various Engineering applications as required for industries
(ii)	equip the students with the scientific advances in technology and make the student suitable for any industrial organization

COURSE OUTCOMES

CO1	EC103.1	Familiarize with various physical quantities, their SI units and errors in measurements. Understand the concepts of vectors for solving engineering problems
CO2	EC103.2	Solve problems in engineering using appropriate equations and formulae related to Mechanics. Understand the concepts of gravitation, planetary motion with reference to applications in satellites
CO3	EC103.3	Familiarize with the knowledge of various forms of energy, thermal physics and concepts of acoustics in relevance to the societal requirements
CO4	EC103.4	Familiarize with the basic knowledge of electricity, magnetism and advances in Modern Physics such as photoelectric cell, optical fibers, superconductors and nanotechnology

LEARNING OUTCOMES

1 UNITS AND MEASUREMENTS

1.1 Introduction to Units and Measurements
1.2 Define the terms: a) Physical quantity b) Fundamental physical quantities and c) Derived physical quantities.
1.3 Explain the concept of units in measurement.
1.4 Define the term 'unit'.
1.5 Define fundamental units and derived units.
1.6 State the SI units of fundamental quantities along with their symbols.
1.7 State the common multiples and submultiples used in the SI system.
1.8 State the rules for writing SI units.
1.9 State the advantages of using SI units.
1.10 Differentiate between direct and indirect measurements.
1.11 Define accuracy and least count in the context of measurement.
1.12 Define error in measurement.
1.13 Define absolute, relative and percentage errors and state their respective formulae.
1.14 Solve numerical problems on errors in measurements.

2 ELEMENTS OF VECTORS

2.1 Explain the concept of vectors.
2.2 Define scalar and vector quantities with relevant examples for each.
2.3 Represent a vector geometrically.
2.4 Define equal vectors, negative vector, unit vector, position vector, co-initial vectors, co-planar vectors.
2.5 Resolve a given vector into its rectangular components.
2.6 State and explain the triangle law of addition of vectors.
2.7 State the parallelogram law of addition of vectors.
2.8 Derive the expressions for the magnitude and direction of the resultant vector using the parallelogram law.
2.9 Illustrate applications of the parallelogram law of vectors using examples (i) Bow and arrow (ii) working of a sling (iii) Flying of a bird.
2.10 Define dot product (scalar product) of two vectors.
2.11 Explain (i) work done (ii) power as examples of dot product.
2.12 Define cross product (vector product) of two vectors.
2.13 Explain (i) linear velocity (ii) torque as examples of cross product.
2.14 Solve numerical problems on (i) resolution of vectors (ii) the parallelogram law of vectors iii) dot product.

3 MECHANICS

3.1 Define linear momentum; Mention its SI unit.
3.2 Define force. Mention its SI unit.
3.3 Define torque. Mention its SI unit.
3.4 Define concurrent forces, co-planar forces.
3.5 State and explain Lami's theorem.
3.6 State equations of motion of a body moving in a straight line with uniform acceleration.
3.7 Define projectile. Give examples.
3.8 Derive the equation for the path of an oblique projectile.
3.9 Define periodic motion.
3.10 Define Ideal Simple pendulum.
3.11 Write formula for the time period of a simple pendulum.
3.12 Solve numerical problems on equations of motion and simple pendulum.

4 FUNDAMENTALS OF ASTRODYNAMICS

4.1 Define acceleration due to gravity (g); Mention its SI unit.
4.2 State and explain Newton's universal law of gravitation.
4.3 Define universal gravitational constant (G) and mention its value in SI unit.
4.4 Derive the relationship between acceleration due to gravity (g) and the universal gravitational constant (G).
4.5 State and explain Kepler's laws of planetary motion.
4.6 Define orbital velocity and state its formula.
4.7 Define escape velocity and state its formula.
4.8 Derive the relationship between escape velocity and orbital velocity.
4.9 Define the term 'satellite'.
4.10 Define natural and artificial satellites. Give examples for each.
4.11 Mention the applications of artificial satellites.
4.12 Solve numerical problems on (i) Newton's law of gravitation (ii) orbital velocity (iii) escape velocity.

5 ENERGY AND THERMAL PHYSICS

5.1 Define work done; Mention its SI unit.
5.2 Define power; Mention its SI unit.
5.3 Define energy; Mention its SI unit.
5.4 List various forms of energy.
5.5 Define potential energy; Give examples and derive its equation.
5.6 Define kinetic energy; Give examples and derive its equation.
5.7 Derive the relationship between kinetic energy and linear momentum.
5.8 State the law of conservation of energy; Give any two examples.
5.9 State Boyle's law; Write its equation.
5.10 State Charles's volume law; Write its equation.
5.11 State Charles's pressure law; Write its equation.
5.12 Define an Ideal gas.
5.13 Derive the ideal gas equation (PV = nRT).
5.14 Solve numerical problems on (i) Work done (ii) Potential energy (iii) Kinetic energy (iv) Relation between K.E. and momentum (v) Gas laws

6 **CONCEPTS OF ACOUSTICS**

6.1 Define longitudinal waves. Give examples.
6.2 Define transverse waves. Give examples.
6.3 Define sound. Mention SI unit for intensity of sound.
6.4 Define musical sound.
6.5 Define noise.
6.6 Distinguish between musical sound and noise.
6.7 Define noise pollution.
6.8 Explain the sources of noise pollution.
6.9 Explain the effects of noise pollution.
6.10 Explain methods of minimizing noise pollution.
6.11 Define Beats. Write formula for beat frequency.
6.12 State Doppler's Effect. Mention its applications.
6.13 Explain the concept of echo.
6.14 Mention the applications of echo.
6.15 Define reverberation and reverberation time.
6.16 Write Sabine's formula and name the parameters in it.
6.17 Solve numerical problems on echo.

7 ELECTRICITY AND MAGNETISM

7.1 State and explain Ohm's law.
7.2 Define electrical resistance; Mention its SI unit.
7.3 Define specific resistance (resistivity); Mention its SI unit.

7.4 State and explain Kirchhoff's Current Law.
7.5 State and explain Kirchhoff's Voltage Law.
7.6 Derive an expression for the balancing condition of Wheatstone's bridge with neat diagram.
7.7 Describe Meter bridge with necessary circuit diagram.
7.8 Write formula to find unknown resistance using meter bridge.
7.9 Explain the concept of magnetic field.
7.10 Define uniform and non-uniform magnetic fields.
7.11 Define magnetic pole strength; Mention its SI unit.
7.12 Define magnetic moment; Mention its SI unit.
7.13 Define magnetic lines of force.
7.14 Write the properties of magnetic lines of force.
7.15 State Coulomb's inverse square law of magnetism. Write its equation.
7.16 Derive the expression for the moment of couple acting on a bar magnet placed in a uniform magnetic field.
7.17 Solve numerical problems on (i) Ohm's law (ii) Kirchhoff's first law (iii) Wheatstone bridge and Meter bridge (iv) Coulomb's inverse square law of magnetism.

8 MODERN PHYSICS

8.1 State and explain photoelectric effect.
8.2 Write Einstein's photoelectric equation and name the terms in it.
8.3 Explain the working of a photoelectric cell.
8.4 List the applications of the photoelectric cell.
8.5 Define critical angle.
8.6 Explain the phenomenon of total internal reflection.
8.7 Define optical fiber; Explain the principle and working of an optical fiber.
8.8 List the applications of optical fiber.
8.9 Define Superconductor and superconductivity.
8.10 List the applications of superconductors.
8.11 Define Nanotechnology and Nano materials.
8.12 Write applications of Nano materials.

CO-PO/PSO MAPPING MATRIX

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	1		1
CO2	3	2	1	1	1		2
CO3	3	2	1	1	1		2
CO4	3	2	1	1	3		2
Average	3	2	1	1	1.5		1.75

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. **Units and measurements:**
   Introduction – Physical quantity – Fundamental and Derived quantities –Unit- Fundamental and derived units - SI system of units –Multiples and Sub multiples – Rules for writing S.I. units- Advantages of SI units – Direct and indirect measurements – Accuracy and least count – Errors: Absolute, relative and percentage errors – Problems.
2. **Elements of Vectors:**
   Introduction of Scalars and Vectors – Representation of a vector –Types of vectors - Resolution of vector into rectangular components – Triangle law of vectors - Parallelogram law of vectors- examples- derivation of magnitude and direction of resultant vector- Dot product- Cross product - Problems.
3. **Mechanics**:
   Introduction to Mechanics – Momentum –force-torque. Concurrent and coplanar forces - Lami's theorem – equations of motion of a body moving in a straight line – projectile - path of projectile in oblique projection – periodic motion -Ideal simple pendulum- Time period of simple pendulum- Problems.
4. **Fundamentals of Astrodynamics:**
   Concept of acceleration due to gravity (g) -Newton's law of gravitation- Universal Gravitational constant G – Relation between g and G- Kepler's laws of planetary motion – Orbital velocity and escape velocity – Satellites: Natural and artificial - Applications of artificial satellites – Problems.
5. **Energy and thermal Physics**
   Work done, Power and Energy - forms of energy - Potential energy - Kinetic energy- Momentum- K.E and Momentum relation – Law of Conservation of energy- Boyle's law - Charle's volume law -Charle's pressure law- Ideal Gas equation- Problems.
6. **Concepts of Acoustics**
   Longitudinal wave- transverse wave- musical sound - noise - Noise pollution – Causes, effects, Methods of minimizing noise pollution- Beats - Doppler's Effect - applications - Echo- Reverberation - Reverberation time-Sabine 's formula - Problems.
7. **Electricity and Magnetism**
   Ohm's law- Resistance - Specific resistance - Kirchhoff's laws - Wheatstone's bridge- Meter Bridge. Concept of magnetic field- magnetic pole strength – Magnetic Moment- magnetic lines of force - Coulomb's inverse square law of magnetism– Torque acting on a bar magnet- Problems.
8. **Modern Physics**
   Photoelectric effect – Einstein photo electric equation – photoelectric cell – Applications of photoelectric cell – critical angle, Total internal reflection- Optical Fiber - Principle – working- Applications of optical fibers - Superconductivity–applications – Nanotechnology – applications.

REFERENCES

[1] *Intermediate Physics*, Vol. I & II, Telugu Academy, English Version.
[2] S. L. Gupta and S. Gupta, *Unified Physics*, Vols. 1–4, New Delhi.
[3] H. C. Verma, *Concepts of Physics*, Vols. 1 & 2, New Delhi: Bharati Bhawan, 2018.
[4] R. Resnick and D. Halliday, *Textbook of Physics*, Vols. I & II, New York: Wiley, 2011.
[5] B. L. Theraja and B. S. Subramanyam, *Fundamentals of Physics*.
[6] Dhanpat Rai Publications, *Textbook of Applied Physics*, New Delhi: Dhanpat Rai & Co.
[7] NCERT, *Physics Textbook for Class XI & XII*, New Delhi: National Council of Educational Research and Training.
[8] PhET Interactive Simulations, "Learning Physics Tools and Online Resources," https://phet.colorado.edu/.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit test	Learning outcomes to be covered
Unit test - I	From 1.1 to 3.12
Unit test - II	From 4.1 to 6.17
Unit test - III	From 7.1 to 8.12

ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC104T	Engineering Chemistry and Environmental Studies	3	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Basic Concepts of Chemistry	14	18	2	1.5	CO1
2	Solutions, Acids and Bases	14	18	2	1.5	CO1
3	Electrochemistry	12	11	1	1	CO2
4	Corrosion	8	11	1	1	CO2
5	Water Treatment	8	11	1	1	CO3
6	Polymers and Engineering Materials	10	11	1	0	CO4
7	Fuels and Alternative Energy Sources	6	3	1	0	CO4
8	Environmental Studies	18	17	3	2	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	develop a fundamental understanding of core chemical principles and their relevance to a wide range of engineering applications
(ii)	explore and analyze natural and anthropogenic environmental challenges through an interdisciplinary lens, incorporating physical, chemical and socio - cultural perspectives
(iii)	reinforce theoretical concepts by conducting relevant experiments exercises

COURSE OUTCOMES

CO1	EC104.1	Explain the basics of atomic structure, chemical bonding, oxidation-reduction, mole concept, concentration expressing methods of solutions, acids-bases, pH and buffer solutions
CO2	EC104.2	Explain electrolysis, Galvanic cell, batteries and corrosion
CO3	EC104.3	Explain the chemistry involved in the treatment of hardness in water
CO4	EC104.4	Explain the preparation and applications of polymers, and understand the composition and uses of alloys, nanomaterials and green fuels
CO5	EC104.5	Explain environmental concepts, pollution types, global issues, green chemistry principles and sustainable development goals

LEARNING OUTCOMES

1.0 Basic Concepts of Chemistry

1.1 Explain the charge, mass of fundamental particles of an atom (electron, proton and neutron).
1.2 Understand the concept of Atomic number and Mass number.
1.3 Calculate the number of electrons, number of protons and number of neutrons in atoms, if Atomic number and Mass number are given.
1.4 Explain the Postulates of Bohr's atomic theory and its limitations.
1.5 Explain the values and significance of four Quantum numbers.
1.6 Define Orbital of an atom and draw the shapes of s, p orbitals.
1.7 Distinguish between orbit and orbital.
1.8 Explain (i). Aufbau principle (ii). Hund's rule and (iii). Pauli's exclusion principle.
1.9 Write the Electronic configuration of elements up to Atomic number 20.
1.10 Explain the significance of chemical bonding.
1.11 Understand the concept of Octet rule.
1.12 Define Ionic bond and explain it in the formation of NaCl.
1.13 Define Covalent bond and explain it in the formation of H_2, O_2 & N_2 molecules (Lewis Dot Method).
1.14 List out the Properties of Ionic compounds and Covalent compounds and distinguish between their properties.
1.15 Understand the electronic concept of oxidation, reduction and redox reactions

2.0 Solutions, Acids and Bases

2.1 Define the terms: (i). Solution (ii). Solute and (iii). Solvent with examples.
2.2 Classify solutions based on physical state of solvent with examples.
2.3 Define the terms: (i). Atomic weight, (ii). Molecular weight, and (iii). Equivalent weight.
2.4 Calculate Molecular weight and Equivalent weight of the given Acids (HCl, H_2SO_4, H_3PO_4), Bases (NaOH, $Ca(OH)_2$, $Al(OH)_3$ and Salts (NaCl, Na_2CO_3, $AlCl_3$).
2.5 Define Mole and solve numerical problems on Mole concept.
2.6 Define Molarity, Normality and solve numerical problems on Molarity and Normality.
(a). Calculate the Molarity & Normality, if Weight of solute and Volume of solution are given.
(b). Calculate the weight of solute, if Molarity or Normality with volume of solution are given.
2.7 Explain Arrhenius theory of Acids and Bases and give its limitations.

2.8 Define pH and mention its Significance.
2.9 Define buffer solution and classify buffer solutions with examples. Give its applications.

3.0 Electrochemistry

3.1 Define the terms (i). Conductor (ii). Semiconductor (iii). Insulator. (iv). Electrolyte (Strong and Weak) and (v). Non-electrolyte. Give two examples for each.
3.2 Define Electrolysis and Explain electrolysis by taking an example of molten NaCl.
3.3 State the applications of electrolysis.
3.4 Understand Electrode potential and Standard reduction potential (SRP).
3.5 Define electrochemical series and state its significance.
3.6 Define Galvanic cell. Explain the construction and working of Galvanic cell.
3.7 Distinguish between electrolytic cell and galvanic cell.
3.8 Define battery and list the types of batteries with examples.
3.9 Explain the construction, working and applications of (i). Dry cell (Leclanché cell) and (ii). Lithium-ion battery.

4.0 Corrosion

4.1 Define the term corrosion.
4.2 State the factors which influencing the rate of corrosion.
4.3 Describe the formation of (a). Composition cell (b). Stress cell and (c). Concentration cell during corrosion.
4.4 Define rusting of iron and explain the mechanism of rusting of iron.
4.5 Explain the methods of prevention of corrosion by:
(a). Protective Coatings (through flow chart with examples) and
(b). Cathodic Protection Methods. ((i). Sacrificial Anode Process and (ii). Impressed Voltage Process)

5.0 Water Treatment

5.1 Define soft water and hard water.
5.2 Define hardness of water and classify its types.
5.3 List out the salts that causing hardness of water (with Formulae).
5.4 State the disadvantages of using hard water in industries.
5.5 Define Degree of hardness and units of hardness (mg/L and ppm).
5.6 Explain the method of softening of hard water by Ion exchange method (By indicative reactions).
5.7 Explain the concept of Reverse Osmosis in removing hardness of water.
5.8 List out the applications and advantages of reverse osmosis technique.
5.9 List out the essential qualities of drinking water/potable water.
5.10 Explain Municipal treatment of water for drinking purpose (only flow chart).

6.0 Polymers and Engineering Materials.

6.1 Explain monomers, polymers and the concept of polymerization.
6.2 Describe the methods of polymerization (a). Addition Polymerization of Polythene and (b). Condensation Polymerization of Bakelite (Only flow chart).
6.3 Define plastic. Write the monomers and uses of plastics:
(i). PVC and (ii) Nylon (6,6).
6.4 Define Biodegradable polymers. State applications of (i). PHBV and (ii). PBAT.
6.5 Define an alloy. Write the composition and applications of the following alloys:
(i). Stainless Steel and (ii). Nitinol.
6.6 Define Nano Materials and State applications of
(i). Graphene and (ii). Nanotubes.

7.0 Fuels and Alternative Energy Sources

7.1 Define the term fuel.
7.2 Classification of fuels as Natural fuels and Synthetic fuels.
7.3 Write the composition and uses of the following:

(i). LPG (ii). CNG and (iii). Power alcohol.

7.4 State the Renewable and Non- renewable energy sources with examples.

7.5 Define Green fuel. State the advantages and disadvantages of hydrogen as a green fuel.

8.0 Environmental Studies

8.1 Importance of environmental studies.

8.2 Define the following terms:
(i). Pollution, (ii). Pollutant, (iii). Sink, (iv). Receptor, (v). Particulate Matter,
(vi). Dissolved Oxygen (DO) and (vii). Threshold Limit Value (TLV).

8.3 State the uses of forest resources.

8.4 Define deforestation. Explain the causes, effects and controlling methods of deforestation.

8.5 Define Air pollution. Explain the causes, effects and controlling methods of Air pollution.

8.6 Explain the global impacts of Air pollution: (i). Global Warming, (ii). Ozone Layer Depletion and (iii). Acid Rain.

8.7 Define Water pollution. Explain the causes, effects and controlling methods of Water pollution.

8.8 Define e – pollution. State the sources of e – pollution. Explain its health effects and its management.

8.9 Define Green Chemistry. List the Green Chemistry Principles.

8.10 Define Sustainable Development and List the Sustainable Development Goals.

CO-PO/PSO MAPPING MATRIX

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	-	-	-
CO2	3	1	1	1	1	-	1
CO3	3	1	1	1	1	-	1
CO4	3	1	1	-	1	-	1
CO5	3	1	-	-	1	1	1
Average	3	1	1	1	1	1	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

.

COURSE CONTENT

1.Basic Concepts of Chemistry

Atomic Structure: Introduction - Fundamental particles – their mass and charge – Atomic number and Mass number - definition with examples – calculation of electrons, protons and neutrons in atoms – Bohr's atomic theory and limitations - Quantum numbers – Orbital concept, shapes of s, p orbitals – Distinguish between orbit and orbital - Aufbau principle - Hund's rule - Pauli's exclusion Principle - Electronic configuration of elements (Atomic number(Z) from 1 to 20).
Chemical Bonding: Introduction – Octet rule - Types of chemical bonds – Ionic bond (NaCl) and Covalent bond (H_2, O_2 & N_2 molecules) as examples – Properties of Ionic and Covalent compounds. Electronic concept of oxidation, reduction and redox reactions.

2.Solutions, Acids and Bases

Solutions: Introduction – Idea of solute, solvent and solution - Types of solutions based on physical state of solvent – Atomic weight – Molecular weight, Equivalent Weight (Acids, Bases and Salts) - Mole concept – Numerical problems on Mole concept - Methods of expressing concentration of a solution – Molarity - Normality – Numerical problems on Molarity and Normality.
Acids and Bases: Introduction - Arrhenius theory of acids and bases – pH Scale – its significance – Buffer solution – Definition – Types of buffer solutions with examples – its applications.

3.Electrochemistry

Introduction - Conductors, Semiconductors, Insulators with examples - Electrolytes (Strong and Weak) and Non-electrolytes – Definition – Examples – Electrolysis – Definition – Electrolysis of molten NaCl – Applications of electrolysis – Electrode potential - Standard reduction potential – Definition – Electrochemical series – Significance – Construction and working of Galvanic cell – Differences between Electrolytic cell and Galvanic cell - Batteries - Types of batteries – Definition and examples – construction, working and applications of: (i). Dry Cell (Leclanché Cell) and (ii). Lithium-ion battery.

4.Corrosion

Introduction – Definition - Factors influencing the rate of corrosion – Composition cell, Stress cell and Concentration cell during corrosion – Rusting of iron and its mechanism – Prevention of corrosion - Protective Coating methods (flow chart with examples) - Cathodic Protection methods.

5.Water Treatment

Introduction – Soft and Hard water – Hardness of water – Types of hardness – salts responsible for hardness - Degree of hardness – Methods of expressing hardness (mg/L and ppm) – Disadvantages of using hard water in industries - Softening of hard water by Ion exchange method – Concept of Reverse Osmosis process – Applications and Advantages of Reverse Osmosis - Essential qualities of drinking water/potable water – Municipal treatment of water for drinking purpose (only flow chart).

6.Polymers and Engineering Materials

Polymers: Introduction- Monomers - Polymers - Polymerization – Types of Polymerization – Addition polymerization (Polythene) and Condensation polymerization (only flow chart of Bakelite) - Plastics – monomers and uses of PVC and Nylon (6,6) - Biodegradable Polymers: (i). PHBV and (ii). PBAT (Composition and Uses).
Engineering Materials: Alloys - Definition - Composition and applications of (i). Stainless Steel and (ii). Nitinol Nano Materials – Definition - Applications of (i) Graphene and (ii). Nanotubes.

7.Fuels and Alternative Energy Sources

Introduction – Definition - Classification of fuels – Composition and uses of (i). LPG (ii). CNG and (iii). Power alcohol - Renewable and Non-renewable energy sources – Advantages and disadvantages of Hydrogen as a green fuel.

8.Environmental Studies

Introduction - Importance of environmental studies – Important terms related to environment – Pollution, Pollutant, Sink, Receptor, Particulate Matter, Dissolved Oxygen (DO), Threshold Limit Value (TLV) - Uses of forest resources – Deforestation - Definition – causes, effects, controlling methods –Air pollution – Definition, causes, effects, controlling methods - Global impacts of Air pollution – Global warming, Ozone layer depletion, Acid rain – Water pollution – Definition, causes, effects, controlling methods – e - pollution, Definition, sources, effects, management - Green Chemistry – Definition – Principles of Green Chemistry – Sustainable Development – Definition – Goals.

REFERENCES

1. Jain, P. C. and Jain, M., *Engineering Chemistry*.
2. Agarwal, O. P., *Engineering Chemistry*, Hi-Tech Publications.
3. Sharma, B. K., *Engineering Chemistry*.
4. De, A. K., *Engineering Chemistry*.
5. Basu, M. and Xavier, S., *Fundamentals of Environmental Studies*.
6. Kaushik, A. and Kaushik, C. P., *Environmental Studies*.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit Test	Learning outcomes to be covered
Unit Test – I	From 1.1 to 2.9
Unit Test – II	From 3.1 to 5.10
Unit Test – III	From 6.1 to 8.10

BASIC ELECTRONICS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC105T	Basic Electronics	6	180	6	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs mapped
1	Passive Components	30	14	2	1	CO1
2	Switches, Connectors, Relays and PCBs	25	14	2	1	
3	Semiconductor Physics	18	11	1	1	CO2
4	Semiconductor Diodes	20	14	2	1	
5	Bipolar Junction Transistor	25	14	2	1	
6	AC Fundamentals	30	11	1	1	CO3
7	Audio Systems	12	11	1	1	CO4
8	Measuring Test Instruments	20	11	1	1	CO5
Total		**180**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	learn the principles of passive components, switches, relays and PCBs
(ii)	understand the formation of semiconductor materials and the working of semiconductor diode and to analyse the working of BJT
(iii)	analyse RL, RC and RLC circuits
(iv)	understand working of Audio systems, measuring and test instruments

COURSE OUTCOMES

CO1	EC105.1	Familiarize different passive components, Switches, Connectors, Relays and preparation of PCBs
CO2	EC105.2	Energy band diagrams, intrinsic and extrinsic semiconductors Formation of diode, working ,characteristics of PN Junction and Zener diodes, Analyse the working of Bipolar Junction Transistor, CE & CB Configurations
CO3	EC105.3	Analyse RL, RC,and RLC circuits
CO4	EC105.4	Working principle of Microphones and Loud Speakers
CO5	EC105.5	Construction & working principle of measuring and test instruments

LEARNING OUTCOMES

1.0 Passive Components

1.1 i)Define the term resistance
ii)Define the term resistor & classify resistors
iii)Draw the circuit symbols of fixed and variable resistors
iv)List the specifications of a resistor.

1.2 State the physical factors that affect the value of a resistor and calculate resistance value by using colour Code.

1.3 Compare the features of carbon and wire wound potentiometers.

1.4 Explain the working of rheostat and mention its applications.

1.5 Define temperature co-efficient of resistance and explain the effects of temperature on resistance.

1.6 Explain the working of thermistor and sensistor and mention their applications.

1.7 State Ohm's Law and its limitations.

1.8 Derive an expression for equivalent resistance of resistors connected in series and in parallel

1.9 Define magnetic flux density, magnetic field intensity. State Faraday's laws of electro - magnetic induction.

1.10 Define Absolute permeability and Relative permeability

1.11 Explain dynamically and statically induced E.M.F

1.12 Define self-inductance, mutual inductance and co-efficient of coupling.

1.13 State the expression for self-inductance, mutual inductance and co-efficient of coupling

1.14 Define the term inductor & classify inductors. Draw the circuit symbols of different types of inductors.

1.15 State expressions for equivalent inductance of inductors connected in series and in parallel

1.16 List the specifications of an inductor.

1.17 Define the term Stray inductance.

1.18 List various core materials used in the construction of inductors.

1.19 Explain the use of Ferrites in the construction of high frequency inductors.

1.20 List the applications of inductors including A.F. and R.F chokes.

1.21 Explain the concept of electrostatic field

1.22 Define the terms absolute permittivity and relative permittivity.

1.23 Define the terms electric potential and potential difference

1.24 Define the terms electric flux, electric field intensity, electric flux density.

1.25 Define the term capacitance.

1.26 State expressions for equivalent capacitance of capacitors connected in series and in parallel
1.27 Explain charging and discharging of capacitor
1.28 Classify capacitors. State different types of capacitors and draw their symbols.
1.29 List the specifications of a capacitor.
1.30 Define the term Stray capacitance.
1.31 State the factors affecting the capacitance of a capacitor.
1.32 Define Di-electric constant and Di-electric strength of a material.
1.33 List the applications of capacitors.

2.0 Switches, Connectors, Relays and PCBs

2.1 Classify switches according to poles and throws
2.2 Sketch the I.S.I symbols of various switches.
2.3 State the need of fuse in electronic equipment.
2.4 Mention different types of fuses.
2.5 State the necessity of connectors in electronic circuits.
2.6 List different types of connectors.
2.7 State the use of MCB.
2.8 Define a relay.
2.9 Classify different relays based on principle of operation, polarization and application.
2.10 List the specifications and applications of relays.
2.11 Explain the working of general-purpose electromagnetic relay.
2.12 Explain the need of PCB in electronic equipment.
2.13 Classify PCBs and list the types of laminates used in PCBs.
2.14 List the methods of transferring layout on to the copper clad sheet.
2.15 List the materials used in screen-printing.
2.16 List the steps involved in screen-printing for making PCBs.
2.17 Explain the methods of etching, cleaning and drilling of PCB.
2.18 Explain the steps involved in making double-sided PCB.
2.19 Explain Surface Mount Technology and its uses.
2.20 List the materials used in soldering.
2.21 List the soldering methods of PCBs.

3.0 Semiconductor Physics

3.1 Define the terms conductivity and resistivity and give their equations.
3.2 Define Valence band, Conduction band and Forbidden energy gap.
3.3 Explain Energy Band diagrams of conductors, semiconductors and Insulators.
3.4 Define Intrinsic Semiconductor and Fermi level.
3.5 Define electron current and hole current.
3.6 Explain the bipolar nature of semiconductors.
3.7 State the need for doping.
3.8 Distinguish between intrinsic and extrinsic semiconductor.
3.9 Explain the formation of P type and N type semiconductor.
3.10 Compare P-type and N-type semiconductors.
3.11 Explain Drift and Diffusion currents.

4.0 Semiconductor Diodes

4.1 Explain the formation of PN junction diode.
4.2 Explain the working of PN junction Diode with forward & reverse biasing.
4.3 Draw the VI characteristics of a diode.
4.4 State diode current equation.
4.5 List the important specifications of a diode.
4.6 Mention the applications of diode.
4.7 Explain reverse breakdown phenomenon.
4.8 Explain the construction and working of Zener diode.
4.9 Draw the forward &reverse bias characteristics of Zener diode.
4.10 Explain Zener breakdown phenomenon.
4.11 Distinguish between Avalanche & Zener breakdowns.
4.12 Mention the applications of Zener diode.
4.13 Explain the working principle of Varactor diode.
4.14 List the applications of varactor diode.

5.0 Bipolar Junction Transistor

5.1 Explain the formation of bipolar junction transistor.
5.2 Explain the working of PNP and NPN Transistors.
5.3 Draw the circuit symbols of NPN and PNP transistor.
5.4 Draw the different transistor configurations.
5.5 Sketch the input & output characteristics of CB, CE and CC configurations.
5.6 Identify the cut-off, saturation and active regions in output characteristics of CB, CE and CC Configurations.
5.7 Define alpha, beta and gamma factors.
5.8 Derive the relationship among alpha, beta and gamma factors.
5.9 Write collector current expression in CB and CE modes of transistor in terms of α, β, IE, IB, IC and ICBO, ICEO.
5.10 Compare CB, CE and CC configurations.

6.0 AC Fundamentals

6.1 Explain the effect of AC flowing through Pure Resistance, Inductance and Capacitance with vector diagrams.
6.2 Explain mathematical representation of vectors in a rectangular and polar forms.
6.3 Define the terms reactance, impedance, admittance, conductance and power factor.
6.4 Explain active, reactive and apparent power in AC circuit.
6.5 Define Q factor of a coil.
6.6 Write the expressions for impedance and current for a series RL, RC and RLC circuits.
6.7 Solve simple problems on series RL and RC circuits.
6.8 Write the expressions for Admittance and voltage for a parallel RL, RC and RLC circuits.
6.9 Solve simple problems on parallel RL and RC circuits

7.0 Audio Systems

7.1 Explain the working of carbon, condenser, Crystal and dynamic microphones along with their polar characteristics.

7.2 Explain the constructional features and principle of operation of PMMC Loudspeaker and its ratings.
7.3 Mention the use of woofers and tweeters.
7.4 State the need for Horn loud speaker.
7.5 Explain the construction and working of Horn loud speaker with suitable diagram.
7.6 Explain the principle, construction and working of magnetic and crystal headphones and their uses.
7.7 List the specifications of Loudspeakers and Microphones.
7.8 Define the terms: speech, music and noise.

8.0 Measuring and Test Instruments

8.1 List the characteristics of ideal voltmeter and ideal Ammeter.
8.2 Explain the construction and principle of operation of PMMC instrument.
8.3 Explain the working of rectifier type voltmeter.
8.4 List the advantages of digital instruments over analog instruments.
8.5 Explain the working of Ramp type digital voltmeter with block diagram.
8.6 State the need for use of analog/digital multimeter.
8.7 State the specifications of digital multimeter: Accuracy, Resolution, Range, Precision, and Display Digits.
8.8 Explain the working of function generator with block diagram

CO-PO/PSO MAPPING MATRIX

COs/POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2			1	3	1	1
CO2	3	3	3		2		3	3		1
CO3	3	3	3	3			2	3	2	2
CO4	3	2	2	2	3	1	2	3	2	2
CO5	3	2	2	3	2		2	3	1	1
Average	3	2.4	2.4	2.5	2.33	1	2	3	1.5	1.4

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 Passive components

Concept of resistance and resistors with classification, symbols, and specifications – Factors affecting resistance and calculation using colour Ohm's law, equivalent resistance in series and parallel circuits – Carbon and wire wound potentiometers Comparison -Rheostat - Temperature coefficient of resistance, thermistors, sensistors and their applications – Magnetic Flux, Flux density, Field Intensity, Faraday's laws, Permeability, induced EMF, self and mutual inductance with expressions – Inductors: types, symbols, equivalent inductance, core materials, ferrites, and applications – Electrostatic field, Permittivity, Potential, potential difference, Electric flux, Electric field intensity, Electric flux density, Concept of capacitance, charging and discharging of capacitors, equivalent capacitance – Types and symbols of capacitors with specifications – Factors affecting capacitance,

dielectric constant and strength – Stray effects in inductance, and capacitance – Applications of resistors, inductors, and capacitors.

2.0 Switches, Connectors, Relays and PCBs:

Classification of switches according to poles and throws – ISI symbols of switches – Fuse and its necessity in electronic equipment – Types of fuses – Necessity of connectors in circuits – Types of connectors – Use of MCB – Definition of relay – Classification of relays based on principle, polarization, and applications – Specifications and applications of relays – Working of general-purpose electromagnetic relay – Need for PCB in electronics – Classification of PCBs – Types of laminates used in PCBs – Methods of transferring layouts to copper clad – Materials used in screen printing – Screen printing steps for PCB making – Etching, cleaning, and drilling methods – Steps for double-sided PCB making – Surface Mount Technology and its uses – Materials used in soldering – Methods of soldering PCBs.

3.0 Semiconductor Physics:

Concept of conductivity and resistivity with equations – Valence band, conduction band and forbidden energy gap – Energy band diagrams of conductors, semiconductors, and insulators – Intrinsic semiconductor and Fermi level – Electron current and hole current – Bipolar nature of semiconductors – Need for doping – Difference between intrinsic and extrinsic semiconductors – Formation of P-type and N-type semiconductors – Comparison of P-type and N-type – Drift and diffusion currents in semiconductors.

4.0 Semiconductor Diodes

Formation of PN junction – Working of PN junction diode under forward and reverse bias – VI characteristics of a diode – Diode current equation – Specifications of diodes – Applications of diodes – Reverse breakdown phenomenon – Construction and working of Zener diode – Forward and reverse bias characteristics of Zener diode – Zener breakdown phenomenon – Difference between avalanche and Zener breakdown – Applications of Zener diode – Principle of varactor diode – Applications of varactor diode.

5.0 Bipolar Transistor

Formation of BJT – Working of NPN and PNP transistors – Circuit symbols of transistors – Transistor configurations (CB, CE, CC) – Input and output characteristics of CB, CE, and CC configurations – Identification of cutoff, saturation, and active regions – Definition of alpha, beta and gamma – Relationship among alpha, beta and gamma – Collector current expressions in CB and CE configurations – Comparison of CB, CE and CC configurations.

6.0 AC fundamentals

AC through pure resistance, inductance, and capacitance with vector diagrams – Vector representation in rectangular and polar form – Concepts of reactance, impedance, admittance, conductance and power factor – Active, reactive and apparent power in AC circuits – Q factor of a coil – Impedance and current expressions for series RL, RC, RLC circuits – Simple problems on series RL and RC circuits – Admittance and voltage expressions for parallel RL, RC, RLC circuits – Simple problems on parallel RL and RC circuits.

7.0 Audio systems.

Working of carbon, condenser, crystal, and dynamic microphones with polar characteristics – Construction and operation of PMMC loudspeaker with ratings – Woofers and tweeters– Need for horn loudspeakers – Construction and working of horn loudspeaker – Principle,

construction, and working of magnetic and crystal headphones – Uses of headphones – Specifications of loudspeakers and microphones – Definitions of speech, music, and noise

8.0 Measuring & Testing Instruments:

Characteristics of ideal voltmeter and ammeter – Construction and working of PMMC instrument – Working of rectifier-type voltmeter – Advantages of digital over analog instruments – Ramp-type digital voltmeter with block diagram – Use of analog and digital multimeter – Specifications of digital multimeter including accuracy, resolution, range, precision, and display digits – Working of function generator with block diagram.

REFERENCES

1. G.K.Mithal, Electronic Devices and Circuits, 23rd Edition- Khanna Publication-1988
2. B. Somanathan, Electronic devices and applications, 2nd Edition- PHI.
3. Dr.K.Padmanabham, P.Swaminathan, Electronic components, 2nd Edition,-Laxmi Publications (P) Ltd
4. Walter c bosshart, Printed circuit boards: design and technology -TMH
5. Millman&Halkias, Electronic devices & Circuits, 4th edition- TMH
6. V K mehata, RohitMehata, Basic electrical engineering-S.Chand Publication

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 2.21
Unit Test-II	From 3.1 to 6.3
Unit Test-III	From 6.4 to 8.8

ELECTRONIC CAD

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC106A	Electronic CAD	2	60	-	-	-

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Introduction to Electronic CAD Tools	16	CO1
2	Basic Circuit Simulation	20	CO2
3	PCB Design Basics	24	CO3
	Total	**60**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	understand and operate various Electronic CAD tools such as TinkerCAD, EveryCircuit, PSPICE, OrCAD, and Proteus
(ii)	simulate basic electronic circuits using different CAD tools and analyze their behaviour
(iii)	develop PCB schematics and layouts using PCB design software such as PCB Wizard and KiCad

COURSE OUTCOMES

CO1	EC106.1	Identify components, use CAD environments, set parameters
CO2	EC106.2	Build and simulate circuits using TinkerCAD, EveryCircuit, PSPICE, OrCAD
CO3	EC106.3	Draw schematics, place components, route PCB, generate Gerber

LEARNING OUTCOMES

1.0 Introduction to Electronic CAD Tools

1.1 Introduction to Electronic CAD tools such as TinkerCAD/EveryCircuit/PSPICE /OrCAD/ProteUs

1.2 Familiarize the circuit design environment of tools such as TinkerCAD/EveryCircuit/PSPICE /OrCAD/ProteUs

1.3 Identify various electronic components, devices, AC and DC power sources, signal generators, CRO, Voltmeter, Ammeter available in the Electronic CAD Tools

1.4 Familiarize with setting of component parameters as per the component value

2.0 Basic Circuit Simulation

2.1 Usage of basic components Resistor, Battery, LED, Switch in TinkerCAD

2.2 Series and Parallel Circuits using EveryCircuit

2.3 Ohm's Law Verification using EveryCircuit tool

2.4 Comparison of circuit simulation tools TinkerCAD, EveryCircuit, PSPICE, OrCAD

2.5 LED control with push button using TinkerCAD

2.6 Buzzer control with switch using TinkerCAD

2.7 LDR Based Night Light Simulation using TinkerCAD

2.8 Battery level indicator using multiple LEDs

2.9 Continuity tester using buzzer and probes

3.0 PCB Design Basics

3.1 Drawing simple schematic using PCB Wizard & KiCad
3.2 Converting schematic to layout using PCB Wizard & KiCad
3.3 Component placement & footprint selection
3.4 Manual and Auto Routing using KiCad
3.5 Design rules and clearance checking
3.6 Gerber File Generation using KiCad
3.7 Practice and review of PCB layouts

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	2	1	1
CO2	3	3	2	3	2	1	1	3	2	1
CO3	3	2	3	3	3	1	2	3	3	2
Average	3	2.33	2	2.33	2.33	1	1.33	2.66	2	1.33

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

COURSE CONTENT

1.0 Introduction to Electronic CAD Tools

Introduction to Electronic CAD tools such as TinkerCAD/EveryCircuit/PSPICE/OrCAD and Proteus – Familiarization with the circuit design environment in different tools – Identification of electronic components and devices including resistors, capacitors, AC and DC power sources, signal generators, CRO, voltmeter, and ammeter – Setting and adjusting component parameters as per required values for circuit design and simulation.

2.0 Basic Circuit Simulation

Usage of basic components such as resistor, battery, LED, and switch in TinkerCAD – Designing and analyzing series and parallel circuits using EveryCircuit Tool – Verification of Ohm's Law through using EveryCircuit Tool – Comparison of circuit simulation tools TinkerCAD, EveryCircuit, PSPICE, and OrCAD – Practical circuit simulations including LED control with push button, buzzer control with switch, LDR-based night light, battery level indicator using LEDs, and continuity tester using buzzer and probes.

3.0 PCB Design Basics

Drawing simple schematics using PCB Wizard and KiCad – Converting schematic diagrams to PCB layouts – Understanding component placement and footprint selection – Manual and auto-routing of PCB traces using KiCad – Applying design rules and clearance checks – Gerber file generation using KiCad- PCB layouts

REFERENCES

1. Don Wilcher, *Getting Started with Tinkercad*, Maker Media, Inc.
2. Joseph G. Tront, *PSpice for Basic Circuit Analysis*, McGraw Hill Education
3. Sham Tickoo, *Learning OrCAD for PCB Design*, CADCIM Technologies
4. Peter Dalmaris, *Designing Circuit Boards with KiCad*, Tech Explorations
5. Paul Scherz, Simon Monk, *Practical Electronics for Inventors*, 4th Edition – McGraw Hill Education
6. Chris Schroeder, *PCB Design Using AutoCAD*, Newnes
7. Bruce Archambeault, *PCB Design for Real-World EMI Control*, Springer
8. KiCad Project Team, *KiCad Documentation and Tutorials*, https://docs.kicad.org

ELECTRIC CIRCUIT ANALYSIS (PRACTICUM -PRACTICAL)

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC107L	Electric Circuit Analysis	6	180	5	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	Theory Periods	Practical Periods	Total No. of Periods	COs Mapped
1	Basic Electrical Circuit	6	8	14	CO1
2	Kirchhoff's Laws , Mesh current and Node voltage	16	28	44	CO2
3	Network Theorems	28	30	58	CO3
4	Resonance in RLC Circuits	16	16	32	CO4
5	Filters & Attenuators	12	20	32	CO5
	Total	**78**	**102**	**180**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	understand apply basic circuit analysis principles
(ii)	learn and analyze mesh current and node voltage analysis
(iii)	learn and verify different network theorems
(iv)	analyze series and parallel resonance circuits, filters and attenuators

COURSE OUTCOMES

CO1	EC107.1	Understanding and applying basic circuit analysis principles through experimental practice
CO2	EC107.2	Apply mesh and node analysis in solving circuits and verifying through experimental practice
CO3	EC107.3	Verify and interpret the results of network theorems in practical circuits
CO4	EC107.4	Analyze and compute parameters of series and parallel resonance circuits, including resonant frequency, bandwidth, and quality factor
CO5	EC107.5	Design & Construction of electrical filters and attenuators

LEARNING OUTCOMES

1.0 Basic Electrical Circuit

1.1 Equivalent resistance of Resistors connected in series
1.2 Equivalent resistance of Resistors connected in parallel
1.3 Voltage division rule
1.4 Current division rule

Experiment. No	Name of the Experiment
1	Construct a series resistive network to calculate the equivalent resistance
2	Construct a parallel resistive network to calculate the equivalent resistance
3	Construct a resistive network to verify voltage division rule
4	Construct a resistive network to verify current division rule

2.0 Mesh current and Node voltage Analysis

2.1 Define the terms: branch, node, junction and loop in circuits
2.2 State and explain the principles of Kirchhoff's current law and Kirchhoff's Voltage law
2.3 Define ideal voltage/current source
2.4 Give the concept of source transformation voltage to current and current to voltage for DC sources.
2.4 Determine the number of mesh equations required to solve the given Network
2.5 Write the mesh current equations for a given network and arrange them in matrix form
2.7 Solve the mesh currents using Cramer's rule.
2.7 Determine the number of node voltage equations for a given network
2.8 Write the node voltage equations for a given network and arrange them in matrix form
2.9 Solve the node voltages using Cramer's rule

Experiment No	Name of the Experiment
5	Conduct an experiment to verify Kirchhoff's current law and Kirchhoff's voltage law
6	Construct a resistive network for a DC Source to find the loop currents , current in and voltage across each component using Mesh current Analysis for two loop & three loop networks
7	Construct a resistive network for a DC Source to find current in and voltage across each component using Node voltage Analysis for 3 node and 4 node networks

3.0 **Network Theorems:**
3.1 State Thevenin's theorem
3.2 Apply the above theorems to solve networks
3.3 State Norton's theorem
3.4 Apply the above theorems to solve networks
3.5 State superposition theorem

3.6 Solve simple problems using superposition theorem
3.7 State Maximum power transfer theorem for DC & AC circuits.
3.8 Solve simple problems using maximum power transfer theorem
3.9 State the importance of impedance matching.

Experiment No	Name of the Experiment
8	Construct a resistive network to calculate the current through a load using Thevenin's theorem for two different circuits
9	Construct a resistive network to calculate the current through a load using Norton's theorem for two different circuits
10	Construct a resistive network to verify super position theorem for two different circuits
11	Construct a resistive circuit to find the maximum power delivered to a load using Maximum power transfer theorem for two different circuits

4.0 Resonance in RLC Circuits

4.1 Explain the concept of resonance in RLC series circuit
4.2 i) State the conditions for series resonance
ii) Derive the formula for frequency of resonance in series RLC circuit
iii) Draw the characteristic curves for series resonance
iv) Define bandwidth of a resonant circuit
v) Define lower cut off and upper cut off frequencies
vi) Give formula for lower cut off and upper cut off frequencies
vii) Solve simple problems on series Resonance.
4.3 i) Explain Parallel AC circuit containing RLC
ii) Explain Resonance in parallel circuits
iii) State the conditions required for parallel resonance
iv) Derive Equation for resonant frequency in parallel resonant circuit
v) Give graphical representation of parallel resonance.
vi) Compare Series and parallel resonance
vii) Solve problems on parallel resonance
viii) Explain the effect of resistance on Bandwidth

Experiment No	Name of the Experiment
12	Construct and test the performance of series Resonant circuit and find the resonant frequency , bandwidth, and quality factor
13	Construct and test the performance of parallel Resonant circuit and find the resonant frequency , bandwidth, and quality factor

5.0 Filters & Attenuators

5.1 Define the terms: neper, decibel, characteristic impedance, propagation constant and Attenuation
5.2 Define the terms: filter, LPF, HPF, BPF and BSF
5.3 Draw the characteristic curves for the above filters

5.4 Give the expression for fc for constant K-LPF,HPF
5.5 List the disadvantages of constant K filters.
5.6 State the function of attenuator circuit and list different types of attenuators.
5.7 Explain T & π type attenuators with circuit diagram

Experiment No	Name of the Experiment
14	Construct a RC Low pass filter and draw its amplitude response
15	Construct a RC High pass filter and draw its amplitude response
16	Design & Construct a simple T-type attenuator circuit and find the attenuation at the output
17	Design & Construct a simple π-type attenuator circuit and find the attenuation at the output

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2	PSO3
CO1	3	2	2	2		2	1	3	1	1
CO2	3	3	3	3		2	2	3	2	2
CO3	3	3	3	3		2	2	3	3	2
CO4	3	2	2	3	1	2	2	3	1	1
CO5	3	3	3	3	1	2	3	3	2	2
Average	3	2.6	2.6	2.8	1	2.0	2.0	3	1.8	1.6

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 Basic Electrical Circuit :
Equivalent resistance of Resistors connected in series & parallel-Voltage division rule-Current division rule

2.0 Mesh current and Node voltage analysis :

Define: branch, node, junction and loop - Kirchhoff's current law and Kirchhoff's Voltage law- Ideal voltage/current source-Mesh current equations – Solve problems - Node voltage equations -simple problems.

3.0 Network theorems:

Thevenin's, and Norton's theorems – solve problems - superposition theorem- Maximum power transfer theorems- solve problems – impedance matching .

4.0 Resonance:

Concept of resonance in RLC series circuit -Conditions for series resonance- frequency of resonance in series RLC circuit- Characteristic curves for series resonance- bandwidth of a resonant circuit- Lower cut off and upper cut off frequencies- Formula for lower cut off and upper cut off frequencies- Simple problems on series Resonance- Parallel AC circuit containing RLC- methods - Resonance in parallel circuits- Conditions required for parallel resonance- Equation for resonant frequency- Graphical representation of parallel resonance- Series and parallel resonance comparison-Problems on parallel resonance- Effect of Resistance on Bandwidth

5.0 Filters and attenuator:

Define Neper, Decibel, Characteristic Impedance, Propagation Constant, Attenuation-Define filter, LPF, HPF, BPF, BSF- characteristic curves of filters - constant K-LPF, HPF-disadvantages –Function of attenuator - T& π attenuators

REFERENCES

1. Hayt&Kemerly, Engineering Circuit analysis, 8th edition, McGraw Hill Publishers
2. Van Valkenberg, Network analysis, PHI
3. Sudhakar&Shyam Mohan, Circuits and Networks,TMH
4. Joseph Adminster, Network Theory- Schaum Series, McGraw Hill Publishers
5. D Roy Choudhury, Networks and Systems, Wiely Eastern Limited
6. A.Chakrabarti,Circuit Theory(Analysis & syntheses),Dhampat rai & co

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit Test	Learning outcome to be covered
Unit test-I	From 1 to 5
Unit test-II	From 6 to 11
Unit test-III	From 12 to 17

BASIC ELECTRONICS LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC108L	Basic Electronics Lab	4	120	4	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Safety precautions and cleaning	4	CO1
2	Identifying different electronic components	12	
3	Soldering & De soldering practice and Preparation of PCB	32	CO2
4	Study of different measuring Instruments and Electronic equipment	24	CO3
5	Testing, obtaining characteristics of electronic devices	28	CO4
6	PA system	08	CO5
7	Batteries	12	
	Total	**120**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	follow safety precautions, identification of electronic components
(ii)	have hands on practice on soldering, de-soldering of circuits and preparation of PCB for given circuits
(iii)	get acquainted with the usage of electronic equipment & measuring instruments
(iv)	test electronic devices and obtain their characteristics
(v)	arrange PA system with different loudspeakers and microphones
(vi)	test the given cells

COURSE OUTCOMES

CO1	EC108.1	Use different electrical safety accessories and practices, Identify different electronic components
CO2	EC108.2	Practice on Soldering, de-soldering of circuits ,PCB designing
CO3	EC108.3	Operating different measuring instruments and electronic equipment
CO4	EC108.4	Plot the characteristics of electronic devices
CO5	EC108-5	Arrangement of PA system, study of Batteries

LEARNING OUTCOMES

1.0 Safety precautions and cleaning

1. Identify safety symbols and interpret what they mean with the help of their colour and shape
2. Practice and follow preventive safety rules to avoid electrical accidents.
3. Select fire extinguishers according to the type of the fire and operate the fire extinguisher to extinguish the fire.
4. Practice the disposal procedure of waste materials.

2.0 Identify different Electronic Components and devices

5. Identify the components, and its terminals, and test :

   i) Colour coded resistors, different fixed and variable type resistors, different Inductors- different types of capacitors: ceramic, disc, paper, mica, gang etc.

   ii) Different SMD resistors, SMD inductors, SMD capacitors

   iii) Diodes, Transistors, JFETs, MOSFETs

   iv) Relays, Switches –SPST, SPDT, DPST, DPDT- Toggle-Push button –Rotary-Slider – Thumb Wheel

   v) Diode, transistor & IC's SMD packages (SOT, PLCC),

   vi) Different LEDs-Red LED, Blue LED, Green LED, Bi colour LED, Infrared LED, different sizes and forms, their specifications

6. Familiarise with

   i) Bread Board

   ii) Bridge rectifier as a device

   iii) DC to DC (Ex: 12V to 5V) converter as a device

   iv) Programmable Regulated power supply

3.0 Soldering practice and Preparation of PCB

7. Familiarise with Temperature controlled Soldering Station.
8. Technique of using soldering iron, Soldering different components and ICs.
9. Soldering components on to general purpose PCB as per the given circuit diagram.
10. Technique of de-soldering using de-soldering pump and wick.
11. Draw PCB for simple circuits and etch them on to a copper clad sheet.
12. Preparing PCB for the given circuit.

4.0 Study of different measuring Instruments and Electronic equipment

13. Study of AC/DC voltmeter, AC/DC ammeter, ohm meter,analog multimeter, digital multi meter.
14. Study of RPS unit, CRO, Function Generator using their manuals and familiarise with the operation of each equipment.
15. i)Measure Resistance using multimeter and compare with the calculated value using the colour code.

    ii) Measure L and C using digital LCR meter and compare with the calculated value using the code.

5.0 Characteristics of electronic devices

16. Obtain VI characteristics of PN junction diode.
17. Obtain VI characteristics of Zener diode.
18. Verify Transistor action as a switch
19. Obtain i/p and o/p characteristics of a transistor in CE configuration.
20. Obtain i/p and o/p characteristics of a transistor in CB configuration

21. Control a load using relay
    i)Turn On and Off DC load (LED/Buzzer/DC motor)
    ii) Turn On and Off AC load (Bulb/Tube light/Fan)

6.0 Testing of Loudspeakers and arranging PA system

22. Measure the input impedance of Loud Speaker
23. Arrange PA system with multi speakers (Two 4 Ω Speakers in Series or Two 8 Ω Speakers in Series or One 4 Ω + One 8 Ω Speaker in Series) and microphones (with cord and cordless)

7.0 Batteries

24. Identify the given cells and test whether they are in good condition or not
25. Connect the given two batteries in series and measure the equivalent voltage. Observe the measured equivalent voltage with respect to the voltage of single battery/Cell
26. Connect the given two batteries in parallel and measure the equivalent voltage. Observe the measured equivalent voltage with respect to the voltage of single battery/Cell
27. Study various sections of Battery charger circuit

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3						2	3		1
CO2	3	2	2	2	2		3	3	2	1
CO3	3	2	2	3			2	3	2	
CO4	3	2	2	2			1	3	2	
CO5	3	2	2	2	3	2	2	3	2	2
Average	3	2	2	2.25	2.5	2	2.0	3	2	1.33

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit Test	Learning outcome to be covered
Unit test-I	From 1 to 9
Unit test-II	From 10 to 20
Unit test-III	From 21 to 27

PHYSICS LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC109L	Physics Lab	3	90	1.5	40	60

Note: For the Physics laboratory, half of the first-year students of each programme will attend, while the remaining half will attend the Chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the 3-hour lab session.

TIME SCHEDULE

S. No.	List of experiments	No. of Periods	Cos Mapped
1	Vernier calipers	03 + 03	CO1
2	Micrometer (Screw gauge)	03 + 03	
3	Verification of Lami's theorem using concurrent forces	03 + 03	
	Revision	03 + 03	
4	Determination of 'g' using simple pendulum	03 + 03	CO2
5	Focal length and focal power of convex lens by distant object method and U-V method	03 + 03	
6	Verification of Boyle's law using Quill tube	03 + 03	
	Revision	03 + 03	
7	Drawing of magnetic lines of force	03 + 03	CO3
8	Resonance apparatus–Determination of velocity of sound in air	03 + 03	
9	Refractive index of a solid using travelling microscope	03 + 03	
	Revision	03 + 03	
	Experiments for demonstration		
10	Meter bridge–Determination of resistance and specific resistance of material of given wire	03 + 03	CO4
11	Projectile motion- study the range of a projectile for different launch angles	03 + 03	
12	Generation of Beats using water columns	03 + 03	
	Total	**45+ 45**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	apply practical physics principles to operate, troubleshoot, and optimize engineering devices
(ii)	develop scientific skills through designing, conducting, and evaluating industry-relevant experiments to enhance technical proficiency

COURSE OUTCOMES

CO1	EC109.1	Apply measurement techniques to improve accuracy; Explain forces maintaining equilibrium in physical systems
CO2	EC109.2	Determine acceleration due to gravity experimentally; Investigate refraction of light at curved surfaces; Relate the gas pressure to volume variations at constant temperature
CO3	EC109.3	Analyze the combined effect of magnetic fields (Earth and artificial magnet); Determine velocity of sound in air using resonance; Demonstrate U-V method to understand the refraction of light at curved surfaces
CO4	EC109.4	Apply Kirchhoff's laws to compute the resistivity of a wire; Examine the projectile motion parameters; Observe and Interpret beat generation phenomenon

LEARNING OUTCOMES

1. Apply measurement techniques using Vernier Calipers to determine the volumes of a cylinder and a sphere.
2. Use a screw gauge to measure and determine the thickness of a glass plate and the cross-sectional area of a wire.
3. Verify Lami's Theorem by analysing a system of concurrent forces.
4. Conduct simple pendulum experiment to calculate the acceleration due to gravity (g) and interpret the result through an $L–T^2$ graph.
5. Determine the focal length and power of a convex lens using distant object method and U–V method, and compare the results.
6. Verify Boyle's Law using a Quill tube by noting pressure (P) and length of air column(L).
7. Illustrate the behaviour of lines of magnetic field around a bar magnet using magnetic compass.
8. Determine the velocity of sound in air at room temperature and at 0°C using resonance apparatus.
9. Determine the refractive index of a solid by using the measurements taken with a travelling microscope.
10. Demonstrate the use of a meter bridge to determine the resistance and specific resistance of a given wire.
11. Simulate projectile motion and observe the range of the projectile for different launch angles using appropriate experimental setup.
12. Demonstrate the phenomenon of beats by creating beat patterns using water columns.

CO-PO/PSO MAPPING MATRIX

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1
CO3	3	1	1	1	1		1
CO4	3	1	1	2	1		1
Average	3	1	1	1.25	1	1	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

Name of the Experiment	Competencies (Revised Bloom's Taxonomy)	Key Competencies (Revised Bloom's Taxonomy)
1.Practice on Vernier Calipers	• Determine the least count • Place the object in accurate position. • Interpret scale readings • Calculate volume of cylinder and sphere	• Interpret Vernier readings • Compute volume using appropriate formulae • Apply measurement data to calculate physical quantities
2.Practice on Screw Gauge	• Determine the least count and zero error • Place the object in accurate position. • Interpret scale readings • Calculate thickness and cross-sectional area	• Analyze scale readings for zero error • Compute thickness and area from measurements • Apply micrometer data to solve practical problems
3.Verification of Lami's Theorem	• Setup experimental arrangement • Apply appropriate weights • Measure angles between forces • Analyze data to verify theorem	• Interpret directions and angles of forces • Evaluate force relationships • Validate Lami's Theorem using experimental data
4. Simple Pendulum	• Arrange the pendulum properly • Measure the time taken for 20 oscillations • Compute time period and	• Measure oscillation intervals accurately • Calculate g using experimental data • Interpret L–T^2 graph to

	acceleration due to gravity • Plot L–T^2 graph	confirm relationship
5. Focal Length and Power of Convex Lens	• Place the object and convex lens in proper positions. • Measure image distance • Compute focal length and Power	• Determine focal length using both methods • Validate optical formulae using experiment
6. Boyle's Law Verification	• Record atmospheric pressure • Measure air column length and calculate the enclosed pressure • Analyze data for PxL consistency	• Setup quill tube in different positions for multiple readings • Interpret pressure–length data
7. Drawing of Magnetic Lines of force	• Draw meridian and set magnet orientation • Sketch the lines of magnetic field using compass.	• Visualize field pattern accurately • Analyze field symmetry
8. Velocity of Sound – Resonance Method	• Assemble apparatus and adjust reservoir • Identify resonating lengths • Calculate velocity of sound at room temperature and at 0^oC.	• Detect resonance points • Compute velocity using resonance data • Extrapolate to standard temperature
9. Refractive Index of a solid using Traveling Microscope	• Determine least count • Measure real and apparent thickness • Calculate refractive index	• Analyze scale readings • Apply refraction formula • Interpret refractive index of a solid.
10. Meter Bridge	• Connect circuit properly • Measure balancing length, radius of given wire • Compute resistance and specific resistance	• Analyze circuit behavior • Calculate unknown resistance • Interpret experimental values for resistivity
11. Projectile motion-study the range of a projectile for different launch angles	• Setup and align launcher • Adjust launch angles • Measure range	• Observe the variations in horizontal range for different angles of projection. • Evaluate trajectory data
12. Generation of Beats using water columns	• Setup beat source using glasses or online tone generator • Generate close frequencies	• Observe frequency interference • Interpret beat frequency data • Analyze patterns using

	• Detect and analyze beat pattern	mobile sensors/ software

SCHEME OF VALUATION FOR END PRACTICAL EXAMINATION

Activity	Marks
Aim, Apparatus, Formulae	6
Tabulations and Readings	12
Calculations	4
Precautions, Results	3
Viva-voce	5
Total marks	**30**

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR

UNIT TEST – I, II & UNIT TEST – III

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From Experiment 1 to 3
Unit Test – II	From Experiment 4 to 6
Unit Test – III	From Experiment 7 to 9

CHEMISTRY LAB

Course code	Course title	No. Of periods/week	Total No. of periods	Marks for FA	Marks for SA	Credits
26EC110L	CHEMISTRY LAB	3	90	20	30	1.5

Note: For the Physics laboratory half of the first-year students of each program will attend, while the remaining half will attend the chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the three-hour lab session.

TIME SCHEDULE

S. No.	Name of the Experiment	No. of Periods	COs Mapped
1	Introduction to Fundamentals of Analytical Chemistry.	03+03	CO1
2	Chemical Recognition by Sensory Cues.	03+03	CO1
3	Preparation of Standard Na_2CO_3 Solution.	03+03	CO1
4	Estimation of HCl Using Standard NaOH Solution.	03+03	CO2
5	Determination of Alkalinity of Water Sample.	03+03	CO2
	Revision	03+03	
6	Estimation of Mohr's Salt Using Standard $KMnO_4$ Solution.	03+03	CO3
7	Determination of Total Hardness of Water Using Standard EDTA Solution.	03+03	CO4
8	Estimation of Chlorides Present in Water Sample Using Standard $AgNO_3$ Solution.	03+03	CO4
9	Analyzing pH of Common Compounds Using Visual and Instrumental Methods.	03+03	CO5
	Revision	03+03	
	Demonstration Experiments		
10	Demonstration of Copper Deposition on an Object by Using Electrolysis Process.	03+03	CO5
11	Demonstration of Construction and Working of a Galvanic Cell.	03+03	CO5
12	Open Ended Experiments/Micro Projects – I.	03+03	CO5
13	Open Ended Experiments/Micro Projects – II.	03+03	CO5
	Total	**45+45**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	perform fundamental analytical chemistry techniques, identify chemical substances using sensory cues and accurately prepare standard solutions
(ii)	evaluate and judge the neutralization point in acid base titration
(iii)	evaluate the endpoint of reduction and oxidation reaction
(iv)	judge the stable end point of complex formation, stable precipitation
(v)	determine the pH of compounds, demonstrate copper deposition using electrolysis, and the working of a galvanic cell

COURSE OUTCOMES

CO1	EC110.1	Perform fundamental analytical chemistry techniques, identify chemical substances using sensory cues and accurately prepare standard solutions
CO2	EC110.2	Evaluate and judge the neutralization point in acid base titration
CO3	EC110.3	Evaluate the endpoint of reduction and oxidation reaction
CO4	EC110.4	Judge the stable end point of complex formation, stable precipitation
CO5	EC110.5	Determine the pH of compounds, demonstrate copper deposition using electrolysis, demonstrate the working of a galvanic cell

LEARNING OUTCOMES

Upon completion of the course the student shall be able to:

1.0 Practice volumetric measurements (using pipettes, measuring jars, volumetric flask, burettes) and gravimetric measurements (using different types of balances), making dilutions, etc.

2.0 Identify the chemical compounds and solutions by senses.

3.0 Practice making standard Na_2CO_3 solutions.

4.0 Conduct titrations adopting standard procedures and using standard NaOH solution for estimation of HCl.

5.0 Conduct titrations adopting standard procedures to determine the alkalinity of given samples of water (one ground water and one surface / tap water) using standard H_2SO_4 solution.

6.0 Conduct titrations adopting standard procedures and using standard $KMnO_4$ solution for estimation of Mohr's Salt.

7.0 Conduct titrations adopting standard procedures to determine the total hardness of given samples of water (one ground water and one surface / tap water) using standard EDTA solution.

8.0 Conduct titrations adopting standard procedures to determine the chlorides present in the given samples of water (one ground water and one surface / tap water) and waste water by using standard $AgNO_3$ solution.

9.0 Conduct the test on given samples of water / solutions (like soft drinks, sewage etc.,) to determine their pH using pH paper, Universal indicator, digital pH meter.

10.0 Demonstrate the electrolysis process of copper deposited on an object.

11.0 Understand the construction and working principle of a Galvanic cell and identify how chemical energy is converted into electrical energy through redox reactions.

12.0 Collect water sample from nearby water body and test for any two parameters. **[Parameters – Alkalinity, Hardness, Chloride and pH]**

13.0 Collect water sample from nearby sewage/industrial effluent and test for any two parameters. **[Parameters – Alkalinity, Hardness, Chloride and pH]**

CO – PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		1			1			
CO2	3	2		1						
CO3	3	2		1						
CO4	3	2		1	1					
CO5	3	2	1	1	1		1			
Average	**3**	**2**	**1**	**1**	**1**		**1**			

3 = Strongly Mapped 2 = Moderately Mapped 1 = Slightly Mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:(i).Assignments (ii).Tutorials (iii). Guest Lectures (iv). Seminars (v). Quiz Competitions (vi).Industrial Visit (vii). Tech Fest (viii). Mini Projects (ix). Group Discussions (x). Virtual Classes and (xi). Library Visits.

COMPETENCIES AND KEY COMPETENCIES TO BE ACHIEVED BY THE STUDENT

Name of the Experiment (No of Periods)	**Competencies**	**Key Competencies**
Introduction to Fundamentals of Analytical Chemistry. (03)	• Develop a foundational understanding of analytical chemistry principles and demonstrate proficiency in basic laboratory techniques, data analysis, and safety protocols.	• Students will master the foundational principles and laboratory techniques of analytical chemistry.
Chemical Recognition by Sensory Cues. (03)	• Develop skills in conducting simple tests and making accurate observations. • Interpret results to draw conclusions about the nature of chemical compounds.	• Develop skills in conducting simple tests and making accurate observations. • Interpret results to draw conclusions about the nature of chemical compounds.
Preparation of Standard Na_2CO_3 Solution. (03)	• Weighing the salt to the accuracy of 0.01mg • Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette.	• Weighing the salt to the accuracy of 0.01 mg. • Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette.
Estimation of HCl Solution Using Standard NaOH Solution. (03)	• Cleaning the glass ware and rinsing with appropriate solutions. • Making standard solutions. • Measuring accurately the standard solutions and titrants. • Filling the burette with titrant. • Fixing the burette to the stand • Effectively controlling the flow of the titrant. • Identifying the endpoint. • Making accurate observations. • Calculating the results.	• Making standard solutions. • Measuring accurately the standard solutions and titrants. • Effectively controlling the flow of the titrant. • Identifying the endpoint. • Making accurate observations.
Determination of Alkalinity of Water Sample (03)		
Estimation of Mohr's Salt Using Standard $KMnO_4$ Solution. (03)		

Name of the Experiment (No of Periods)	**Competencies**	**Key Competencies**
Determination of Total Hardness of Water Using Standard EDTA Solution. (03) Estimation of Chlorides Present in Water Sample by Using Standard $AgNO_3$ Solution. (03)		
Analyzing pH of Common Compounds Using Visual and Instrumental Methods. (03)	• Know pH range (0 – 14) and classify substances as acidic, neutral and basic. • Accurately measure pH using pH paper and universal indicator. • Note color changes and interpret pH values correctly. • Perform precise pH tests to ensure reliable results. • Record pH data and observations clearly. • Connect pH results to real- world contexts. • Familiarize with instrument. • Choose appropriate 'Mode'/ 'Unit'. • Prepare standard solutions/buffers, etc. • Standardize the instrument with appropriate standard solutions. • Make measurements accurately.	• Accurately measure pH using pH paper and universal indicator. • Perform precise pH tests to ensure reliable results. • Prepare standard solutions/buffers, etc. • Standardize the instrument with appropriate standard solutions. • Make measurements accurately.
Demonstration of Copper Deposition on an Object by Using Electrolysis Process. (03)	• Prepare standard solutions. • Selection of electrodes. • Set up and perform an electrolysis experiment accurately and safely. • Analyze the deposition of Copper on an object.	• Set up and perform an electrolysis experiment accurately and safely. • Analyze the deposition of Copper on an object.

Name of the Experiment (No of Periods)	**Competencies**	**Key Competencies**
Demonstration of Construction and Working of Galvanic Cell.(03)	• Prepare standard solutions. • Selection of electrodes. • Making of salt bridge. • Construct a simple galvanic cell using appropriate electrodes and electrolyte solutions. • Explain the working principle of a galvanic cell, including electron flow, redox reactions, and the function of the salt bridge	• Construct a simple galvanic cell using appropriate electrodes and electrolyte solutions. • Explain the working principle of a galvanic cell, including electron flow, redox reactions, and the function of the salt bridge.
Open Ended Experiments /Micro Projects – I. (03) Open Ended Experiments/ Micro Projects – II. (03)	• Identifies a relevant chemical problem or question based on prior knowledge. • Demonstrates proficiency in basic chemistry lab techniques (e.g., titration, preparation). • Prepares solutions accurately (Molarity, dilutions, standardizations). • Handles chemicals safely following MSDS guidelines and standard lab practices. • Uses instruments relevant to the experiment (e.g., pH meter, and digital balance) correctly. • Calibrates and maintains instruments when needed. • Interprets instrumental output with understanding of underlying chemical principles. • Makes accurate, timely and detailed observations of chemical reactions (e.g., color changes, precipitate formation). • Records quantitative and qualitative data systematically. • Maintains an organized and complete lab notebook. • Works effectively in pairs or groups; shares responsibilities and discusses findings collaboratively. • Presents results through oral discussion, lab reports, or visual presentations using proper chemical terminology.	• Prepares solutions accurately (Molarity, dilutions, standardizations). • Uses instruments relevant to the experiment (e.g., pH meter, and digital balance) correctly. • Calibrates and maintains instruments when needed. • Makes accurate, timely and detailed observations of • chemical reactions • (e.g., color changes, precipitate formation).

SCHEME OF VALUATION FOR END PRACTICAL EXAMINATION

Activity	Marks
Aim, Apparatus, Formulae	6
Tabulations and Readings	12
Calculations	4
Precautions, Results	3
Viva-voce	5
Total marks	**30**

REFERENCE BOOKS

1. VOGEL's Textbook of Quantitative Analysis, Sixth Edition, Pearson Education Limited.
2. VOGEL's Textbook of Qualitative Analysis, Seventh Edition, Pearson Education Limited.
3. Y. Bharathi Kumari & Jyotsna Cherukuri - Laboratory Manual of Engineering Chemistry for Engineering Students of JNT Universities.
4. Instrumental Methods of Chemical Analysis.
5. NCERT Chemistry Laboratory Manual for Class XII.
6. Practical Chemistry by the Royal Society of Chemistry Education.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TEST – I , UNIT TEST – II & UNIT TEST-III

Unit Test	Experiments to be covered
Unit Test – 1	From Experiment 1 to 3
Unit Test – 2	From Experiment 4 to 6
Unit Test – 3	From Experiment 7 to 9

COMPUTER & DIGITAL SKILLS LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/Year	Credits	Marks for FA	Marks for SA
26EC111L	Computer and Digital Skills	3	90	1.5	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No of Periods	COs Mapped
1	Computer hardware and Software Basics	3	CO1
2	Windows Operating System	3	CO1
3	MS Word	18	CO2
4	MS Excel	21	CO3
5	MS Power Point	18	CO4
6	AI ,ML& Quantum computing Tools	27	CO5
Total		**90**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with basics of Computer Hardware and Software
(ii)	familiarize operating systems
(iii)	familiarize with Microsoft word
(iv)	familiarize with Microsoft Excel
(v)	familiarize with Microsoft Power point
(vi)	familiarize with AI ,ML, Quantum Computing Tools

COURSE OUTCOMES

CO1	EC111.1	Identify hardware and software components
CO2	EC111.2	Prepare documents with given specifications using word processing software
CO3	EC111.3	Use Spread sheet software to make calculation and to draw various graphs/charts
CO4	EC111.4	Use Power point software to develop effective presentation for a given theme or topic
CO5	EC111.5	To use basic AI ,ML& Quantum Computing Tools

LEARNING OUTCOMES

I. Computer Hardware and Software Basics

1. a) To get familiarized with Computer system and hardware connections
   b) To start and Shut down Computer correctly
   c) To explore Windows Desktop
2. To check the software details of the computer
3. To check the hardware present in your computer

II. Windows's operating system

4. To work with Files and Folders
5. To use Windows Accessories: Calculator –Notepad –WordPad–MS Paint

III. MS-WORD

6. To get familiarized with Ribbon layout of MSWord
7. To perform basic word processing
8. To use basic formatting techniques
9. To insert a table of required number of rows and columns
10. To insert Objects, Clipart and Hyperlinks
11. To use Mail Merge feature of MS Word
12. To use Equations and symbols features

IV. MS-EXCEL

13. To get familiarized with MS-EXCEL ribbon layout
14. To access and enter data in the cells
15. To edit a spread sheet-Copy, Cut, Paste, and selecting Cells
16. To use built in functions and Data Formatting
17. To create Excel Functions, use auto fill feature
18. To enter a Formula for automatic calculations
19. To sort and filter data in sheet
20. To present data using Excel Graphs and Charts
21. To format a Work sheet in Excel for printing using Page layout
22. To develop lab report formats of respective discipline.

V. Practice with MS-POWERPOINT

23. To get familiarized with Ribbon layout features of Power Point.
24. To create a simple Power Point Presentation
25. To set up a Master Slide in Power Point
26. To insert Text and Objects
27. To insert Flow Charts
28. To insert Tables
29. To insert Charts/Graphs
30. To insert video and audio
31. To animate text, objects and slides.
32. To Review Presentations

VI. AI,ML & Quantum Computing Tools

33. To get familiarized with AI Tools
34. To get familiarized with working of Chat GPT
35. Identify Objects using AI Tools based on CNN, YOLO, SSD,R-CNN
36. To paraphrase text using AI Tools (PEGASUS,GPT, T5)

37. To use text-to-Image Generation AI Tools (DALL-E,MID JOURNEY)
38. To use voice command simulation AI Tools (SPEECH-TO-TEXT)
39. To get familiarized with ML Tools
40. To get familiarized with Quantum Computing Tools
41. To familiarize with quantum bits (qubits) using Dirac notation
42. To familiarize the behavior of single and multiple qubit gates.
43. To familiarize with Qubit as a Coin / Spin Analogy

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	1	1	3	2	1
CO2	2	1	2	1	3	1	1	2	2	2
CO3	2	3	3	2	3	1	1	3	2	2
CO4	1	1	2	1	3	2	1	2	2	3
CO5	2	3	3	2	3	1	1	3	3	2
Average	2	2	2.2	1.4	3.0	1.2	1.0	2.6	2.2	2.0

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

Key competencies:

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
1 (a).	To get familiarized with Computer system and hardware connections	a. Connect cables to external hardware and operate the computer	a. Identify the parts of a computer system: i). CPU ii). Mother Board iii) Monitor iv) CD/DVD Drive v) Power Switch vi) Start Button vii) Reset Button viii) RAM ix) SSD /HDD b. Identify and connect various peripherals c. Identify and connect the

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			cables used with computer system d. Identify various ports on CPU cabinet and connect Keyboard, Mouse and peripherals
1(b).	Start and Shut down Computer correctly	a. Login and logout as per the standard procedure b. Operate mouse & Key Board	a. Login using the password b. Start and shut down the computer c. Use Mouse and Key Board
1 (c).	Explore Windows Desktop	a. Access application programs using Start menu b. Use taskbar and Task manager	a. Familiarity with Start Menu, Taskbar, Icons and Shortcuts b. Access application programs using Start menu, Task manager c. Use Help support
2.	Check the software details of the computer System	a. Access the properties of computer and to find the details	a. Finding the details of operating system being used b. Finding the details of edition/version Service Pack installed
3.	Check the hardware present in your computer	a. Access device manager and to find the details b. Type /Navigate the correct path and Select icon related to the details required	a. Finding the CPU name and clock speed b. Finding the details of RAM and hard disk present c. Accessing Device manager using Control Panel and check the status of devices like mouse and key board c. Using My Computer to check the details of Hard drives and partitions
4.	Working with Files and Folders	a Create files and folders b Rename, arrange and search for the required folder/file	a. Create folders and organize files indifferent folders b. Use cut, copy and paste commands to organize files and folders

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
		c. Restore deleted files from Recycle bin	c. Arrange icons by name, size, type and Modified d. Search for a file or folder and find its path e. Create short cut to files and folders (in other folders) on Desktop f. Familiarity with the use of My Documents g. Familiarity with the use of Recycle Bin
5.	Use Windows Accessories like Calculator– Notepad– WordPad –MS Paint	a. Use windows accessories and select correct text editor based on the situation. b. Use MS paint to create /Edit pictures and save in the required format	a. Access Calculator using Run command b. Familiarity with the use of Calculator c. Create Text Files using Notepad, WordPad and observe the difference in file sizes d. Use MS paint to create .jpeg, .bmp files
6.	Get familiarized with Ribbon layout of MS word.	a. Create a Document and name appropriately and save it b. Set paper size and print options	a. Create/Open a document b. Use Save and Save as features c. Work on two Word documents simultaneously d. Choose correct Paper size and Printing options
7.	Perform basic Word Processing	a. Use key board and mouse to enter/edit text in the document. b. Use short cuts c. use Spell /Grammar Check features for auto corrections	a. Typing text b. Keyboard usage c. Mouse Usage (Left click/Right click/Scroll) d. Using Keyboard shortcuts e. Using Find and Replace features in MS-word f. Use Undo and Redo Features e. Use spell check to correct Spellings and Grammar
8.	Use basic formatting techniques	a. Format Text and paragraphs and using various text styles. b. Use bullets and	a. Formatting Text b. Formatting Paragraphs c. Setting Tabs d. Formatting Pages e. Use various Font Styles

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
		numbers to create lists. c. Use Templates/Themes d. Insert page numbers, date, headers and footers	f. Insert bullets and numbers g. Using Themes and Templates h. Insert page numbers, header and footer
9.	Insert a table of required number of rows and columns	a. Insert table in the word document and edit b. Use sort option for arranging data.	a. Editing the table by adding the fields, deleting rows and columns, inserting sub table, marking borders. Merging and splitting of cells in a Table b. Changing the back ground color of the table c. Using table design tools d. Using auto fit – fixed row/column height/length – Even distribution of rows /columns feature e. Converting Text to table and Table to Text f. Use Sort feature of the Table to arrange data in ascending/descending order
10.	Insert objects, clipart and Hyperlinks	a. Insert hyperlinks & Bookmarks b. Create organization charts/flow charts	a. Creating a 2-page document and Insert hyperlinks and Bookmarks. b. Creating an organization chart c. Preparing an Examination schedule notice with a hyper link to Exam schedule table.
11.	Use Mail merge feature of MSWord	a. Using Mail merge feature	a. Using mail merge to prepare individually addressed letters d. Using mail merge to print envelopes.
12.	Use Equations and symbols features.	a. Enter Mathematical symbols and Equations in the word document	a. Exploring various symbols available b. Inserting a symbol in the text c. Inserting mathematical equations in the document

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
13.	Get familiarized with MS Excel Ribbon layout	a. Get familiarized with excel layout b. Use various features available in toolbar	a. Open /create an MS Excel spread sheet and familiarity with MS Excel layout b. Use Quick Access Tool bar, Title Bar, Worksheets, Formula Bar, Status Bar
14.	Access and Enter data in the cells	a. Access and select the required cells by various addressing methods b. Enter and edit data	a. Moving around a Work sheets using Quick access toolbar Selecting Cells, Entering Data-Editing a Cell, Wrapping of Text-Deleting a Cell Entry, saving a File, Closing Excel
15.	Edit spread sheet select, Copy, Cut, Paste	Format the excel sheet	a. Inserting and Deleting Columns and Rows b. Creating Borders c. Merging and aligning center d. Adding back ground Color Changing the Font, Font Size, and Font Color e. Formatting text with Bold, Italicize, and Underline f. Working with Long Text, Change a Column's Width
16.	Use built in functions and Format Data	Use built in functions in Excel	a. Performing Mathematical Calculations b. Verification AutoSum c. Perform Automatic Calculations d. Aligning Cell Entries
17.	Enter a Formula for automatic calculations	Enter formula for automatic calculations	a. Entering formulae b. Using Cell References in Formulae c. Using Automatic updating function of Excel Formulae d. Using Mathematical Operators in Formulae d. Using Excel Error Message and Help
18.	Create Excel Functions, Fill Cells	a. To Create Excel sheets	a. Using Reference Operators b. Working with sum, Sum if, Count and Count If Functions c. Filling Cells Automatically

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
		involving cross references and equations b. Using the advanced functions for conditional calculations	
19.	Sort and filter data in sheet.	a. Refine the data in a worksheet and keep it organized b. Narrow a worksheet by selecting specific choice	a. Sorting data in multiple columns b. Sorting data in a row c. Sorting data using Custom order d. Filter data in work sheet
20.	Practice Excel Graphs And Charts	a. Use data in Excel sheet to Create technical charts and graphs b. Prepare various graphs from data.	a. Using data in sheets for getting charts. b. Producing various charts.
21.	Format a and print features Work sheet in Excel, use page setup	Format Excel sheet a. Insert headers &footers and print	a. Shading alternate rows of data b. Adding currency and percentage symbols c. Changing height of a row and width of a column d. Changing data alignment e. Inserting Headers and Footers f. Set Print Options and Printing.
22.	Develop lab report formats of respective discipline	Use Headers/Footers/Page Numbers for preparing reports	a. Creating Lab reports using MS Excel
23.	Get familiarized with Ribbon layout &features of PowerPoint.	Access required options in the toolbar	Explore and use various options in PowerPoint a. Home b. Insert c. Design d. Animation e. Slideshow f. View b. Review

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
24.	Create a simple Power Point Presentation	a. Create simple Power Point presentation with photographs /Clip Art and text boxes Use bullets option	a. Inserting a New Slide into Power Point b. Changing the Title of a Power Point Slide c. Using Bullets in PowerPoint d. Adding an Image to a Power Point Slide e. Adding a Text box to a Power Point slide
25.	Set up a Master Slide in PowerPoint and add notes	a. Setup Master slide and format b. Add notes to master slide.	a. Creating a PowerPoint Design Template b. Modifying themes c. Switching between Slide master view and Normal view d. Formatting a Design Template for Master Slide e. Adding a Title Slide to a Design Template f. Using the Slide Show g. Adding Notes to a Power Point Presentation slide
26.	Insert Text and Objects	a. Insert Text and Objects b. Use 3d features	a. Inserting Text and objects b. Setting Indents and line spacing c. Inserting pictures/clipart d. Formatting pictures e. Inserting shapes and word art f. Using 3d features to g. Arrange objects
27.	Create Flow Charts /Organizational Charts	a. Create organizational Charts and flow charts using smart art	a. Creating a Flow Chart in PowerPoint b. Grouping and Ungrouping Shapes h. Use smart art
28.	Insert Tables	a. Insert tables and format	a. Using Tables in PowerPoint b. Formatting the Table Data c. Changing Table Background

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
29.	Insert Charts/Graphs	a. Create charts and Bar graphs, Pie Charts and format.	a. Creating 3D Bar Graphs in PowerPoint b. Working with the Power Point Datasheet c. Formatting a PowerPoint Chart Axis d. Formatting the Bars of a Chart e. Creating Power Point Pie Charts f. Using Pie Chart Segments g. Creating 2D Bar Charts in Power Point h. Formattingthe2DChart i. Formatting a Chart Back ground
30.	Insert audio & video, Hyperlinks in a slide and Add narration to the slide	a. Insert Sounds and Video in appropriate format. b. Add narration to the slide c. Use hyperlinks to switch to different slides and files	a. Inserting sounds in the slide and hide the audio symbol b. Adjusting the volume in the settings c. Inserting video file in the format supported by PowerPoint in a slide d. Using automatic and on click options e. Adding narration to the slide f. Insert Hyperlinks
31.	Create Animation effects	d. Add animation effects	a. Applying transitions to slides b. Using special animation effects like Entrance, Emphasis, Motion c. Paths &Exit as per requirement.
32.	Reviewing presentation	a. Use Spell and Grammar check feature b. Setup slideshow c. Add timing to the slides e. Setup automatic slide show	a. Checking spelling and grammar b. Previewing presentation c. Setting up slideshow d. Setting up resolution e. Using Rehearse Timing feature in PowerPoint f. Using PowerPoint Pen Tool During slideshow

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			g. Saving h. Printing presentation Slides as Hand-out
33	Familiarizing with AI Tools	Introductions of AI tools and their applications. Understand the basic use cases and functionality of AI tools (like Chat GPT, Google Gemini, Teachable Machine, etc.). 1.	a) Grasping the concept of Artificial Intelligence and how tools mimic human thinking or behavior. b) Identifying and interacting with AI tools such as: **Chat GPT** (natural language processing), **Google Teachable Machine** (image/audio classification), **DALL·E / Bing Image Creator** (AI art), **Grammarly / Quillbot** (AI-based writing assistants).
34	Usage of ChatGPT	a) Introduction to ChatGPT, an AI-powered conversational assistant. b) To explore ChatGPT's capabilities in answering questions, generating content, and solving problems.	a) Operating the ChatGPT interface (web or app), input prompts, and interpret outputs. b) Using ChatGPT to generate summaries, ideas, code snippets, explanations, emails, etc. c. Evaluating the relevance and accuracy of ChatGPT's responses.
35	Object identification using AI Tools based on CNN, YOLO, SSD, R-CNN	a. Get awareness about object detection techniques using AI. b. To explore how AI tools based on**CNN, YOLO, SSD, and R-CNN** detect and classify objects in images/videos.	a) Differentiating object detection from image classification. b) Using web-based AI tools or platforms that demonstrate object detection (e.g., Teachable Machine, Roboflow, Edge Impulse, Hugging Face Demos). c) Observing and comparing

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			the speed, accuracy, and bounding box behavior of different models.
36	Paraphrase text using AI Tools (PEGASUS, GPT, T5)	a. Get awareness about AI-powered text paraphrasing techniques. b. To explore the usage and functioning of transformer-based models like **PEGASUS**, **GPT**, and **T5**	a) Recognizing of Natural Language Processing (NLP) tasks and how transformer models like PEGASUS, GPT, and T5 can be used. b) Using AI tools to generate reworded versions of sentences or paragraphs while retaining the original meaning. c) Interacting with user-friendly interfaces like: • Hugging Face demos • ChatGPT • Quillbot • Parrot.ai
37	Text-to-Image Generation using AI Tools (DALL-E, MIDJOURNEY)	a) Get awareness about**text-to-image generation** using advanced AI models. b) To explore the usage of tools like **DALL·E** and **Mid journey** convert text prompts into realistic or artistic images.	a. Learning usage of how AI models generate visual content from natural language prompts. b. Formulating effective, clear, and creative text prompts to generate meaningful images. c. Enhancing creative thinking by translating ideas into visual representations using AI. d. Analyzing and comparing output quality, style, and relevance between DALL·E and Mid journey.
38	Voice Command Simulation using AI Tools (SPEECH-TO-TEXT)	a. Get awareness about **Speech-to-Text (STT)** technology and its role in AI-powered voice recognition systems.	a. Using AI tools to generate text from speech. b. Reading prompts and commands to analyze how accurately the tool transcribes voice. c. Using voice to simulate commands such as opening files, dictating

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			emails, or interacting with virtual assistants.
39	Usage of ML Tools	a) To use ML tools for suitable real-world applications b. To use **popular ML tools and platforms** through simple, hands-on demonstrations.	a. Understanding key ML terms like dataset, training, testing, classification, prediction, and accuracy. b. Learning to use beginner-friendly ML tools such as: • **Teachable Machine by Google** (image/audio recognition) • **Microsoft Lobe** (no-code image classification) • **Weka** (GUI-based ML toolkit) • **IBM Watson Studio** (visual data workflows)
40	Usage of Quantum Computing Tools	a. To explore and interact with **quantum computing simulation tools** and platforms.	a. Understanding key terms: **Qubit**, **Superposition**, **Entanglement**, **Quantum Gate**, **Quantum Circuit**. b. Navigate and use beginner-friendly quantum computing tools: • **IBM Quantum Experience (IBM Q / Qiskit)** • **Microsoft Quantum Development Kit** • **Quirk (online quantum circuit simulator)** • **Quantum Playground by Google**
41	To familiarize with quantum bits (qubits) using Dirac notation	a) To introduce the concept of a **qubit** as the fundamental unit of quantum information. b) To understand the representation of qubits using **Dirac (bra-ket) notation**.	• Identify and interpret the basic qubit states: • $\|0\rangle = \begin{bmatrix}1\\0\end{bmatrix}$ • $\|1\rangle = \begin{bmatrix}0\\1\end{bmatrix}$ • Understand that a qubit can exist in a **superposition**: • $\|\psi\rangle = \alpha\|0\rangle + \beta\|1\rangle$, where α and β are complex numbers and $\|\alpha\|^2 + \|\beta\|^2 = 1$ a) Learn how to write and read quantum states using the kept ($|\rangle$) and bra ($\langle|$) notations.

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			b) Understand the purpose of ⟨ψ| and how it represents a dual vector in quantum mechanics.
42	To familiarize the behaviour of single and multiple qubit gates.	a. To understand the concept of **quantum gates** and their role in quantum circuits.	a) Recognize the function and matrix representation of: • **Single-qubit gates**: ○ **Pauli-X (NOT)**: flips |0⟩ ↔ |1⟩ ○ **Hadamard (H)**: creates superposition ○ **Pauli-Z**: applies a phase flip • **Multi-qubit gates**: ○ **CNOT**: flips target qubit based on control ○ **Toffoli (CCNOT)**: controlled-controlled NOT **SWAP**: exchanges the states of two qubits
43	To familiarize with Qubit as a Coin / Spin Analogy	a) To introduce the concept of a **qubit** using intuitive physical analogies. b) To help students understand **quantum superposition** through the **coin toss** or **spin-½ particle** analogy. b.	a. Relate a **qubit in superposition** to a **coin spinning in the air**: • Classical coin: heads (0) or tails (1) • Spinning coin: both until observed (|0⟩ and |1⟩ at once) b.Use **spin analogy**: a particle with spin "up" (|0⟩) or "down" (|1⟩), or in between (superposition)

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

Unit Test	Learning outcome to be covered
Unit test-I	From 1 to 12
Unit test-II	From 13 to 32
Unit test-III	From 33 to 43

III SEMESTER

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
III SEMESTER

Course Code	Course title	Instruction periods/ week		Practicum (Y/N)	Total no. of Periods/ Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC301T	Electronic Circuits	6	-	N	90	4	6	30	70	100
26EC302T	Analog and Digital Communication Systems	6	-	N	90	4	6	30	70	100
26EC303T	Digital Electronics	6	-	Y	90	4	6	30	70	100
ELECTIVE COURSES										
26EC304E	Engineering Mathematics-II	3	-	N	45	2	3	30	70	100
26EC305E	Signals and Systems									
26EC306E	Computer Hardware and Servicing									
AUDIT COURSE										
26EC307A	Basics of Drone Technology	2	-	N	30					
PRACTICAL COURSES										
26EC308L	Electronic Circuits Lab		6	N	90	2	3	40	60	100
26EC309L	Analog and Digital Communication Systems Lab		4	N	60	1.5	3	40	60	100
26EC310L	Programming in C and MATLAB		6	Y	90	2	3	40	60	100
26EC311C	Student Centric Activities		3	-	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**	**30**	**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26EC304E is common elective to all programmes. All third semester courses are common to ECII.

ELECTRONIC CIRCUITS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC301T	Electronic Circuits	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	DC Power Supplies & Wave shaping Circuits	20	22	2	2	CO1
2	Small Signal and Large Signal Amplifiers	20	25	3	2	CO2
3	Feedback amplifiers &Oscillators	18	17	3	1	CO3
4	Field Effect Transistors	10	11	1	1	CO4
5	Linear ICs and Applications	22	25	3	2	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	understand the different stages of regulated power supplies and Wave shaping Circuits
(ii)	understand different small signal and large signal amplifiers
(iii)	explain different feedback amplifiers and oscillators
(iv)	analyse the working of different types of FETs
(v)	analyze the applications of linear ICs(OP-AMP)

COURSE OUTCOMES

CO1	EC301.1	Explain rectifier circuits and regulated power supplies and describe different wave shaping circuits
CO2	EC301.2	Explain the working of small signal and large signal amplifiers
CO3	EC301.3	Explain the working of feedback amplifiers, Describe various oscillator circuits
CO4	EC301.4	Analyse the working of different types of FETs
CO5	EC301.5	Analyse the OP-Amp application circuits

LEARNING OUTCOMES

1.0 DC Power Supplies and Wave Shaping Circuits

1.1 State the necessity of D.C. power supply for Electronic circuits
1.2 Draw the block diagram of DC Regulated Power Supply and explain the function of each block
1.3 Explain the working of Half wave rectifier, Full Wave centre tapped rectifier and Bridge Rectifier circuits with wave forms
1.4 Write the equations for RMS value and average value(DC value) voltages and currents for above rectifiers(no need to derive the expressions)
1.5 i) Define ripple factor and efficiency of a rectifier.
ii) Write the expressions for ripple factor and efficiency for different rectifiers.
1.6 Compare HW, FW Centre tapped and Bridge Rectifiers
1.7 State the need for filter circuits and List the different types of filters used in rectifier circuits
1.8 Define Voltage Regulation
1.9 State the need for a DC regulated power supply
1.10 List the types of voltage regulators
1.11 State the need of wave shaping circuits
1.12 Classify different linear and non-linear wave shaping circuits
1.13 Explain RC differentiator circuit with wave forms
1.14 Explain RC integrator circuit with wave forms
1.15 Classify clippers.
1.16 Explain the working of different unbiased diode clipper circuits
1.17 Explain the working of different biased diode clipper circuits
1.18 Explain the double ended diode clipper with waveforms
1.19 Explain the working of clamper circuit
1.20 List the applications of clippers and clampers

2.0 Small Signal and Large Signal Amplifiers

2.1 i) State the concept of DC and AC load lines
ii) Define operating point of transistor amplifier
iii) List the factors affecting the operating point
iv) Explain the need of the selection of proper operating point
2.2 Mention the importance of transistor biasing
2.3 State the need for stabilization
2.4 Define Stability factor and give their equations
2.5 List the types of biasing circuits
2.6 i) Draw the self bias circuit and explain how it provides stability
ii) State the importance of emitter by-pass capacitor, C_E in self bias circuit
2.7 State the importance of heat sink.
2.8 Classify the amplifiers based on frequency of operation, period of conduction and type of coupling.
2.9 Define the terms gain, gain in dB, frequency response and bandwidth of an amplifier
2.10 Draw the practical single stage transistor CE amplifier and explain the function of each component.
2.11 State the need for Multistage amplifier (Cascading of amplifiers)
2.12 Explain the working of two-stage RC coupled amplifier with circuit diagram
2.13 Draw and explain the frequency response of RC coupled amplifier

2.14 Explain the working of two-stage transformer coupled amplifier with circuit diagram
2.15 Draw and explain the frequency response of transformer-coupled amplifier
2.16 State the need for power amplifier
2.17 Compare voltage and power amplifier
2.18 Classify power amplifiers based on period of conduction
2.19 Explain the working of Class A, Class B, Class AB and Class C amplifiers with waveforms and mention the efficiency.
2.20 Explain the working of complementary symmetry Push-pull power amplifier with circuit diagram
2.21 Explain the working of Class-AB Push-pull amplifier circuit
2.22 Mention the applications of Class C Amplifiers

3.0 Feedback Amplifiers and Oscillators

3.1 State the concept of feedback
3.2 Compare positive and negative feedback.
3.3 Explain negative feedback amplifier with block diagram
3.4 Derive the expression for the gain of negative feedback amplifier
3.5 List the four types of negative feedback amplifiers
3.6 State the effect of negative feedback on gain, bandwidth, input and output impedances of an amplifier
3.7 List the merits of negative feedback amplifiers
3.8 Draw the block diagrams of voltage series, current series, current shunt and voltage Shunt feedback amplifiers
3.9 Compare characteristics of the above feedback amplifiers
3.10 State the conditions (Barkhausen criteria) for an amplifier to work as an oscillator
3.11 Classify oscillator circuits
3.12 Explain the working of an RC phase shift oscillator with a circuit diagram
3.13 Explain the working of Hartley oscillator with a circuit diagram
3.14 Explain the working of Colpitt's oscillator with a circuit diagram
3.15 Write the expressions for frequency of oscillations and conditions for sustained oscillations of the above circuits (No need to derive)
3.16 Draw the equivalent circuit of piezoelectric crystal
3.17 Explain the working of crystal oscillator with a circuit diagram
3.18 List the advantages of crystal oscillators
3.19 List the applications of RC, LC and Crystal oscillators.

4.0 Field Effect Transistor

4.1 Classify Field Effect Transistors.
4.2 Explain the construction and working principle of N-channel JFET.
4.3 Draw and explain the drain characteristics of JFET.
4.4 Draw and explain the transfer characteristics of JFET.
4.5 Define the parameters of JFET and obtain the relation among them.
4.6 List the advantages of FET over BJT.
4.7 Explain the construction & working of N-channel Enhancement type MOSFET.
4.8 Explain the construction & working of N-channel Depletion type MOSFET.

4.9 Draw the Drain characteristics of N-channel Depletion MOSFET.

4.10 Compare JFET and MOSFET.

5.0 Linear Integrated Circuits

5.1 List the advantages and disadvantages of Integrated Circuits over discrete circuits.

5.2 Classify ICs based on manufacturing process

5.3 Explain the working of differential amplifier constructed using BJTs.

5.4 i) Draw the circuit symbol of an operational amplifier.
ii) List the characteristics of ideal operational amplifier.
iii) Define the terms: Input impedance, Open loop gain, Slew rate, CMRR, Input offset voltage, Input offset Current and give the typical values of each.
iv) Draw the pin diagram of IC 741 and state the function of each pin

5.5 i) Explain the function of Op Amp as Inverting amplifier with a circuit diagram and waveforms.
ii) Explain the function of Op-Amp as Non Inverting amplifier with a circuit diagram and waveforms.
iii) Derive the expressions for the gain of OP-AMP as inverting and Non inverting Amplifiers.
iv) Explain the function of OP-Amp as: a) Summer b) Scale changer c) Integrator and d) Differentiator

5.6 Explain the working of OP-Amp based Wein-bridge Oscillator circuit

5.7 Explain the working of OP-Amp based RC Phase shift oscillator circuit

5.8 Explain the working of OP-Amp based Astable multi-vibrator with waveforms.

5.9 Explain the working of OP-Amp based Schmitt trigger circuit with waveforms

5.10 i) Explain the Voltage to current converter circuit.
ii) List any three applications of Voltage to current converter.

5.11 i) Explain the Current to Voltage converter circuit.
ii) List any three applications of Current to Voltage converter.

PO-CO Mapping

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1	1			3	1	1
CO2	3	3	2	1	1			3	2	1
CO3	3	3	2	1	1			3	2	1
CO4	3	3	2					3	2	1
CO5	3	3	2	1	1		1	3	2	3
Average	3	3	2	1	1		1	3	1.8	1.4

COURSE CONTENT

1.0 DC Power Supplies and Wave Shaping Circuits

Necessity of DC power supply- Half wave, Full wave and Bridge rectifiers -Working , Wave forms, RMS value, Average value of voltages and currents - Ripple factor and efficiency – Comparison of HW, FW Centre tapped, and bridge rectifiers – Need for filters –types of filter circuits- – Voltage regulation –Types of voltage regulators. Need of

wave shaping circuit- Linear and non-linear wave shaping networks - RC differentiator circuit - wave forms - RC integrator circuit - wave forms - classification of clippers - working of unbiased –biased -double ended diode clipper circuits – clamper circuit - applications of clippers and clampers

2.0 Small Signal and Large Signal Amplifiers

DC and AC load lines- transistor biasing- operating point- types of biasing circuits- bias stabilization- stability factor - self bias - heat sink-Practical transistor CE amplifier - Classification of amplifiers based on frequency, period of conduction and coupling- Multistage amplifier - gain, frequency response and bandwidth of an amplifier- RC coupled amplifier - frequency response of RC coupled amplifier- transformer coupled amplifier - Frequency response of transformer coupled amplifier

Need for Power Amplifier- comparison of voltage and power amplifier -Classification of power amplifiers based on conduction (Class A, B, AB, C)- operation of Class A, Class B, Class AB & Class C with waveforms- Applications of Class C Amplifiers as - Efficiencies of different power amplifiers

3.0 Feedback Amplifiers& Oscillators

Concept of feedback – positive and negative feedback-Block diagram of negative feedback amplifier - four types of negative feedback amplifiers- Block diagrams of voltage series, current series, current shunt and voltage Shunt feedback amplifiers- Expression for the gain of negative feedback amplifiers- Effect of negative feedback on gain, bandwidth, input and output impedances- comparison of characteristics of feedback amplifiers.

Condition for an amplifier to work as an oscillator (Barkhausen criteria) - RC phase shift oscillator -Hartley oscillator- Colpitts oscillator - Equivalent circuit of crystal - crystal oscillator - Advantages of crystal oscillator- Applications of RC,LC and crystal oscillators.

4.0 Field Effect Transistor

Classification –N channel JFET Construction, Principle of operation –Drain characteristics – Transfer characteristics – Parameters of JFET – Relationship - Advantages of JFET over BJT –N Channel enhancement MOSFET – Construction, working- N Channel depletion MOSFET – Construction, working - Drain and transfer characteristics of N channel Depletion MOSFET – Comparison of JFET and MOSFET

5.0 Linear Integrated Circuits and OP-AMP applications

Advantages and disadvantages of Integrated circuits over discrete circuits- Classifications of ICs based on manufacturing process–Differential Amplifier- Operational amplifiers– circuit symbol – ideal characteristics-Input impedance, Open loop gain, Slew rate, CMRR, Input offset voltage, Input offset Current – IC 741- Pin diagram- OP-AMP as inverting amplifier &Non inverting amplifier

OP-Amp as summer, scale changer, integrator, differentiator- Wein bridge oscillator – RC Phase shift oscillator - Astable, multivibrators- Schmitt trigger-– Voltage to current converter- applications – current to voltage converter- Applications

REFERENCES

1. G. K. Mithal, *Electronic Devices and Circuits*, 23rd ed. New Delhi: Khanna Publishers, 2014.
2. D. A. Bell, *Electronic Devices and Circuits*, 4th ed. New Delhi: PHI Learning.
3. T. F. Bogart Jr., J. S. Beasley, and G. Rico, *Electronic Devices and Circuits*, 6th ed. Pearson Education, 2004.
4. A. Mottershead, *Electronic Devices and Circuits: An Introduction*. New Delhi: PHI Publications.
5. J. Millman and C. C. Halkias, *Integrated Electronics*. New Delhi: Tata McGraw-Hill.
6. R. A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, 4th ed. Upper Saddle River, NJ: Prentice Hall.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.9
Unit Test-II	From 3.10 to 5.11

ANALOG AND DIGITAL COMMUNICATION SYSTEMS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC302T	Analog and Digital Communication Systems	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Amplitude Modulation Techniques	17	21	3	1.5	CO1
2	Angle Modulation	17	14	2	1	CO2
3	Transmitters and Receivers	20	25	3	2	CO3
4	Digital communicatio n principles	16	18	2	1.5	CO4
5	Digital modulation techniques	20	22	2	2	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize the concepts of analog communication systems and digital communication systems
(ii)	equip with various issues related to analog and digital communications, modulation, demodulation, transmitters, receivers and noise performance
(iii)	learn the practical importance and applications of communication systems

COURSE OUTCOMES

CO1	EC302.1	Understand the amplitude modulation techniques
CO2	EC302.2	Familiarize with angle modulation methods
CO3	EC302.3	Describe the principles and working of transmitters and receivers
CO4	EC302.4	Interpret the Digital Communication and multiplexing techniques
CO5	EC302.5	Describe different digital modulation techniques and Modems

LEARNING OUTCOMES

1.0 Amplitude modulation

1.1 Explain the basic elements of a communication system with a block diagram.
1.2 Draw the Electromagnetic spectrum of radio waves and mention the applications of each band.
1.3 Distinguish between time domain and frequency domain waveforms.
1.4 Define modulation
1.5 State the need for modulation in communication systems.
1.6 Define baseband signal, carrier signal and modulated signal.
1.7 Classify various types of continuous wave modulation techniques.
1.8 Define amplitude modulation and draw its waveform.
1.9 Derive the time-domain equation of an AM signal with single tone message signal.
1.10 Define the modulation index of an AM signal.
1.11 Derive the formula to measure modulation index from AM signal.
1.12 Draw the frequency spectrum of an AM signal.
1.13 Define bandwidth and give the formula for bandwidth of an AM signal.
1.14 Draw the waveforms of (i) critical modulated and (ii) over modulated AM waves.
1.15 State the effects of over modulation.
1.16 Derive the expression for the total power required to transmit an AM signal.
1.17 State the need for DSBSC and derive the formula for percentage of power saved in DSBSC compared to standard AM.
1.18 State the need for SSB modulation and derive the formula for percentage of power saved in SSB compared to standard AM.
1.19 List the advantages and disadvantages of DSBSC compared to standard AM.
1.20 List the advantages and disadvantages of SSB compared to standard AM.
1.21 Solve simple problems on power calculations and frequency spectrum of AM signal.
1.22 State the concept of Vestigial Sideband modulation used for TV signal transmission.

2.0 Angle Modulation Techniques

2.1 Define angle modulation.
2.2 List the types of angle modulation.
2.3 Define Frequency modulation and draw its waveform.
2.4 Define frequency deviation and modulation index of an FM signal.
2.5 Derive the time domain equation for FM signal.
2.6 Draw the frequency spectrum of FM wave.
2.7 State Carson's rule to compute bandwidth of an FM signal.
2.8 Distinguish between narrowband and wideband FM.
2.9 Define Phase Modulation.
2.10 Explain the basic relation between FM and PM from their equations.
2.11 Explain the need for pre-emphasis and de-emphasis.
2.12 Compare AM, FM and PM.
2.13 Classify different types of noise.
2.14 Define thermal noise.
2.15 Define the terms: i) Signal to Noise Ratio; ii) Noise Figure; and iii) Noise Temperature.

3.0 Transmitters and Receivers

3.1 List the specifications of transmitters.
3.2 List the types of AM transmitters.
3.3 Distinguish between low level and high-level modulated AM transmitters.
3.4 Draw the block diagram for high level modulated AM transmitter and explain its working.
3.5 Draw the block diagram of low-level modulated AM Transmitter and explain its working

3.6 List the types of FM transmitters.
3.7 Draw and explain the block diagram of indirect method of FM generation (Armstrong method)
3.8 Classify radio receivers.
3.9 Define Sensitivity, Selectivity and Fidelity of a radio receiver.
3.10 i) Draw the block diagram of TRF receiver and explain the function of each block.
ii) State the limitations of TRF receiver.
3.11 Explain the working of super heterodyne AM receiver with a block diagram.
3.12 Define the terms Image frequency and IMRR in a radio receiver.
3.13 State the factors to be considered while selecting IF.
3.14 State the need for AVC (AGC).
3.15 Draw and explain the circuit diagram of practical AM detector.
3.16 Explain the working of super heterodyne FM receiver with a block diagram.
3.17 Explain the process of demodulation using Foster-Seeley discriminator (Phase discriminator) in FM receivers.

4.0 Digital Communication Principles

4.1 Distinguish between analog and digital signals.
4.2 List the advantages and disadvantages of digital communication over analog communication system.
4.3 Define information capacity of a channel.
4.4 State the Hartley theorem for information capacity
4.5 Mention the Shannon's limit on channel capacity.
4.6 State sampling theorem and mention its significance in pulse modulation techniques.
4.7 State aliasing effect.
4.8 Classify pulse modulation techniques.
4.9 Define PAM and draw its waveform.
4.10 Define PWM and draw its waveform.
4.11 Define PPM and draw its waveform.
4.12 Compare PAM, PWM and PPM.
4.13 Define the term quantization.
4.14 Explain the process of quantization with waveforms.
4.15 State quantization noise.
4.16 Explain the coding and decoding of a PCM signal.
4.17 Define Multiplexing and state the need for multiplexing.
4.18 List various types of multiplexing techniques.
4.19 Explain the concept of Frequency Division Multiplexing with block diagram.
4.20 Explain the concept of Time Division Multiplexing with block diagram.
4.21 Compare FDM and TDM.

5.0 Digital Modulation Techniques

5.1 State the need for data encoding.
5.2 List different data encoding schemes [Unipolar (RZ & NRZ), Polar (RZ, NRZ, Manchester, and Differential Manchester), and Bipolar (AMC)].
5.3 Distinguish between Asynchronous data communication and Synchronous data communication.

5.4 Define bit overhead and overhead efficiency of data communication system.
5.5 List Different error control techniques.
5.6 Explain parity check method of error detection.
5.7 Explain Checksum method of error detection.
5.8 Explain CRC method of error detection with an example.
5.9 Explain method of error correction using FEC method (Hamming method).
5.10 State the need for digital modulation.
5.11 State the difference between bit rate and baud rate.
5.12 Define ASK, FSK and PSK.
5.13 Explain Binary ASK modulator with block diagram.
5.14 Explain Binary ASK coherent demodulator with block diagram.
5.15 Explain BFSK modulator with block diagram.
5.16 Explain Coherent BFSK demodulator.
5.17 Explain BPSK modulator with block diagram.
5.18 Explain BPSK demodulator with block diagram.
5.19 State the need for multilevel digital modulation techniques.
5.20 Explain QPSK modulation and draw its constellation diagram.
5.21 Compare ASK, FSK and PSK.
5.22 State the need for QAM.
5.23 Explain QAM Modulator with block diagram and draw its constellation diagram.
5.24 State the need for a MODEM in data communications.
5.25 List different types of MODEMs.
5.26 List the features of Digital Subscriber Line (DSL) Modems.
5.27 List the features of Asynchronous Digital Subscriber Line (ADSL) Modems.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2			2		2	3		2
CO2	3	2			2		2	3		2
CO3	3	1	1		2		2	3	1	2
CO4	3	1	1		2		3	3	2	2
CO5	3	3	3		2		3	3	2	2
Average	3	1.8	1.67		2		2.4	3	1.67	2

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

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COURSE CONTENT

1.0 Amplitude modulation

Elements of a communication system - block diagram- EM spectrum – time domain signal-frequency domain signal- need for modulation - baseband, carrier, and modulated signals -amplitude modulation-time-domain equation for an AM signal-frequency spectrum of an AM signal-bandwidth of an AM signal - effects of over modulation - relation between total power and carrier power in AM –Concept of DSBSC and SSB and VSB modulation- advantages and disadvantages of DSB SC and SSB.

2.0 Angle Modulation techniques

Angle modulation- types of angle modulation-Definition of Frequency modulation - Phase modulation - time domain equation for FM signal-bandwidth of FM signal-modulation index of an FM signal- frequency spectrum of FM - narrow band and wide band FM- pre-emphasis and de-emphasis – compare AM, FM and PM - types of noise-thermal noise - signal to noise ratio, noise figure and noise temperature.

3.0 Transmitters and Receivers.

Specifications of transmitters- AM Transmitters - high level modulated AM transmitter - low level modulated AM Transmitter -FM Transmitters - Indirect method of FM transmitter (Armstrong method)- Classification of radio receivers- Sensitivity - Selectivity and Fidelity- TRF receiver and its limitations-Super heterodyne receiver - image frequency - IMRR- choice of IF- AVC – Practical AM detector –FM receiver- Foster-Seeley discriminator.

4.0 Digital Communication Principles

Difference between analog and digital communication - Information capacity of channel-Sampling theorem - pulse modulation techniques – PAM – PWM – PPM - Quantization-Coding and decoding of PCM- Multiplexing techniques- need for Multiplexing –FDM- TDM- comparison of FDM and TDM.

5.0 Digital Modulation Techniques

Data encoding techniques - Asynchronous data communication- Synchronous data communication -Overhead efficiency – Error control methods – Parity check – Check sum- CRC — Hamming method – Digital modulation – bit rate - baud rate Digital modulation techniques- Binary ASK- BFSK- BPSK- QPSK- QAM – Constellation Diagram, Comparison of ASK, FSK, PSK, QAM-- Modems – need for modem – types of modems -DSL- ADSL modems.

REFERENCES

1. R. Blake, *Electronic Communications Systems*. Thomson Delmar Learning.
2. G. Kennedy and B. Davis, *Electronic Communication Systems*. New Delhi: Tata McGraw-Hill Education Pvt. Ltd.
3. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, *Signals, Systems and Communication*.
4. H. Taub and D. L. Schilling, *Principles of Electronic Communication Systems*, 3rd ed. New Delhi: McGraw-Hill Education (India) Pvt. Ltd., 2009.
5. G. K. Mithal, *Radio Communication*. New Delhi: Khanna Publishers.
6. T. L. Singhal, *Analog and Digital Communication*. New Delhi: McGraw-Hill Education.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.7
Unit Test-II	From 3.8 to 5.27

DIGITAL ELECTRONICS (PRACTICUM-THEORY)

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC303T	Digital Electronics	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Basics of Digital Electronics & Logic Families	20	22	2	2	CO1
2	Combinational Logic circuits.	20	25	3	2	CO2
3	Sequential Logic Circuits.	30	22	2	2	CO3
4	Semiconductor memories.	10	17	3	1	CO4
5	A/D & D/A Converters	10	14	2	1	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with various number systems, postulates of Boolean algebra, logic gates, logic circuits and Logic families
(ii)	analyse the working of logic gates, combinational and sequential circuits and memories
(iii)	learn the practical importance and applications of digital electronic circuits, A/D and D/A converters

COURSE OUTCOMES

CO1	EC303.1	Convert a number from one system to another system, implement logic circuits, analyse logic expressions and logic families
CO2	EC303.2	Design combinational logic circuits
CO3	EC303.3	Construct different sequential logic circuits
CO4	EC303.4	Describe different semiconductor memories
CO5	EC303.5	Explain the working of Analog to Digital Converters (ADC) and Digital to Analog Converters (DAC)

LEARNING OUTCOMES

1.0 Basics of Digital Electronics and Logic families

1.1 i) Explain Binary, Octal, Hexadecimal number systems.
ii) Convert a given decimal number into Binary, Octal, and Hexadecimal number and vice versa
iii) Convert a given binary number into octal and hexadecimal number and vice versa

1.2 Perform binary addition, subtraction, multiplication, and division.

1.3 i) Write 1's complement and 2's complement numbers for a given binary number.
ii) Perform subtraction of binary numbers in 2's complement method.

1.4 Compare weighted and Un-weighted codes.

1.5 Write Binary equivalent number for a number in Excess-3 and Gray Code and vice-versa.

1.6 State different postulates in Boolean algebra

1.7 State the De-Morgan's theorems

1.8 Explain the basic logic gates AND, OR, NOT gates with their truth tables

1.9 Explain the working of universal logic gates (NAND, NOR gates) with truth tables

1.10 Explain the working of an Exclusive–OR gate with truth table

1.11 Realize AND, OR, NOT operations using NAND, NOR gates

1.12 Explain standard representations for logical functions (SOP and POS form)

1.13 Write Boolean expressions from the given truth table

1.14 Simplify Boolean Expression using Karnaugh map (up to 3 variables)

1.15 Classify logic families

1.16 List the important characteristics of Digital ICs of different logic families.

1.17 Define the terms: propagation delay, Noise margin, Fan-in, Fan-out, and Power dissipation of digital ICs.

1.18 Explain the working of totem- pole output TTL NAND gate with circuit diagram.

1.19 Explain the working principle of CMOS Technology with diagram

1.20 Explain the working of CMOS NAND and CMOS NOR Gates with circuit diagram.

Lab experiments

1.21 Verify the Truth tables of all Logic gates

1.22 Realize the basic gates with the help of universal gates

2.0 Combinational logic circuits

2.1 State the concept of combinational logic circuit.

2.2 i) Explain Half adder circuit using Ex-OR, AND gates
ii) Realize Half-adder using NAND & NOR gates.

2.3 i) Explain the operation of Full adder circuit with truth table using Ex-OR gate and basic gates.
ii)Realize full-adder using two Half-adders and an OR gate

2.4 Explain the working of 4 Bit parallel adder using full adders.

2.5 Explain the logic circuit of 4-bit 2's compliment adder/subtractor.

2.6 Explain 4x1 Multiplexer with logic circuit and its applications

2.7 Explain 1x4 De-multiplexer with logic circuit and its applications

2.8 Explain the working of 8x3 encoder

2.9 Explain the working of 3x8 decoder

2.10 Explain the working of BCD to decimal decoder

2.11 State the need for a tri-state buffer.

2.12 Draw the logic symbols of unidirectional/ bi-directional tri-state buffers.

2.13 Realize four-bit magnitude comparator

Lab experiments

2.14 Implement half adder and full adder circuits using TTL/CMOS gates and verify their truth tables
2.15 Verify the function of 4-bit magnitude comparator 7485 IC
2.16 Verify the function of 4-bit parallel adder 7483 IC
2.17 Verify the truth table of Multiplexer IC 74153/74151

3.0 Sequential logic circuits

3.1 State the concept of Sequential logic circuits.
3.2 Distinguish between combinational and sequential logic circuits
3.3 Explain NAND and NOR latches with truth tables.
3.4 i) State the necessity of clock in digital circuits
ii) Differentiate between level triggering and edge triggering
3.5 Explain clocked SR Flip flop using NAND gates.
3.6 State the need for preset and clear inputs.
3.7 i) Explain level clocked JK Flip flop (using SR Flip flops) with truth table.
ii) State race around condition in JK flipflops
3.8 Explain the logic circuits of D Flip flop and T Flip flops with truth tables
3.9 Explain the master slave JK Flip flop with necessary diagrams.
3.10 Draw the symbols of edge triggered D and T Flip flops.
3.11 List the applications of Flip flops.
3.12 Define the term modulus of a counter.
3.13 i) Explain the working of 4-bit asynchronous counter with circuit diagram and timing diagram.
ii) Explain the working of asynchronous decade counter with circuit diagram and timing diagram.
iii) Explain the working of asynchronous 3 bit up-down counter with circuit diagram.
3.14 Explain the working of 4-bit synchronous counter with circuit diagram.
3.15 Distinguish between synchronous and asynchronous counters.
3.16 i) State the necessity of Registers and classify registers based on data i/o operations
ii) Explain the working of 4-bit shift left register with circuit diagram
iii) Explain the working of 4-bit shift right register with circuit diagram.
iv) List any four common applications of shift registers.

Lab experiments

3.17 Verify the truth tables of Flip flops (IC 7474 and IC 7476)
3.18 Verify the function of shift register (ICs like 7495)
3.19 Verify the function of 7490 as decade counter
3.20 Verify the function of 741183 as up/down counter

4.0 Semiconductor memories

4.1 Classify different types of semiconductor memories
4.2 Define the terms: i) memory read operation, ii) memory write operation, iii) access time, iv) memory capacity, v) address lines, and vi) word length related to memories
4.3 Differentiate:
i) Read Only Memory & Read write memory
ii) Sequential access memory & Random Access Memory
4.4 Explain working of diode ROM with suitable circuit diagram
4.5 Distinguish between EEPROM and UVEPROM

4.6 Explain the working of basic dynamic MOS RAM cell with suitable circuit diagram
4.7 Compare static RAM and dynamic RAM
4.8 State the difference between Flash ROM and NV RAM
4.9 State the use of pen drive, SD Card, solid state hard disk.

Lab experiment

4.10 Verify the function of RAM IC 7489

5.0 A/D & D/A Converters.

5.1 State the need for A/D and D/A conversion.
5.2 Define the terms resolution, Accuracy, Monotonicity and settling time of D/A converter.
5.3 Explain D/A conversion using R-2R ladder network.
5.4 Explain A/D conversion using counter method.
5.5 Explain A/D conversion using successive approximation method
5.6 List IC numbers of any three ADCs
5.7 List IC numbers of any three DACs

List of Experiments

5.8 Design R-R ladder network and test its basic operation using digital inputs
5.9 Design and implement a counter type ADC using a counter and a DAC

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	1	1		1	3	1	
CO2	3	3	3	1	1			3	1	1
CO3	3	3	3	1	1			3	1	1
CO4	3	3			1		1	3	1	1
CO5	3	3	3	3	3		1	3	3	3
Average	3	3	2.5	1.5	1.4		1	3	1.4	1.5

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 Basics of Digital Electronics and Logic families

Number systems- Conversion from one number system to another number system- Binary Arithmetic-Weighted and un-weighted codes - parity Bit- Boolean algebra – Basic gates- Universal gates - De-Morgan's theorems-Realize AND, OR, NOT operations using NAND, NOR gates-SOP and POS forms-Write Boolean expressions from the given truth table-Karnaugh map (up to 4 variables)-Logic family-Classification of logic families- characteristics of logic families- CMOS working Principle- NAND/NOR Logic gates using CMOS Technology

2.0 Combinational logic circuits

Concept of combinational logic circuits- Half adder circuit - Full adder circuit - a 4 Bit parallel adder using full adders- 2's compliment parallel adder/ Subtractor circuit- Serial adder -Performance of serial and parallel adder- Operation of 4x1 Multiplexers- Operation of 1 to 4 de-multiplexer- applications- 8x3 Encoder - 3x8 decoder- applications - Tri-state buffer- working of simple tri state buffer -Types of tri-state buffers- 4 bit magnitude comparator.

3.0 Sequential logic circuits

Concept of Sequential logic circuits- NAND and NOR latches - Necessity of clock - Concept of level and edge triggering - Clocked SR flip flop circuit using NAND gates- Need for preset and clear inputs - Circuit of level Clocked JK flip flop (using S-R flip-flops) -Race around condition- Master slave JK flip flop circuit - edge triggered clocked D and T flip flops - Truth table, Circuit diagram - Symbols of above Flip Flops- Applications of flip flops-Modulus of a counter- 4-bit asynchronous counter - Asynchronous decade counter with a circuit - 4-bit synchronous counter –differences between synchronous and asynchronous counters- asynchronous 3 bit up-down counter – Need for a Register - Types of registers- 4 bit shift left and shift right registers - Applications of shift registers.

4.0 Semiconductor memories

Types of memories -Memory read operation, write operation, access time, memory capacity, address lines and word length- ROM and RAM- Diode ROM- EEPROM and UVEPROM- Dynamic MOS RAM cell- static RAM and dynamic RAM- Differences between Flash ROM and NV RAM – use of pen drive, SD card, solid state disk

5.0 A/D & D/A Converters.

Need for A/D and D/A conversion -Resolution, Accuracy, Monotonicity, and settling time of D/A converter - D/A conversion using R-2R ladder network - A/D conversion using counter method and successive approximation method - IC numbers of any three ADCs, DACs

REFERENCES

1. A. Malvino and C. Leach, *Digital Computer Electronics*, 3rd ed. New Delhi: Tata McGraw-Hill.
2. R. P. Jain, *Modern Digital Electronics*, 3rd ed. New Delhi: Tata McGraw-Hill.
3. R. L. Tokheim, *Digital Electronics: Principles and Applications*. New York: McGraw-Hill, 2008.
4. G. K. Kharate, *Digital Electronics*. Oxford: Oxford University Press.
5. M. M. Mano, *Digital Logic and Computer Design*. Delhi: Pearson Education, 2017.
6. R. A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, 4th ed. Upper Saddle River, NJ: Prentice Hall.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.4
Unit Test-II	From 3.5 to 5.9

ENGINEERING MATHEMATICS-II

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC304E	Engineering Mathematics-II	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/Unit title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
Unit – I: Applications of Definite Integrals						
1	Area of curves	4	7	1	½	CO1
2	Volumes of Solids of Revolution	3	4	0	½	CO1
3	Mean and RMS values	4	11	1	1	CO1
4	Numerical Integration	4	8	0	1	CO1
Unit – II: Differential Equations						
5	Introduction to Differential Equations	4	6	2	0	CO2
6	Solution of first order differential equations	6	14	2	1	CO2
7	Solution of second order homogeneous and non-homogeneous linear differential equations	5	14	2	1	CO2
Unit – III: Probability and Statistics						
8	Probability	5	14	2	1	CO3
9	Measures of Dispersion	6	14	2	1	CO3
10	Correlation	4	8	0	1	CO3
	Total	**45**	**100**	**12**	**8**	
			Marks	36	64	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	apply integral techniques to solve various engineering problems
(ii)	solve first-order and first-degree differential equations and second-order homogeneous and non-homogeneous linear differential equations
(iii)	analyse data using the concepts of probability and statistical techniques

COURSE OUTCOMES

CO1	EC304.1	Apply definite integrals in engineering applications
CO2	EC304.2	Solve first-order and first-degree differential equations and second-order homogeneous and non-homogeneous linear differential equations
CO3	EC304.3	Apply various probability and statistical techniques for data analysis

LEARNING OUTCOMES

1.0 Apply definite integrals in engineering applications.

1.1 Find the area bounded by a curve and axes.
1.2 Determine the volumes of solids of revolution along the x-axis.
1.3 Obtain the Mean and R.M.S values of simple functions.
1.4 Solve the problems of areas using Numerical Integration.

2.0 Solve first-order and first- degree differential equations and second-order homogeneous and non-homogeneous linear differential equations.

2.1 Define a Differential equation, its order and degree.
2.2 Find order and degree of a given differential equation.
2.3 Form a differential equation by eliminating arbitrary constants.
2.4 Solve the first order and first degree differential equations by variables separable method.
2.5 Solve linear differential equation of the form $\frac{dy}{dx} + \mathrm{P}y = \mathrm{Q}$, where P and Q are functions of x only or constants.
2.6 Solve Differential equations of the type $(aD^2 + bD + c)\, y = 0$ where a ($\neq 0$), b, and c are real numbers.
2.7 Define complementary function, particular integral and general solution of a non-homogeneous linear differential equation of second order with constant coefficients.
2.8 Describe the method of solving $f(D)y = e^{ax}$, where f(D) is a polynomial of second order.

3.0 Apply various probability and statistical techniques for data analysis.

3.1 Recall the basic probability principles.
3.2 State addition theorem of probability for two mutually exclusive and exhaustive events.
3.3 Solve simple problems on addition theorem.
3.4 Explain conditional event and conditional probability.
3.5 Solve simple problems on conditional probability.
3.6 Explain dependent, independent events and state multiplication theorem.
3.7 Solve simple problems on multiplication theorem.
3.8 Recall the measures of central tendency.
3.9 Explain the significance of measures of dispersion to determine the degree of heterogeneity of the data.
3.10 Find the measures of dispersion, Range, Mean Deviation and Standard Deviation for ungrouped data.
3.11 Explain the merits and demerits of these measures of dispersion.
3.12 Explain bivariate data.
3.13 Explain the concept of covariance and correlation between two variables.
3.14 Find Spearman's rank correlation coefficient.

CO/PO – MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	3				3	3	1
CO2	3	1	1	1				3	1	1
CO3	3	3	3	3				3	3	3
Avg.	3	2.33	2.33	2.33				3	2.33	1.66

Note: The gaps in CO/PO mapping can be met with appropriate activities as follows:

For PO5: Appropriate quiz programmes may be conducted at intervals and duration as decided by concerned faculty.

For PO6: Seminars on applications of mathematics in various engineering disciplines are to be planned and conducted

For PO7: Plan activities in such a way that students can visit the Library to refer standard books on Mathematics and access the latest updates in reputed national and international journals. Additionally, encourage them to attend seminars and learn mathematical software tools.

COURSE CONTENT

1. Applications of Definite Integrals:

Area bounded by a curve and axes. Volume of Solids of Revolutions. Mean and RMS values of a function on a given interval. Numerical Integration.

2. Differential Equations:

Definition of a differential equation, Order and degree of a differential equation, Formation of differential equations. Solutions of differential equations of first order and first-degree using variables separable method and linear differential equation of the type $\frac{dy}{dx} + \mathrm{P}y = \mathrm{Q}$ Solutions of homogenous and non-homogeneous linear differential equations of second order with constant coefficients.

3. Probability & Statistics:

Addition theorem of probability, conditional probability, dependent and independent events with multiplication theorem. Measures of dispersion, range, mean deviation and standard deviation of ungrouped data, merits and demerits. Bivariate data, correlation, Spearman's rank correlation coefficient.

TEXTBOOK

Engineering Mathematics-II, a textbook for second year third semester diploma courses, prepared & prescribed by SBTET, AP.

REFERENCES

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Schaum's Outlines Differential Equations, Richard Bronson & Gabriel B. Costa
3. Schaum's Outline: Introduction to Probability and Statistics, Seymour Lipschutz & John J. Schiller.
4. M.Vygodsky, Mathematical Handbook: Higher Mathematics, Mir Publishers, Moscow.

SUGGESTED E-LEARNING REFERENCES

1. https://www.khanacademy.org/
2. https://www.wolframalpha.com/
3. https://onlinecourses.nptel.ac.in/
4. http://tutorial.math.lamar.edu/

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II

Unit Test	Learning Outcomes to be Covered
Unit Test-I	1.1 to 2.5
Unit Test-II	2.6 to 3.14

SIGNALS AND SYSTEMS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC305E	Signals and Systems	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Basics of Integrations	07	14	2	1	CO1
2	Signals and their properties	06	25	3	2	CO2
3	LTI Systems and Laplace Transforms	12	25	3	2	CO3
4	Fourier analysis of Continuous time Signals	15	22	2	2	CO4
5	Sampling and Quantization	05	14	2	1	CO5
Total		**45**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	overview the mathematical requirements for the signal and system analysis, representation and classification of different types of signals continuous time, Discrete time, Periodic and aperiodic, energy and power signals
(ii)	understand processing of signals by the system, system properties (Linearity, Time invariance, Causality, and Stability)
(iii)	master the mathematical tools Fourier Analysis, Laplace Transform for analysing signals and systems in both time and frequency domain
(iv)	understand the Process of converting continuous time signals to Discrete time signals using Sampling and Quantization techniques

COURSE OUTCOMES

CO1	EC305.1	Overview the mathematical requirements for signal and system analysis
CO2	EC305.2	Understand different types of signals and different operations on them
CO3	EC305.3	Understand the LTI systems and to familiarize with Laplace Transforms
CO4	EC305.4	Familiarize with the concepts of Fourier analysis of continuous time signals
CO5	EC305.5	Understand the sampling and quantization process of continuous time signals

LEARNING OUTCOMES

1. Mathematical overview (Integrations)

1.1. Understand the concept of Indefinite integrals and list their properties
1.2. Familiarize with standard integral formulas for common functions
1.3. State the Different methods of evaluation of integrations and solve integrals
1.4. Understand the definite integrals and list their properties
1.5. List the Properties of Definite Integrals
1.6. Use the properties of definite integrals, simplify and practice the different Definite Integral problems
1.7. Solve problems on integrals with infinite limits

2. Signals and their properties

2.1. Define the signal and classify the different types of signals
2.2. Distinguish the continuous Time Signal and Discrete time signal
2.3. Explain the mathematical and graphical representation of basic elementary Continuous signals (Impulse Function, Step Function, Ramp, and Exponential signals)
2.4. Explain the mathematical and graphical representation of basic elementary discrete time signals like (Unit Impulse, Unit step, Ramp, and Exponential signals)
2.5. Explain the (i) Even and odd signals, (ii) Periodic and non-periodic signals, (iii) Energy and Power signals with examples
2.6. Explain the Basic Operations on signals (i) Amplitude Scaling, (ii) Time Scaling, (iii) Time shifting with examples

3. LTI Systems and Laplace Transforms

3.1. Define System
3.2. classify different systems, Linear/ non-linear, time variant/ time invariant, stable/unstable, causal/noncausal
3.3. Define LTI System
3.4. State the convolution theorem of a continuous time signals
3.5. State the properties of convolution
3.6. Define the Laplace transform
3.7. State the following properties of the Laplace transforms
  3.7.1. Linearity
  3.7.2. Time shifting
  3.7.3. Shifting in S-Domain
  3.7.4. Time scaling
  3.7.5. Convolution Property
  3.7.6. Differentiation in time domain, S-Domain

3.7.7. Initial and final value theorem

3.8. Write Laplace transforms of following functions: i) Delta function, ii) Unit step function, iii)Ramp function, and iv) Exponential function v) Sine and Cosine functions

3.9. State Inverse Laplace Transform

3.10 Explain the methods to find the Inverse Laplace Transform with simple example

4. Fourier Analysis of Continuous time Signals

4.1. State the need for Fourier series analysis of a periodic signal

4.2. State the Dirichlet's conditions for convergence of Fourier analysis

4.3. Evaluation of exponential and trigonometric coefficients for a continuous time periodic signal

4.4. Determine the Fourier series representation of the different periodic signals (square, triangular, and sawtooth)

4.5. Explain the Parseval's relation for continuous time periodic signals

4.6. State the Expression for Fourier Transform pair of a non-periodic signal and explain with example problems

4.7. State the following properties of the Fourier transforms

4.7.1. Linearity

4.7.2. Time shifting

4.7.3. Frequency shifting

4.7.4. Differentiation and Integration

4.7.5. Time and Frequency Scaling

4.7.6. Duality

4.8. Find the Fourier transform of the following signals and draw their spectra i)x(t)=δ(t), (ii)x(t)=u(t), (iii) $x(t) = e^{j\omega t}$, (iv) $x(t) = \sin(\omega t)$,(iv) $x(t) = \mathrm{Cos}\ (\omega t)$v)r(t)=k.t

4.9. Explain the Time convolution theorem

4.10. Explain the Frequency convolution theorem

5. Sampling and Quantization

5.1. Explain the basic principle of sampling

5.2. State and explain the Sampling theorem of a baseband signal

5.3. Distinguish between Under sampling, Over sampling, and Critical sampling

5.4. Define the Nyquist sampling rate

5.5. Explain the Aliasing distortion

5.6. Define the Quantization and state the need of Quantization of signals

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1				3	2	
CO2	3	3	2	1	2			3		
CO3	3	3	2	1	2			3		
CO4	3	3	2	1	2			3	1	
CO5	3	3	2	1	2			3		
Average	3	3	2	1	2			3	1.5	

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures,

(v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 Mathematical Overview (Integrations)

Indefinite integrals: Indefinite integrals and properties, standard integral formulas, methods of evaluation of integrations, simple problems, Definite Integrals: Definite Integrals and their Properties and simple problems.

2.0 Continuous time signals

Signals: Definition, Representation of elementary signals (impulse, step, ramp, sinusoidal, exponential)- Mathematical Operations on Signals: Time shifting, scaling, and inversion- Definitions: Signals, systems, and their interrelationship. Classification of Signals: Continuous-time vs. discrete-time, periodic vs. aperiodic, even/odd, energy/power, deterministic/random- Basic Operations on Signals: Amplitude scaling, time shifting, time reversal

3.0 LTI Systems and Laplace Transforms

Systems: Definition, classification (linear/nonlinear, time-invariant/variant, causal/non-causal, stable/unstable), basic system properties: Linearity, time-invariance, causality, stability. Laplace Transforms: definition, properties, system analysis, Impulse response, convolution and Inverse Laplace Transform

4.0 Fourier analysis of Continuous time signals

Fourier Series: Representation of periodic signals, trigonometric and exponential forms, Examples of periodic signals, Parseval's relation, Fourier Transform: Definition, properties, computation for various signals, Representation of aperiodic signals, convolution theorem, applications in system analysis.

5.0 Sampling and Quantization

Sampling, Sampling theorem, types of sampling, Nyquist rate, aliasing, ideal and flat top sampling, quantization-midrise and midtread.

REFERENCES

1. B. P. Lathi, *Signals, Systems and Communications*. Hyderabad: BSP Publications, 2013.
2. A. V. Oppenheim, A. S. Willsky, and S. H. Nawab, *Signals and Systems*, 2nd ed. New Delhi: Prentice Hall of India.
3. P. Ramesh Babu and R. Ananda Natarajan, *Signals and Systems*, 4th ed. Kolkata: Scitech Publications, 2011.
4. S. Haykin and B. Van Veen, *Signals and Systems*, 2nd ed. Hoboken, NJ: Wiley.
5. A. Rama Krishna Rao, *Signals and Systems*. New Delhi: Tata McGraw-Hill, 2008.
6. M. J. Robert, *Fundamentals of Signals and Systems*. New York: McGraw-Hill International Edition, 2008.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.5
Unit Test-II	From 3.6 to 5.6

COMPUTER HARDWARE AND SERVICING

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC306E	Computer Hardware and Servicing	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Motherboard	9	25	3	2	CO1
2	Computer Peripherals	9	14	2	1	CO2
3	Computer Accessories	8	14	2	1	CO3
4	PC assembly & Software Installation	9	25	3	2	CO4
5	PC servicing	10	22	2	2	CO5
Total		**45**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with Motherboard Components of PC
(ii)	familiarise with the computer peripherals and accessories
(ii)	understand PC assembly, software installation procedures and to learn about the troubleshooting concepts of PC/LAPTOP

COURSE OUTCOMES

CO1	EC306.1	Familiarize with Motherboard Components of PC
CO2	EC306.2	Familiarise with the computer peripherals
CO3	EC306.3	Familiarise with the computer accessories
CO4	EC306.4	Understand PC assembly, software installation procedures
CO5	EC306.5	Learn about the troubleshooting concepts of PC/LAPTOP

LEARNING OUTCOMES

1.0 Understand motherboard and its features

1.1 Draw the component layout of PC-AT motherboard and explain briefly about the function of each component
1.2 List different expansion slots available on the motherboard.
1.3 List the specifications of processor
1.4 Differentiate the key features and advantages of DDR5 compared to DDR4 memory.
1.5 List various SMPS power supply connectors used in PC-AT and State their use

1.6 State the benefits of integrated Wi-Fi 6E and Bluetooth 5.3 on motherboards.
1.7 List any four reasons for popularity of USB ports
1.8 List different USB standards supported by modern motherboards (USB 3.2, USB4, USB-C) and state their features

2.0 Comprehend the use of various computer peripherals

2.1 State the use of common input devices keyboard, mouse, scanner and webcam, touchpad, game controller.
2.2 State the use of common output devices monitor, printer, speaker and projector.
2.3 State important features of modern multimedia speakers.
2.4 Explain the working principle of an optical mouse and how it tracks motion.
2.5 List different types of storage peripherals (external HDD, SSD, USB drives, memory cards) and state their specifications.
2.6 Explain the working of Hard Disk Drive (HDD) and how data is accessed.
2.7 Explain the working of Solid State Drive (SSD) and how data is accessed.
2.8 List the uses and advantages of SSD in modern motherboards.
2.9 Compare the important features of Hard Disk drive (HDD) and Solid State Drive (SSD)
2.10 List the important specifications of LCD monitor.

3.0 Comprehend the use of various Computer Accessories

3.1 State the principle of working and use of different types of modern printers: Laser and 3D Printers.
3.2 State the use of scanner and compare Flatbed and Sheet-fed Scanners.
3.3 Define OCR (Optical Character Recognition) and explain how it converts images to editable text.
3.4 State the important features of Laptop computer.
3.5 Differentiate between a Desktop and a Laptop computer.
3.6 List important features and applications of Tablet (TAB).
3.7 Explain how the connectivity (pairing) is established between Bluetooth accessories (wireless keyboard, mouse and headphones) and Bluetooth enabled PC/Laptop.

4.0 PC assembly and software installation

4.1 Explain the steps in assembling a PC.
4.2 List the steps involved in editing of CMOS set up
4.3 Describe the process of formatting.
4.4 State the need for disk partitioning
4.5 Define Power OnSelf-Test (POST).
4.6 Explain the booting procedure.
4.7 Compare File Allocation Table (FAT) and NTFS.
4.8 Describe the structure and uses of Windows registry
4.9 Explain general steps involved in the installation of WINDOWS OS
4.10 State the need for installation of device drivers.

5.0 Understand PC/ LAPTOP Troubleshooting

5.1 State the role of POST (Power-On Self-Test) error beep codes in diagnosing PC startup problems.
5.2 List the steps involved in troubleshooting a system that does not power on.
5.3 Explain the procedure to address problems related to RAM detection and memory errors.
5.4 Explain the steps to resolve problems with unrecognized USB ports and peripheral devices.

5.5 Explain how to boot into Safe Mode and its significance in system troubleshooting.
5.6 List the steps to identify and resolve driver-related problems in Windows (graphics, network, and sound).
5.7 State the functions of Device Manager and Task Manager in performing basic system diagnostics.
5.8 Explain the steps to carry out disk clean-up, disk checking, and defragmentation.
5.9 List the basic procedures for troubleshooting connectivity issues with Wi-Fi and LAN.
5.10 Explain how to perform system restore and recovery using built-in Windows tools.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	2	3	2	1
CO2	3	2	2	2	1	1	2	3	2	1
CO3	2	2	2	2	1	1	2	3	2	1
CO4	3	3	3	3	1	2	2	3	3	2
CO5	3	3	3	3	2	2	3	3	3	2
Average	2.8	2.4	2.2	2.4	1.2	1.4	2.2	3	2.4	1.4

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. Understand motherboard and its features

Layout of PC-AT motherboard - specifications of processor- Expansion slots- Differentiate between DDR5, DDR4 memory- various SMPS power supply connectors - integrated Wi-Fi 6E and Bluetooth 5.3 - reasons for popularity of USB ports- USB standards

2. Comprehend the use of various computer peripherals

Input devices (keyboard, mouse, scanner, webcam, touchpad, and game controller) - output devices (monitor, printer, speaker, and projector)-modern multimedia speakers- optical mouse- storage peripherals (external HDD, SSD, USB drives, and memory cards)- Hard Disk Drive (HDD) -Solid State Drive (SSD) - specifications of LCD monitor.

3. Comprehend the use of various Computer Accessories

Modern printers: Laser, 3D Printers - scanner - OCR (Optical Character Recognition) - Laptop computer-Differentiate between a Desktop and a Laptop computer - Tablet (TAB)- Connectivity between Bluetooth accessories (wireless keyboard, mouse, and headphones) and Bluetooth enabled PC/Laptop.

4. PC assembly and software installation

Assembling a PC- Editing of CMOS set up- formatting - disk partitioning - POST- Booting procedure- File Allocation Table (FAT) and NTFS- Windows's registry- installation of WINDOWS OS -installation of device drivers.

5. **Understand PC/ LAPTOP Troubleshooting**

Role of POST (Power-On Self-Test) error beep codes- troubleshooting a system-RAM detection and memory errors- unrecognized USB ports and peripheral devices - boot into Safe Mode - identify and resolve driver-related problems in Windows -functions of Device Manager and Task Manager-disk clean-up, disk checking, and defragmentation - troubleshooting connectivity issues with Wi-Fi and LAN- system restore and recovery using built-in Windows tools.

REFERENCES

1. R. K. Prasad, *Troubleshooting and Maintenance of PC*. New Delhi, India: Khanna Book Publishing, 2019.
2. B. Govindarajalu, *IBM PC and Clones: Hardware, Troubleshooting and Maintenance*, 2nd ed. New Delhi, India: Tata McGraw-Hill Education, 2002.
3. S. S. Shinde and D. D. Shah, *Computer Hardware and Networking*. Pune, India: Nirali Prakashan, 2020.
4. K. L. James, *Computer Hardware and Maintenance*. New Delhi, India: PHI Learning Pvt. Ltd., 2017.
5. M. T. Savaliya and A. A. Shaikh, *Hardware and Troubleshooting*. Ahmedabad, India: Tech-Max Publications, 2021.
6. N. L. Bhagyashree and R. D. Pawar, "An Overview of Common Laptop Troubleshooting Problems and Their Solutions," *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, vol. 4, no. 1, pp. 100–104, Jan. 2019

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.3
Unit Test-II	From 3.4 to 5.10

BASICS OF DRONE TECHNOLOGY

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC307A	Basics of Drone Technology	2	30	-	-	-

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Introduction to Drones	6	CO1
2	Familiarization with core drone hardware and communication systems	18	CO2
3	Applications of Drones	6	CO3
	Total	**30**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	understand the basic concepts, evolution, types, subsystems, and regulatory aspects of drones
(ii)	familiarize with core drone hardware components, sensors, actuators, flight controllers, and communication systems used in drone operation
(iii)	understand various applications of drones across agriculture, surveillance, logistics, emergency response, defence, and emerging future trends

COURSE OUTCOMES

CO1	EC307.1	Familiarize with the need, operation and applications of Drones
CO2	EC307.2	Familiarize with core drone hardware and communication systems
CO3	EC307.3	Know about the applications of Drones

LEARNING OUTCOMES

1. Introduction to Drones

1.1. Define Drone and State the purpose of Drone
1.2. Explain the evolution of drones.
1.3. Classify different types of drones.
1.4. List the different applications of Drones.
1.5. Draw the basic functional block diagram of a typical Drone and explain the functions of major subsystems found in drones.
1.6. Explain the roles of pitch, yaw, and roll in drone movement using electronic controls.
1.7. List the common sensors used in drones.
1.8. State the working of inertial sensors (IMU) and their integration with the flight controller.
1.9. Explain the working of RF communication systems used in drone control.
1.10. Explain the rules and regulations related to the usage of Drones in India

2. Familiarization with core drone hardware and communication systems

2.1. State the need of drone frame and explain the structure and function of drone frames.
2.2. List different motors used in drones
2.3. Explain the working of drone motors and the role of propellers in generating lift and control.
2.4. What is flight controller used in drones and Explain the role of the flight controller in managing drone stability and orientation.
2.5. List different batteries used in drones.
2.6. State the function of power distribution boards (PDB) used in drones.
2.7. Explain the role and electronic integration of Electronic Speed Controllers (ESCs) with motors.
2.8. Explain the function of radio transmitters and receivers in drone operation.
2.9. Explain the importance of signal frequency and modulation in drone communication systems.
2.10. Explain the concept of line-of-sight control and signal range limitations in Drone communication systems.
2.11. Explain about the working of flight controller and ESC with receiver module.
2.12. Explain failsafe settings and signal loss handling mechanisms in drone electronics.
2.13. List different sensors and cameras used in Drones
2.14. State the use of GPS modules in drone navigation.
2.15. Explain the role of the Inertial Measurement Unit (IMU) in stabilizing drone motion.
2.16. Explain the function and application of LiDAR in altitude sensing and obstacle avoidance.
2.17. Explain the differences between FPV, HD, thermal, and multispectral cameras used in drones.

3. Applications of Drones

3.1. State the use of drones in agriculture for crop monitoring, pesticide spraying.
3.2. State the role of drones in aerial photography and cinematography for media, film production, and journalism.
3.3. State about the support of drones in surveying and mapping through photogrammetry and LiDAR for construction and land planning.
3.4. State the application of drones in emergency response such as search and rescue operations, fire detection, and disaster assessment.
3.5. Explain how drones are used in package delivery systems, including last-mile delivery in logistics and e-commerce.
3.6. Explain the military and defence uses of drones in surveillance, reconnaissance, and unmanned combat missions.
3.7. Explain the use of drones in smart cities for traffic monitoring, crowd management, and law enforcement.
3.8. Explain future trends in drone applications, including autonomous drones and swarm technology.

CO-PO/PSO MAPPING MATRIX

COs / POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	2	2	1	1
CO2	3	3	2	2	3	1	1	3	2	2
CO3	3	2	1	1	2	1	2	2	1	1
Average	3	2.33	1.33	1.33	2.33	1	1.66	2.33	1.33	1.33

COURSE CONTENT

1.0 Introduction to Drones

Drone-its purpose – evolution- classification- applications-basic functional block diagram - functions of different subsystems- roles of pitch, yaw, and roll in drone movement using electronic controls-common sensors used in drones-working of inertial sensors (IMU) and their integration with the flight controller- RF communication systems -drone control-rules and regulations related to the usage of drones in India

2.0 Familiarization with core drone hardware and communication systems

Drone frame- structure and function-different motors and their role in generating lift and control-flight controller and its role- different batteries used in drones- power distribution boards (PDB) used in drones- Electronic Speed Controllers (ESCs) with motors- radio transmitters and receivers in drone operation- signal frequency and modulation- the concept of line-of-sight control and signal range limitations in Drone communication systems- working of flight controller and ESC with receiver module-failsafe settings and signal loss handling mechanisms - different sensors and cameras - use of GPS modules.- role of the Inertial Measurement Unit (IMU) in stabilizing drone motion- function and application of LiDAR in altitude sensing and obstacle avoidance-differences between FPV, HD, thermal, and multispectral cameras used in drones.

3.0 Applications of Drones

Application- drones in agriculture for crop monitoring, pesticide spraying- in aerial photography- in surveying and mapping-applications of drones in emergency response-in package delivery systems, logistics and e-commerce- military and defence - use of drones in smart cities for policing- future trends in drone applications.

REFERENCES

1. R. K. Tripathi, *Drone Technology and Applications*, New Delhi, India: Khanna Publishing House, 2021.
2. A. S. Pillai, *Unmanned Aerial Vehicles: Principles, Design, and Applications*, New Delhi, India: Universities Press (India) Pvt. Ltd., 2020.
3. R. K. Sharma and A. Singh, *Drone Technology: A Practical Approach*, New Delhi, India: BPB Publications, 2021. [eBook available]
4. M. P. Pandya, *Drone Engineering: UAV Technology, Design and Applications*, Ahmedabad, India: Technical Publications, 2022. [eBook available]
5. N. B. Kolhatkar, *Fundamentals of Drone Technology*, Pune, India: NiraliPrakashan, 2021.
6. R. A. Khan, *Drone Technology: Fundamentals and Applications*, New Delhi, India: S. Chand Publishing, 2023. [eBook available]

ELECTRONIC CIRCUITS LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC308L	Electronic Circuits Lab	6	90	2	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Rectifiers, Power supplies and wave shaping circuits	21	CO1
2	Amplifiers and oscillators	18	CO2
3	FET characteristics and OP-AMP circuits	24	CO3
4	Circuit simulation using Pspice or equivalent software	27	CO4
Total		**90**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	construct and measure various parameters of rectifiers, Power supplies and Wave Shaping Circuits
(ii)	construct and measure various parameters of Amplifiers and Oscillators
(iii)	test and obtain characteristics of FETs and OP-AMPs applications
(iv)	simulate clipper, clamper and OP-AMP circuits using simulation software

COURSE OUTCOMES

CO1	EC308.1	Construct the rectifiers and obtain different parameters. Construct clipper and clamper circuits and obtain the waveforms
CO2	EC308.2	Construct the Amplifiers and obtain different parameters. Construct Oscillators, obtain output waveform and calculate output frequency
CO3	EC308.3	Test, obtain characteristics of FETs andConstruct the Circuits using OP-AMP and observe the waveforms
CO4	EC308.4	Pspice or equivalent software simulation

LEARNING OUTCOMES

1.0 Rectifiers, Power supplies and Wave Shaping Circuits

1. Obtain output waveforms and measure DC o/p voltage, ripple voltage of a Half –Wave rectifier with/ without filter at different loads and compare with that theoretical values

2. Obtain output waveforms and measure DC o/p voltage, ripple voltage of a centre-tapped full wave rectifier with/ without filter at different loads and compare with that theoretical values
3. Obtain output waveforms and measure DC o/p voltage, ripple voltage of a Bridge rectifier with/ without filter at different loads and compare with that theoretical values
4. Obtain the voltage regulation characteristics of IC regulator (78XX,79XX,LM317)
5. Construct i)Positive Clipper ii)Negative Clipper iii)Double sided clipper using diodes and observe the waveforms
6. Construct Clamper circuit using diode and observe the waveforms.

2.0 Amplifiers and Oscillators

7. Plot the frequency response characteristics of a RC coupled Amplifier
8. Construct RC Phase shift oscillator and verify the effect of varying the RC component values and observe the output waveforms on CRO
9. Implement Hartley oscillator and verify the effect of varying the tank circuit component values and observe the output waveforms on CRO.
10. Implement Colpitt's oscillator and verify the effect of varying the tank circuit component values and observe the output waveforms on CRO.
11. Construct Crystal oscillator and the observe output waveforms on CRO

3.0 Testing and obtaining characteristics of FETs and OP-AMPs

12. Obtain the Drain and mutual characteristics of N –Channel JFET.
13. Obtain the Drain and mutual characteristics of N –Channel MOSFET.
14. Implement and test 741 Op-Amp as a) Inverting amplifier, b) Non Inverting amplifier, and c) Voltage follower (Buffer) – observe the wave forms
15. Implement and test 741 Operation amplifier as a) summer, b) Differentiator, and c) Integrator
16. Implement Astable multivibrator using Op-Amp and observe the output waveform on CRO
17. Implement RC-phase shift oscillator Circuit using Op-Amp and observe the output waveform on CRO

4.0 Circuit simulation using PSPICE or equivalent software

18. Construct and test the Regulated Power Supply for any given DC voltage using 78XX/79XX
19. Construct i) Positive Clipper, ii)Negative Clipper, iii)Double sided clipper, and iv)Clamper using diodes and observe the waveforms
20. Simulate CE amplifier and observe the effect of disconnecting bypass capacitor.
21. Plot the frequency response characteristics of a transformer coupled CE Amplifier
22. Simulate a) Summer, b) Differentiator, c) Integrator, and c) Scale changer using Op-Amp
23. Simulate monostable multivibrator using OP-AMP.
24. Simulate Wien bridge oscillator circuit using OP-AMP and observe the effect of change in component values

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CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2		3	1	2
CO2	3	2	2	1	1	2		3	1	2
CO3	3	2	2	1	1	2		3	1	2
CO4	3	2	2	3			2	3	3	3
Average	3	2	2	1.5	1	2	2	3	1.5	2.25

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

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TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1 to 12
Unit Test-II	From 13 to 24

ANALOG AND DIGITAL COMMUNICATION SYSTEMS LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC309L	Analog and Digital Communication Systems Lab	4	60	1.5	40	60

TIME SCHEDULE

S. No.	Chapter/Unit Title	No. of Periods	COs mapped
1	Analog Communication	20	CO1
2	Digital Communication	20	CO2
3	Simulation of Analog Communication systems using PSPICE or equivalent software	10	CO3
4	Simulation of Digital Communication systems using PSPICE or equivalent software	10	CO4
	Total	**60**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarisation with analog and digital modulation and demodulation techniques
(ii)	simulate Analog and Digital modulation circuits using simulation software
(iii)	learn the practical importance of Analog and Digital modulation

COURSE OUTCOMES

CO1	EC309.1	Construct AM, FM, PAM, PWM, PPM modulation and demodulation circuits and observe waveforms
CO2	EC309.2	Construct PCM, ASK, FSK, PSK modulator and demodulation circuits and TDM, FDM circuits and observe the waveforms
CO3	EC309.3	Simulate Analog modulation circuits using P-spice or equivalent software
CO4	EC309.4	Simulate Digital modulation circuits using P-spice or equivalent software

LEARNING OUTCOMES

ANALOG COMMUNICATION

1. Conduct an experiment to observe AM waveform and determine Modulation index using CRO.
2. Conduct an experiment to observe FM waveform.
3. Verify and observe Pulse amplitude modulation and demodulation waveforms on CRO

4. Verify and observe Pulse Width modulation and demodulation waveforms on CRO
5. Observe pulse position modulation and demodulation waveforms on CRO

DIGITAL COMMUNICATION

6. Set up a Pulse code modulator/ Demodulator circuit and observe the waveforms.
7. Set up an ASK modulator and demodulator and observe the waveforms.
8. Set up an FSK modulator and demodulator and observe the waveforms
9. Set up a PSK modulator and demodulator and observe the waveforms
10. Perform an experiment on Time Division Multiplexing/ De-multiplexing circuit and observe the waveforms.
11. Perform an experiment on Frequency Division Multiplexing/ De-multiplexing circuit and observe the waveforms.

Simulation using PSPICE or equivalent software

12. Connect a circuit to generate AM waveform and determine Modulation index
13. Connect a circuit to generate FM waveform and determine Modulation index
14. Connect a circuit to generate Pulse amplitude modulation and observe the waveforms
15. Connect a circuit to generate Pulse Width modulation and observe the waveforms
16. Set up an ASK modulator and demodulator and observe the waveforms.
17. Set up an FSK modulator and demodulator and observe the waveforms.
18. Set up a PSK modulator and demodulator and observe the waveforms.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2		2	3		3	1	2
CO2	3	3	2		2	3		3	1	2
CO3	3	3	2	3			3	3	3	2
CO4	3	3	2	3			3	3	3	2
Average	3	3	2	3	2	3	3	3	2	2

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From Experiment 1 to Experiment 9
Unit Test-II	From Experiment 10 to Experiment 18

PROGRAMMING IN C& MATLAB (PRACTICUM -PRACTICAL)

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC310L	Programming in C & MATLAB	6	90	2	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	C Programming Basics	11	CO1
2	Conditional statements and Arrays	17	CO2
3	Strings, Functions & Pointers	17	CO3
4	Structures & Unions	8	CO4
5	MATLAB practice	37	CO5
	Total	**90**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with programming in C language and MATLAB
(ii)	understand the programming in C language and MATLAB
(iii)	learn the practical importance and applications of programming in C language and MATLAB

COURSE OUTCOMES

CO1	EC310.1	Practice the programs on basics of C Programming
CO2	EC310.2	Practice the programs on conditional statements and Arrays of C Programming
CO3	EC310.3	Practice the programs on strings, functions and pointers of C programming
CO4	EC310.4	Practice the programs on the structures and unions in C-Programming
CO5	EC310.5	Practice the MATLAB programs

LEARNING OUTCOMES

1.0 C Programming Basics

THEORY

1.1 Give the basic structure of C program
1.2 Mention the character set, keywords, datatypes and declaration & initialization of variables
1.3 List Assignment, Arithmetic, Relational, logical, bitwise logical, increment/decrement operators supported by C
1.4 Mention printf () and scanf () functions with examples

LAB ACTIVITIES

1.5 Practice sample programs

2.0 Conditional Statements and Arrays

THEORY

2.1 Describe the conditional expression
2.2 List the four conditional statements supported by C
2.3 Write the syntaxes of the following conditional statements and explain
   i. If
   ii. If.. else.
   iii. Nested if …else
2.4 Write the syntax of switch case statement and explain.
2.5 Write the syntaxes of the following iterative statements and explain
   iv. While
   v. do.. while
   vi. for

LAB ACTIVITIES

2.6 Write simple programs based on conditional statements.
   i) Write a program to find whether a given year is leap year or not
   ii) Write a program to find biggest of three numbers
   iii) Write a program to check whether a given number is even or odd by using bitwise logical operator
   iv) Write a program to check whether a given character is vowel or consonant by using switch case statement
   v) Write a program to perform arithmetic operations using switch case statement
2.7 Write programs based on iterative statements.
   i) Write a program to find sum of n natural numbers
   ii) Write a program to find sum of digits of a given number
   iii) Write a program to check whether a given number is Armstrong or not
   iv) Write a program to print fibonacci series using loops.
   v) Write a program to print even and odd numbers
   vi) Write a program to check whether a given number is prime number or not
   vii) Write a program to print prime numbers between two given numbers
   viii) Write a program to check whether a given number is PALINDROMEor not

2.8 i) Write a C program to find largest / smallest number in an array
   ii) Write a C program to sort the numbers in an array in ascending order
   iii) Write a C program to find sum of elements of an array
2.9 Write a C program to perform matrix addition/subtraction/Multiplication

3.0 Strings, Functions & Pointers

THEORY

3.1 Define String
3.2 State the use of function in C
3.3 Explain declaration of a function in program
3.4 State the use of return statement.
3.5 Explain passing of parameters to the function
3.6 Define a pointer.
3.7 Declare a pointer, assign a pointer, initialize a pointer
3.8 Differentiate address and dereferencing operators.

LAB ACTIVITIES

3.9 Practice different string manipulation functions strcat(),strcmp(),strcpy() and strlen()

3.10 Practice the operation of getchar(),getch(),getche() and putchar() functions
3.11 Practice simple programs on functions call techniques
3.12 Practice pointer arithmetic operations with examples

4.0 Structures & unions

THEORY

4.1 Define structure & union in C
4.2 Differentiate between structure and union
4.3 State the function of pre-processor directives in C

LAB ACTIVITIES

4.4 Practice the method of declaring, initializing a structure variable and accessing of members of a structure
4.5 Practice a program to read & print a book database consisting of Title of book, author, no. of pages, price as fields
4.6 Practice a program to find size of a structure
4.7 Practice the programs with conditional pre-processor directives.
4.8 Practice the programs with Unconditional pre-processor directives.

5.0 MATLAB practice

THEORY

5.1 Familiarize with basic structure of MATLAB
5.2 Distinguish between C & MATLAB

LAB ACTIVITIES

5.3 Practice the usage of
i) Rows and column vectors creation
ii) Ones, Rand, Zeros
iii) linspace operator
iv) clc,clear,who, whos commands
v) long assignment
vi) Format command
vii) Elementwise multiplication, division, power operations
viii) round, floor, ceil, abs, max, min, length, sort, sum, prod, mean, median, std commands
xi) input command

5.4 Practice the usage of
i) Array indexing
ii) Accessing array elements
iii) Finding the number of elements in array
iv) Adding array horizontally
v) Equally spaced 1D array
vi) Addition, subtraction and multiplication of matrices
vii) Determinant of matrices, identity matrix

5.5 Practice the programs with decision making statements :i) if…end statement, ii) if..else..end statement, and iii) if..elseif…else..endstatement used in MATLAB
5.6 Practice the programs with: i) while loop, ii) for loop used in MATLAB
5.7 Practice plot commands such as: i) plot(x,y, ii) fplot(), iii) title(), iv) xlabel(), v) ylabel(), vi) ezplot(), vii) subplot(), viii) bar(), ix) pie(), and x) ezsurf() in MATLAB

5.8 Practice plotting of line, exponential graph, parabola, circle, sinusoidal wave
5.9 Practice the plotting two exponential graphs using hold on command
5.10 Practice plotting 3 dimensional plots in MATLAB using plot3 command
5.11 Practice
i) Finding roots, derivative of polynomial using MATLAB
ii) Product, division of 2 polynomials using MATLAB

iii) Finding approximate value of definite integral using quad command
iv) Finding roots of nonlinear function using fzero

5.12 Practice
i) Creating function file in MATLAB
ii) Anonymous function in MATLAB
iii) Symbolic function syms & subs

5.13 Practice the usage of :
i) SIMULINK
ii) GUI

5.14 Practice
i) Capacitor charging and discharging simulation using Simulink
ii) Half wave, Full wave rectifiers simulation using Simulink
iii) Converting temperature from Celsius to Fahrenheit using Simulink
iv) Usage of hit crossing block in Simulink

5.15 Practice Digital clock using MATLAB GUI

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1			1			3	1	1
CO2	3	2	2		1			3	2	2
CO3	3	2	2		1			3	2	2
CO4	3	2	2		1			3	2	2
CO5	3	2	2	2	1		2	3	2	2
Average	3	1.8	2	2	1		2	3	1.8	1.8

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

REFERENCES

1. BalaguruSwamy.E, Programming in ANSI C, , 3rd Edition, TMH
2. Kamthane, Programming with ANSI and Turbo C, Pearson Education
3. Gottfried (Schaum Series), Programming in C, McGraw Hill
4. ReemaThareja, Programming in C by, Oxford university press.
5. YashwantKanetkar, Let us C, BPB Publication, New Delhi
6. Pratap,Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford University Press
7. Ram N.patel , Ankush mittal,Programing in MATLAB: aproblem solving approach , PERSON

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.9
Unit Test-II	From 3.10 to 5.15

IV SEMESTER

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
IV SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC401T	Microcontrollers and Interfacing	6	-	Y	90	4	3	30	70	100
26EC402T	Microwave and Satellite Communication	6	-	N	90	4	3	30	70	100
26EC403T	Industrial Electronics	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EC404E	Medical Electronics	3	-	N	45	2	3	30	70	100
26EC405E	Python Programming									
26EC406E	Swayam Course in Emerging Technologies with 2 Credits	-			-		-	-	-	-
AUDIT COURSE										
26EC407A	Artificial Intelligence	2	-	N	30					
PRACTICAL COURSES										
26EC408L	Communication and Employability Skills		4	Y	60	2	3	40	60	100
26EC409L	Industrial Electronics Lab		6	N	90	2	3	40	60	100
26EC410L	IOT and Sensors Lab		6	N	90	1.5	3	40	60	100
26EC411C	Student Centric Activities		3	-	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26EC408L is common laboratory to all programmes.

MICROCONTROLLERS AND INTERFACING (PRACTICUM-THEORY)

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC401T	Microcontrollers and Interfacing	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Architecture of Microcontroller 8051	20	22	2	2	CO1
2	Instruction set of 8051 microcontrollers	20	25	3	2	CO2
3	8051 Programming Concepts	20	22	2	2	CO3
4	Interfacing Simple I/O devices	15	17	3	1	CO4
5	Programming in Embedded C	15	14	2	1	CO5
	Total	**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with various microcontrollers
(ii)	understand the programming and applications of 8051 microcontrollers
(iii)	learn the practical importance and applications of microcontrollers

COURSE OUTCOMES

CO1	EC401.1	Describe the Architecture of 8051 microcontroller
CO2	EC401.2	Explain the instruction set of 8051 microcontroller
CO3	EC401.3	Analyse 8051 programming for Arithmetic and Logical operations
CO4	EC401.4	Describe the Interfacing techniques of I/O devices with 8051 microcontroller
CO5	EC401.5	Analyse 8051 programming using Embedded C

LEARNING OUTCOMES

1.0 ARCHITECTURE OF MICROCONTROLLER 8051

1.1 List the features of microcontrollers.
1.2 Compare microprocessors and microcontrollers
1.3 State the details of 8051 microcontroller family chips

1.4 Draw the functional block diagram of 8051 microcontroller and state the function of each block
1.5 Draw the pin diagram of 8051 microcontroller and specify the purpose of each pin
1.6 Explain the internal memory organization of 8051 with suitable diagram
1.7 Explain the external memory organization of 8051
1.8 List various special function registers of 8051 and state their functions
1.9 Explain PSW register of 8051
1.10 Explain the SFRs associated with timer/counters of 8051
1.11 Explain the modes of operations of counters & timers in 8051
1.12 List the interrupts of 8051
1.13 Explain the SFRs associated with interrupts of 8051
1.14 Explain the SFRs associated with serial communication of 8051
1.15 List the modes of operation of serial communication with 8051
1.16 Describe various I/O ports of 8051

2.0 INSTRUCTION SET OF 8051 MICRO CONTROLLERS

2.1 State the need for an instruction set
2.2 Mention the instruction format of 8051
2.3 State the terms operation code, operand and illustrate these terms by writing an instruction
2.4 Define fetch cycle, execution cycle, and instruction cycle.
2.5 Distinguish between machine cycle and T-state.
2.6 Define the terms machine language, assembly language, and mnemonics.
2.7 Classify the 8051 instructions into one byte, two byte and three-byte instructions
2.8 Classify the 8051 instructions based on their function
2.9 List the various addressing modes of 8051and explain them with examples.
2.10 Explain various data transfer group of instructions of 8051 with examples
2.11 Explain various arithmetic instructions of 8051
2.12 State the effect of arithmetic operations on flags of 8051 with examples
2.13 Explain the logic instructions and recognize the status of flags for given data conditions
2.14 List various bit manipulation instructions of 8051 and illustrate with examples
2.15 Explain unconditional jump instructions of 8051
2.16 Explain conditional jump instructions of 8051
2.17 Explain CALL and RET instructions of 8051
2.18 State the use of NOP instruction of 8051

3.0 8051 PROGRAMMING CONCEPTS USING ASSEMBLY LANGUAGE

3.1 List the various symbols used in drawing flow charts
3.2 Write programs in 8051 assembly language to illustrate the application of data copy instructions
3.3 Write programs in 8051 assembly language to perform single byte and double byte addition and subtraction.
3.4 Write programs in 8051 assembly language which use jump instructions
3.5 Write a delay subroutine to introduce time delay of given time period (in milliseconds) without using 8051 internal timers.
3.6 Write a program to introduce time delay of given time period (in milliseconds) using 8051 internal timers.
3.7 Define a subroutine and state its use.
3.8 Explain the sequence of program when subroutine is called and executed.
3.9 Explain information exchange between the program counter and the stack and identification of stack pointer register when a subroutine is called and executed.
3.10 Illustrate PUSH, POP instructions with an example.
3.11 Define the term debugging a program
3.12 Explain the principles of single step and break point debugging techniques

LAB ACTIVITIES

3.13 Write and execute an ALP to perform Block move – 10 bytes of data from 0X30-0X39 to 0X40-0X49
3.14 Write and Execute an ALP to perform Block exchange – 10 bytes of data between 0X30-0X39 to 0X40-0X49
3.15 Write and execute an ALP to perform: Addition, subtraction, division, and multiplication of two 8-bit numbers
3.16 Write and execute an ALP to perform addition of two16-bit numbers
3.17 Write and execute an ALP to perform subtraction of two16-bit numbers
3.18 Write and execute an ALP to the find Smallest/Largest number in 10bytes of data stored from 0X30 to 0X39 and store the result in the next location i.e., 0X3A
3.19 Write and execute an ALP to find the 2's complement of given 8-bit number

4.0 INTERFACING SIMPLE I/O DEVICES

4.1 Explain the Interfacing concepts of push button switches and LEDs with 8051
4.2 Draw a diagram to connect an LED to a port pin and write an 8051-assembly language program to blink it with a given time delay.
4.3 Interface a common cathode/anode seven segment display with 8051 and write a program to display a given decimal number
4.4 State the functions of pins of 16×2 LCD module
4.5 List the instruction command codes for programming 16×2 LCD module
4.6 Explain Interfacing of 16×2 LCD module to 8051
4.7 Describe key bouncing problem and de-bouncing solutions
4.8 Write a program to make an LED connected to port pin P1.5, light up for specific time on pressing a switch connected to port pin P2.3
4.9 Write a Program to make an LED connected to pin P1.7 to blink at a specific rate

LAB ACTIVITIES

4.10 Execute a program to make an LED connected to port pin P1.5, light up for specific time on pressing a switch connected to port pin P2.3
4.11 Execute a Program to make an LED connected to pin P1.7 to blink at a specific rate
4.12 Interface a 7 segment LED display with 8051 microcontroller and write and execute a program to display a given decimal digit
4.13 Interface a small DC motor with 8051 and write a program to rotate the motor in clockwise/anti clockwise direction.
4.14 Interface a 4x4 Matrix Key Board and 16x2 LCD with 8051 and write and execute program to display key pressed on LCD display
4.15 Interface stepper motor with 8051 and write and execute a program to run the motor continuously
4.16 Interface 8051 with Relay to drive a lamp and write and execute a program to switch ON/OFF the lamp

5.0 PROGRAMMING USING EMBEDDED C

5.1 List the differences between C and Embedded C
5.2 List the reasons for writing programs in Embedded C
5.3 Explain the C data types for 8051
5.4 Write an 8051 C program to store the data in the accumulator
5.5 Write a program to load three numbers into Accumulator and send them to port 1
5.6 Write an 8051 C program to send values 00 – FF to port P1
5.7 Write an 8051 C program to toggle all the bits of P1 continuously.
5.8 Write an 8051 C program to toggle bits of P1 ports continuously with 250 ms.

5.9 Write an 8051 C program to toggle all the bits of port P1 continuously with some delay in between. Use Timer 0, in 16-bit mode to generate the delay.

LAB ACTIVITIES

5.10 Execute an 8051 C program to send values 00 – FF to port P1
5.11 Execute an 8051 C program to toggle all the bits of port P1 continuously.
5.12 Execute an 8051 C program to toggle bits of port P1 continuously with 250 ms delay.
5.13 Execute a C program for 8051 to transfer the letter 'A' serially at 9600 baud continuously. Using 8-bit data and 1 stop bit.
5.14 Execute an 8051 C program to toggle all the bits of port P1 continuously with some delay in between. Use Timer 0, in 16-bit mode to generate the delay.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	2	3	2	1
CO2	3	3	2	2	1	1	2	3	3	1
CO3	3	3	3	2	1	1	2	3	3	1
CO4	3	3	3	3	1	1	2	3	3	2
CO5	3	3	3	3	1	1	3	3	3	2
Average	3	2.8	2.4	2.2	1	1	2.2	3	2.8	1.4

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. ARCHITECTURE OF MICROCONTROLLER 8051

Features of micro controllers - Compare Microprocessors and Microcontrollers - block diagram of 8051 microcontroller - pin diagram of 8051 microcontroller- internal memory & external memory organizations- various special function registers- PSW - SFRs, Counters & timers, interrupts in 8051 - Serial communication of 8051 - I/O ports of 8051.

2. INSTRUCTION SET OF 8051 MICROCONTROLLERS

Need for an instruction set - instruction format of 8051 - opcode, operand, machine cycle and T-state - major groups in the instruction set - various addressing modes of 8051 - data transfer, arithmetic, logical, branching and Boolean instructions - one byte, two byte and three-byte instructions - unconditional and conditional jump instructions - CALL and RET instructions - NOP instruction.

3. 8051 PROGRAMMING CONCEPTS

Various symbols used in drawing flow charts - programs in mnemonics to illustrate the application of data copy instructions - programs to perform single byte - double byte and multi byte addition and subtraction - the application of jump instruction in the program - program using delay subroutines - subroutine and its use - PUSH, POP instructions - single step and break point debugging techniques.

4. INTERFACING SIMPLE I/O DEVICES

Interfacing of push button switches and LEDs - seven segment display interface - functions of pins of LCD - Interfacing 16x2 LCD to 8051 - Program LCD in assembly language - Interfacing of a 4x4 Matrix Key Board - key bouncing problem and de-bouncing solutions.

5. PROGRAMMING USING EMBEDDED C

Introduction to Embedded C - Compare C and Embedded C - Data types - Embedded C Programs.

REFERENCES

1. M. A. Mazidi and J. G. Mazidi, *The 8051 Microcontroller and Embedded Systems Using Assembly and C*, 2nd ed. Delhi: Pearson Education.
2. K. J. Ayala, *The 8051 Microcontroller*. New Delhi: Thomson/Delmar Learning.
3. M. Predko, *Programming and Customizing the 8051 Microcontroller*. New Delhi: Tata McGraw-Hill.
4. A. V. Deshmukh, *Microcontrollers: Theory and Applications*. New Delhi: Tata McGraw-Hill.
5. S. Ghoshpal, *The 8051 Microcontroller: Instruction, Programming and Interfacing*. Delhi: Pearson Education.
6. K. Ayala, *The 8051 Microcontroller*, 3rd ed. New Delhi: Cengage Learning India.
7. R. Kapadia, *8051 Microcontroller and Embedded Systems*. Jico Student Edition

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.4
Unit Test-II	From 3.5 to 5.14

MICROWAVE & SATELLITE COMMUNICATION SYSTEMS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC402T	Microwave and Satellite Communication	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No.of Periods	Weightage of Marks	No. of Short Answer Questions	No of Essay Questions	COs Mapped
1	Transmission lines and Wave Propagation	20	21	3	1.5	CO1
2	Antennas	18	18	2	1.5	CO2
3	Microwave Components and Devices	25	25	3	2	CO3
4	RADARs	15	22	2	2	CO4
5	Satellite Communication System	12	14	2	1	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize the concepts of Microwave Engineering, Radar and Satellite communication systems
(ii)	equip with various issues related to Microwave Engineering, Radar and Satellite communication systems
(iii)	learn the practical importance and applications of Microwave Engineering, Radar and Satellite communication systems

COURSE OUTCOMES

CO1	EC402.1	Explain the transmission Lines and wave propagation
CO2	EC402.2	Interpret the Radiation patterns of various Antennas
CO3	EC402.3	Analyse various microwave components and devices
CO4	EC402.4	Analyse the Radar Engineering
CO5	EC402.5	Explain the principles of Satellite communication

LEARNING OUTCOMES

1.0 TRANSMISSION LINES AND WAVE PROPAGATION

1.1 List different types of transmission lines
1.2 Draw the electrical equivalent circuit of transmission line.
1.3 Write the transmission line equations and give their significance.
1.4 Define the primary and secondary constants of a transmission line.
1.5 Explain the significance of characteristic impedance and Propagation constant of a transmission line.
1.6 Derive the relation between Characteristic impedance, open circuit impedance and short circuit impedance of a transmission line.
1.7 Define reflection coefficient and standing wave ratio and give the relation between them.
1.8 Explain the concept of Reflection, Refraction, and diffraction of EM waves.
1.9 Explain the effect of refraction on wavefronts of an EM wave in the atmosphere (Tilting of wavefront)
1.10 Explain the Ground wave propagation with the equation for electric field at a distant place.
1.11 List the applications and limitations of ground wave propagation.
1.12 Classify different layers of ionosphere and briefly explain them.
1.13 Explain the ionospheric wave (sky wave) propagation
1.14 Define the terms
i) Critical Frequency, ii) MUF, iii) Skip Distance, and iv) Skip Zone
1.15 Explain the difference between Actual height and Virtual height of an Ionosphere.
1.16 Explain Space wave (tropospheric wave) propagation and factors affecting space wave propagation (LOS).
1.17 Explain the reason for formation of duct layer
1.18 Explain the duct propagation
1.19 Explain the Tropospheric Scatter Propagation.

2.0 ANTENNAS

2.1 Explain radiation mechanism of an antenna from transmission line theory.
2.2 State the following parameters of antenna
i. Radiation pattern
ii. Front-to -back ratio
iii. Directive gain
iv. Directivity
v. Power gain
vi. Beamwidth
vii. Bandwidth
viii. Antenna resistance: Radiation and Loss Resistance
ix. Antenna efficiency
x. Antenna aperture (Effective area)
xi. Antenna polarization
2.3 Explain Isotropic radiator.
2.4 Classify antennas based on i) Radiation pattern, ii) Frequency range.

2.5 Explain the function of dipole and folded dipole antennas and give their applications.
2.6 List different microwave antennas.
2.7 Explain different horn antennas and list the applications.
2.8 Explain the construction and working principle of Parabolic Dish antenna.
2.9 State the need for antenna arrays.
2.10 Explain about end-fire array and broadside array.
2.11 State the need for smart antennas.
2.12 List the main types of smart antennas (Switched beam and Adaptive array)
2.13 Explain the working principle of smart antennas.
2.14 List the applications and advantages of smart antennas.

3.0. MICROWAVE COMPONENTS AND DEVICES

3.1 Define microwave frequencies.
3.2 State the different microwave frequency bands and their applications.
3.3 State the function of waveguides and classify them.
3.4 Explain the concept of wave propagation in rectangular waveguide.
3.5 Explain the reason for the non-existence of TEM mode in a waveguide.
3.6 Define TE (Transverse Electric) Mode and TM (Transverse Magnetic) Mode.
3.7 Define the terms: i) dominant mode, ii) cut-off wavelength, iii) cut-off frequency, iv) phase velocity, and v) group velocity related to waveguides.
3.8 List different Microwave passive devices.
3.9 State the uses of T-junctions: i) E-Plane Tee, ii) H-Plane Tee, and iii) Hybrid Tee
3.10 State the uses of i) Microwave Bends, ii) Microwave tapers, and iii) Microwave Twist.
3.11 Mention the use of i) Microwave Isolator, ii) Microwave circulator.
3.12 Explain the construction and working of Reflex Klystron oscillator.
3.13 Explain the construction and working of Magnetron oscillator.
3.14 Explain the construction and working of Travelling Wave Tube amplifier.
3.15 List the applications of microwave tubes.
3.16 List different microwave solid state devices.
3.17 Explain the construction and working of Gunn diode.
3.18 Explain the construction and working of IMPATT diode.

4.0 RADARS

4.1 State the basic working principle of a RADAR.
4.2 Derive the free space RADAR range equation.
4.3 Explain the factors affecting range of a RADAR.
4.4 Classify RADARs.
4.5 Draw the block diagram of a pulse RADAR and explain the function of each block.
4.6 State the major advantages & disadvantages of a pulsed RADAR system.
4.7 State the need for duplexer.
4.8 List the various displays used in RADAR.
4.9 Explain the Doppler Effect.
4.10 Draw and explain the block diagram of Continuous Wave (CW) RADAR.
4.11 Draw and explain the Moving Target Indicating (MTI) RADAR
4.12 Explain the concept of blind speed and give the formula for blind speed.
4.13 Write expression for blind speed and explain
4.14 List the applications of RADARs.

5.0 SATELLITE COMMUNICATION SYSTEM

5.1 State the need for satellite communication.

5.2 List the advantages of satellite communication system over terrestrial communication system.
5.3 Explain uplink and down link frequencies.
5.4 List various types of satellites (LEOs, MEOs and GEOs).
5.5 List the advantages of Geosynchronous satellites.
5.6 Draw and explain block diagram of a Satellite on board.
5.7 Draw the block diagram of earth station and explain each block.
5.8 List the functions of the satellite transponder.
5.9 Mention different types of satellite transponders
5.10 Explain regenerative transponder with block diagram
5.11 List different frequency bands used for satellite communication systems
5.12 Explain the application of satellite in GPS (Global Position System) with suitable diagram.
5.13 Explain the application of satellite in Direct to Home (DTH) TV with suitable diagram.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3				1			3		1
CO2	3	2	1		2			3	1	
CO3	3	1	1		1			3		1
CO4	3	3	2	1	2			3		2
CO5	3	3	1	2	3		1	3	1	2
Average	3	2.25	1.25	1.5	1.8		1	3	1	1.5

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1 TRANSMISSION LINES AND WAVE PROPAGATION

Transmission lines-Primary and Secondary constants-transmission line equations--reflection coefficient-standing wave ratio-Ground wave propagation -Applications, limitations - layers of ionosphere -sky wave propagation- Actual height, Virtual height, Critical frequency - Maximum usable frequency- Skip distance, Skip zone (dead zone)-Space wave (tropospheric wave) propagation-Duct propagation & Tropospheric scattering

2 ANTENNAS

Radiation of EM waves from antennas- Isotropic radiator - Classify antennas - Antenna Parameters - dipole and folded dipole antennas-different microwave antennas- Horn antenna - Parabolic reflector – end fire array and Broadside array-smart antennas

3 MICROWAVE COMPONENTS AND DEVICES

Microwave frequencies - rectangular waveguides - TE (Transverse Electric) Mode and TM (Transverse Magnetic) Mode- T-junctions - Microwave Bends - Microwave tapers- isolator-circulator-Reflex Klystron - Magnetron- Travelling Wave Tube- microwave solid state devices - Gunn diode - IMPATT diode.

4 RADARS

Working principle of a RADAR- Radar Range Equation- Pulse Radar -need for duplexer – displays of RADAR-Continuous Wave (CW) Radar- Doppler Effect - Moving Target Indicating (MTI) Radar – blind speed – Applications of RADARs

5 SATELLITE COMMUNICATION SYSTEMS

Block diagram of a satellite on board- Advantages - block diagram of earth station- satellite transponders –application of satellite in GPS (Global Position System), Direct to Home (DTH) TV.

REFERENCES

1. F.E.Terman, Electronic and Radio engineering, McGraw Hill Publishers
2. George F Kenndy, Electronic communication system, McGraw Hill Publishers
3. Athanasios G.Kanatas, Athanasios D.Panagopopulos, Radio Wave Propagation and channel modelling for earth-space systems, CRC Press
4. Umesh Sinha, Networks and Transmission lines, Satya Prakashan, Tech India Publications, New Delhi, 2001.
5. Samuel Y. Liao, Microwave Devices and Circuits, Pearson Publishers
6. G.S.N. Raju, Microwave devices, I K International Publishing House Pvt. Ltd
7. E.V.D. Glazier and H.R.L. Lamont, Transmission and Propagation, The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.
8. K D Prasad, Antenna Theory, Satya Prakashan, Tech India Publications, New Delhi, 2001.
9. A.V. Bakshi, Transmission line and waveguides, Technical Publications, 2009

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.7
Unit Test-II	From 3.8 to 5.13

INDUSTRIAL ELECTRONICS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC403T	Industrial Electronics	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Power Electronic Devices	20	29	3	2	CO1
2	Inverters, SMPS, UPS & Battery Management	20	26	2	2	CO2
3	Transducers and Timers	22	29	3	2	CO3
4	Opto Electronic Devices	13	16	2	1	CO4
5	Control Systems	15	16	2	1	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	explain the principles and working of basic power electronic devices
(ii)	explain the principle and working of inverters, SMPS, and UPS, and describe the basics of battery management system
(iii)	explain the working of different transducers and describe the operation of IC 555 timer as an Astable Multivibrator
(iv)	explain the principle, working, and characteristics of optoelectronic devices
(v)	explain open-loop and closed-loop control systems and block diagram reduction techniques with examples

COURSE OUTCOMES

CO1	EC403.1	Describe Power Electronic Devices (SCR, DIAC, TRIAC, GTO SCR etc.)
CO2	EC403.2	Understand the principle of working of Inverters, SMPS, UPS, and Battery Management
CO3	EC403.3	Understand and the concept of different Transducers and Timers
CO4	EC403.4	Understand the concept of Opto Electronic Devices
CO5	EC403.5	Explain the open loop and closed loop control systems

LEARNING OUTCOMES

1.0 POWER ELECTRONIC DEVICES

1.1 List different thyristor family devices.
1.2 Sketch the ISI circuit symbols of SCR, SCS, SBS, SUS, DIAC, TRIAC, and GTO SCR
1.3 Explain the construction and working of SCR and its VI Characteristics
1.4 Mention the ratings of SCR
1.5 Explain the construction and working of GTO SCR
1.6 Explain construction and working of DIAC & TRIAC
1.7 Explain Volt-ampere characteristics of DIAC & TRIAC
1.8 Compare the features of SUS, SBS, SCS & LASCR
1.9 Explain the construction and working of UJT
1.10 Define intrinsic stand-off ratio and Negative Resistance Region of UJT
1.11 Explain SCR triggering using UJT
1.12 Explain the speed control of DC motor using SCR
1.13 List the applications of DIAC, TRIAC, & SCR

2.0 INVERTERS, SMPS, UPS, & BATTERY MANAGEMENT

2.1 State the need for inverters
2.2 State the principle of operation of inverter
2.3 Explain the working of MOSFET based Inverter circuit
2.4 Explain Voltage control of inverter using PWM
2.5 List the applications of inverters
2.6 Explain the working of SMPS with block diagram
2.7 List the applications of SMPS
2.8 Explain the working of Off Line UPS and Online UPS
2.9 List the applications of UPS
2.10 List various Batteries used in Industries and e-vehicles
2.11 State the importance of Battery Management
2.12 Explain the Battery management concepts used in e-vehicles
2.13 List various methods used for charging for Battery
2.14 Explain the working of a battery charging circuit.
2.15 Understand the various stages of charging Battery
2.16 Understand the concept of short circuit protection of Battery
2.17 Understand the concept of Overload protection of Battery
2.18 Understand the concept of deep Discharge protection of Battery

2.19 Understand the concept of Over Heat protection of Battery

3.0 TRANSDUCERS & TIMERS

3.1 Define the term transducer
3.2 Classify the different electrical/electronic transducers on the basis of principle of operation and applications.
3.3 List the different Resistive, Inductive and Capacitive transducers
3.4 Explain the working principle, construction, and applications of resistance strain gauge.
3.5 Explain the working principle, construction and, applications of potentiometric transducer.
3.6 Explain the construction and working of LVDT
3.7 State the concept of piezo-electric effect
3.8 Explain the construction and working of Piezo-electric transducer
3.9 Explain the construction and working of Thermocouple transducer
3.10 Explain the working principle of Accelerometer
3.11 Draw the pin diagram of 555 IC and state the function of each pin
3.12 Draw the internal block diagram of 555 IC and explain the function of each block.
3.13 Draw the circuit of Monostable multi-vibrator using 555 IC and explain its working
3.14 Draw the circuit of Bistable multi-vibrator using 555 IC and explain its working
3.15 Draw the circuit of an Astable multi-vibrator using 555 IC and explain its working

4.0 OPTO-ELECTRONIC DEVICES:

4.1 Explain the principle of LDR and list the applications of LDR.
4.2 Explain the structure, working principle and characteristics of LED.
4.3 List the applications of LED.
4.4 Explain the structure, operation and characteristics of photo diode.
4.5 Explain the structure, operation and characteristics of photo transistor.
4.6 List the applications of photo diode and photo transistor.
4.7 Explain the working of opto-coupler.
4.8 List the applications of opto-couplers.
4.9 Explain the working principle of LCD.
4.10 List the applications of LCD.

5.0 CONTROL SYSTEMS

5.1. Define system and Control system.
5.2. Classify control systems
5.3. Explain the basic block diagram of control system
5.4. Explain an open loop control system with block diagram.
5.5. Give examples for open loop control system.
5.6. Give three merits and demerits of open loop control.
5.7. Explain the closed loop system with the help of a block diagram.
5.8. Give Examples for closed loop system
5.9. Compare Open loop and closed loop control systems.
5.10. Define Transfer function
5.11. Explain block diagram reduction techniques.
   a) Reduce blocks in cascading
   b) Reduce blocks in parallel
   c) Reduce positive and negative feedback loops
   d) Move a summing point before or after a block
   e) move a pickoff(branch) point before or after a block correctly.
5.12. Solve simple problems using the above techniques

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3				1			3		1
CO2	3	2	1		2			3	1	
CO3	3	1	1		1			3		1
CO4	3	3	2	1	2			3		2
CO5	3	3	1	2	3		1	3	1	2
Average	3	2.25	1.25	1.5	1.8		1	3	1	1.5

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc

COURSE CONTENT

1. **POWER ELECTRONIC DEVICES**

Thyristor family devices- ISI circuit symbols - working of SCR-Two-transistor model of SCR and its VI Characteristics-ratings of SCR- working of GTO SCR- working of DIAC & TRIAC-Volt-ampere characteristics of DIAC & TRIAC-modes of TRIAC triggering-SUS, SBS, SCS & LASCR -construction and working of UJT-intrinsic stand-off ratio of UJT-negative resistance region of UJT-SCR triggering using UJT, Speed control of DC motor using SCR,applications of SCR,TRIAC and DIAC.

2. **INVERTERS, SMPS, UPS & BATTERY MANAGEMENT**

Need of inverters -MOSFET based Inverter circuit- PWM Voltage control of Inverter -SMPS with block diagram-applications of SMPS -Off Line UPS and Online UPS-Different Batteries used in Industry and E-vehicles- Battery charging & Battery management concepts

3. **TRANSDUCERS &TIMERS**

Introduction, classification of transducers, Resistive, Inductive, capacitive transducers, Strain gauge, Potentiometric transducer, LVDT. Piezoelectric effect, Piezoelectric transducer, Thermocouple transducer, accelerometers, pin configuration of IC 555, Functional block diagram, Monostable, Bistable, Astable multivibrators using IC 555 timer

4. **OPTO-ELECTRONIC DEVICES**:

Construction, working principle of LDR, LED, Photo Diode, Photo Transistor, LCD, Optocoupler and their applications

5. **CONTROL SYSTEMS**

Definition of system and Control system-open loop control system-merits and demerits of open loop control-closed loop system-comparison between open loop and closed loop control systems-Transfer function

REFERENCES

1. Bimbhra P.S, Power Electronics, Khanna Publishers Delhi
2. P.C.Sen., PowerElectronics, McGraw Hill Education, India
3. S.K.Bhattacharya, S.Chatterjee, Industrial Electronics and Control, McGraw Hill Education, India
4. Nagarath&Gopal, Control system Engineering, 5th edition, new age international Publishers
5. Muhammad H. Rashid, Power electronics (Devices, circuits & applications), 4th edition, PERSON
6. V.R Moorthi, Power electronics:Devices, circuits & Industrial applications, OXFORD Publications
7. Optoelectronics and photonics principles and practices, safa O.Kasap

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.5
Unit Test-II	From 3.6 to 5.12

MEDICAL ELECTRONICS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC404E	Medical Electronics	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Bio electric potentials	5	6	2		CO1
2	Bio-Electrodes and Bio-Recorders	10	25	3	2	CO2
3	Assist Devices	10	22	2	2	CO3
4	Imaging systems	10	25	3	2	CO4
5	Patient monitoring systems	10	22	2	2	CO5
Total		**45**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with Human body functioning
(ii)	familiarize with ECG, EEG and EMG, Defibrillator, Pace makers, Ventilators
(iii)	learn about Modern Imaging Techniques adopted in medical field
(iv)	study patient monitoring systems and electrical hazards and safety measures in medical field

COURSE OUTCOMES

CO1	EC404.1	Explain the generation of different bio electric potentials
CO2	EC404.2	Explain the working of ECG, EEG and EMG
CO3	EC404.3	Know the working of different human assist devices
CO4	EC404.4	Understand and working of imaging systems used in medical field
CO5	EC404.5	Awareness about electrical hazards while using medical instruments to patients and precautionary safety measures

LEARNING OUTCOMES

1.0 BIOMEDICAL SUBSYSTEM AND BIO ELECTRIC POTENTIALS

1.1 Describe various subsystems of human body
1.2 Describe the characteristics of human cell
1.3 Define resting potential and acting potential
1.4 Draw the waveform of acting potential and explain
1.5 Draw and explain bioelectric signal waveform
1.6 Explain the electrical potentials generated in brain, heart and muscle
1.7 List the components of medical instrumentation

2.0 BIO-POTENTIAL ELECTRODES AND BIO-MEDICAL RECORDERS

2.1 Mention the different types of amplifiers used in biomedical instrumentation and state their function.
2.2 State the need for a bio-potential electrode
2.3 Distinguish between electrode and transducer
2.4 Explain the electrode-electrolyte interface
2.5 Classify the Bio-potential electrodes.
2.6 Draw and analyze Electro Cardio Gram waveform
2.7 Explain various lead configurations used in ECG recording.
2.8 List the types of various electrodes used in ECG recording
2.9 Draw the block diagram of ECG recorder and explain
2.10 Draw and analyze Electro Encephalogram
2.11 List the types of various electrodes used in EEG recording.
2.12 Explain the working of EEG machine with a block diagram
2.13 Draw and explain Electromyogram
2.14 Mention various electrodes used in EMG measurements
2.15 Explain the working of EMG system with block diagram

3.0 HUMAN ASSIST DEVICES

3.1 Know muscle simulators
3.2 State the need for a Defibrillator
3.3 Classify Defibrillators
3.4 Explain the working principle of DC & AC Defibrillators.
3.5 List the advantages of DC Defibrillators over AC Defibrillators.
3.6 List the precautions to be taken while handling defibrillators
3.7 Explain the defibrillator analyser
3.8 State the need of a Cardiac Pacemaker.
3.9 Classify Pacemakers on various aspects.
3.10 Mention the modes of operation of Pace maker and explain its working
3.11 Describe Diathermy
3.11 Explain short wave and Ultrasonic Diathermy
3.12 State the use of respirators and ventilator

4.0 UNDERSTAND WORKING AND APPLICATIONS OF IMAGING SYSTEMS

4.1 List the different types of Biomedical imaging systems.
4.2 Describe the function of X-ray unit
4.3 List the applications of X-ray machine
4.4 List the features of portable X-ray machine.
4.5 Describe Radiography

4.6 Describe the method for Computerized Tomography (CT)
4.7 Describe the working of ultrasound diagnostic system
4.8 Describe the working of Magnetic Resonance Imaging
4.9 List the applications of MRI
4.10 State the need of PET scan.

5.0 UNDERSTAND PATIENT MONITORING SYSTEMS

5.1 State the principle of Biotelemetry.
5.2 Explain patient monitoring in ICU and draw the system of arrangement
5.3 Draw information transfer system and explain
5.4 List the common remote patient monitoring devices
5.5 Know the medical features of smart watch.
5.6 Explain the principle of measuring the blood pressure and heart beat using smart watch
5.7 State the use of glucometer and mention its uses.
5.8 Explain the principle of Pulse Oximeter
5.9 Explain the physiological effects of electrical current
5.10 Mention effects of macro and micro shock
5.11 Mention preventive measures to reduce shock hazards
5.12 Describe telemedicine

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1							1	
CO2	3	1	2		1			3	1	3
CO3	3	1						3		3
CO4	3	1						3		3
CO5	3	1						3		3
Average	3	1	2		1			3	1	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 BIOMEDICAL SYSTEM AND BIO ELECTRIC POTENTIALS

Human body as one system –sub systems-man-Instrument System-Human Cell-Origin of bio-electric potential and propagation of action potential-resting potential-typical waveform of action potential-bio electric signal waveform-period and voltage range

2.0 BIO-POTENTIAL ELECTRODES AND BIO-MEDICAL RECORDERS

List of types of amplifiers used in biomedical instrumentation- bio-potential electrode-need-Distinguish between electrode and transducer-electrode-electrolyte interface-types-Basics of ECG--ECG waveform-Electrodes for ECG-ECG system blocks and

working-Treadmill Test-Basics of EEG-Electrodes for EEG-EEG system blocks and working- -The muscle action- EMG waveform- electrodes used in EMG measurements-EMG system block diagram-working.

3.0 HUMAN ASSIST DEVICES

Muscle Simulators-Defibrillator-classification- DC & AC Defibrillators-advantages of DC Defibrillators- Defibrillator analyzer- Cardiac Pacemaker- types of Pace makers-modes of operation of Pace makers –Diathermy- short wave and Ultrasonic Diathermy-respirators and ventilators.

4.0 IMAGING SYSTEMS

Types of imaging systems-X-rays-function, Applications-portable X-ray machine-features- Radiography- Computerized Tomography- ultrasound diagnostic system working- Magnetic Resonance Imaging-working, applications- need of PET scan

5.0 PATIENT MONITORING SYSTEMS

Biotelemetry- Intensive Care and Patient monitoring in ICU - system arrangement-information transfer system –remote patient monitoring devices-smart watch-features, measurement of blood pressure and heart beat-glucometer-uses-pulse oximeter-physiological effects of electrical current- major and minor shock-preventive measures to reduce shock hazards-maintaining safe environment- telemedicine

REFERENCES

1. K. M. van De Graaff, *Concepts of Human Anatomy and Physiology*, Subsequent ed. Dubuque, IA: William C. Brown Publishers, 1998.
2. G. J. Tortora and B. H. Derrickson, *Principles of Anatomy and Physiology*, 10th ed. Hoboken, NJ: John Wiley & Sons.
   Also: A. Wilson and M. Anne, *Ross and Wilson Anatomy and Physiology in Health and Illness*, 12th ed. London: Elsevier Health, 2014.
3. C. Raja Rao and S. K. Guha, *Principles of Medical Electronics and Biomedical Instrumentation*. Hyderabad: University Press.
4. J. J. Carr and J. M. Brown, *Introduction to Biomedical Equipment Technology*. Englewood Cliffs, NJ: Prentice Hall.
5. L. Cromwell, F. J. Weibell, and E. A. Pfeiffer, *Biomedical Instrumentation and Measurements*. New Delhi: PHI Learning.
6. M. Arumugam, *Biomedical Instrumentation*. New Delhi: Anuradha Publications.
7. J. G. Webster, *Medical Instrumentation: Application and Design*, 4th ed. Hoboken, NJ: Wiley, 2009.
8. R. S. Khandpur, *Handbook of Biomedical Instrumentation*, 3rd ed. New Delhi: McGraw-Hill Education.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.7
Unit Test-II	From 3.8 to 5.12

PYTHON PROGRAMMING

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC405E	Python Programming	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Introduction to Python and Basic Data Types	8	14	2	1	CO1
2	Lists, Tuples, and Dictionaries	9	25	3	2	CO2
3	Operators, Input/Output, and Control Structures	9	22	2	2	CO3
4	Functions and Argument Handling	8	14	2	1	CO4
5	Arrays and NumPy Library	11	25	3	2	CO5
Total		**45**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize students with Python programming and its syntax
(ii)	understand the fundamental concepts of Python including data structures, control flow, and functions
(iii)	develop the ability to solve real-world problems using Python, including applications of libraries such as NumPy

COURSE OUTCOMES

CO1	EC405.1	Describe the basic syntax, data types, and string operations in Python
CO2	EC405.2	Explain and apply Python data structures like lists, tuples, and dictionaries for data manipulation
CO3	EC405.3	Develop Python programs using operators, input/output functions, and control structures
CO4	EC405.4	Construct user-defined functions and utilize different types of arguments including *args and **kwargs
CO5	EC405.5	Create and manipulate arrays using NumPy and perform matrix operations in Python

LEARNING OUTCOMES

1.0 INTRODUCTION TO PYTHON AND BASIC DATA TYPES

1.1 Explain the basic features, simplicity, and applications of Python programming.
1.2 Justify why Python is widely used for general-purpose, high-level programming.
1.3 Demonstrate basic arithmetic operations such as addition, subtraction, multiplication, division, modulus, exponentiation, and floor division using Python operators.
1.4 Illustrate the use of the print() function to display messages or outputs in Python.
1.5 Define built-in data types in Python such as int, float, str, bool, and complex.
1.6 Identify string elements and subparts using indexing and slicing.
1.7 Apply built-in string methods like lower(), upper(), strip(), replace(), and split() for text manipulation.
1.8 Explain the use of the underscore _ in the Python interactive shell to access the last evaluated result.
1.9 Demonstrate type casting using int(), float(), str(), and bool() functions.
1.10 Use relational operators (==, !=, >, <, >=, <=) to compare values and return Boolean results.
1.11 Construct a set using the set data type to store unique, unordered elements.
1.12 Apply the id() function to retrieve the memory address of a variable.

2.0 LISTS, TUPLES, DICTIONARIES AND OPERATIONS

2.1 Define the list data type and state its properties such as ordered, mutable, and ability to store mixed data types.
2.2 Demonstrate how to use list methods like append(), insert(), and copy() for list manipulation.
2.3 Apply list methods like count() and index() to find occurrences and positions of elements.
2.4 Illustrate how to delete list elements using remove(), pop(), and del statement.
2.5 Use the extend() method to add multiple elements from another iterable to a list.
2.6 Apply methods such as sort(), min(), max(), clear(), and reverse() to modify and retrieve data from lists.
2.7 Explain the characteristics of the tuple data type and how it differs from lists.
2.8 List commonly used dictionary methods such as copy(), clear(), and get().
2.9 Use methods like keys(), values(), and pop() to access and remove dictionary items.
2.10 Construct a dictionary by combining two lists using the zip() function and dict() constructor.
2.11 Add new key-value pairs to an existing dictionary using assignment operations.
2.12 Access multiple values under a single key using lists or other collections in a dictionary.
2.13 Access data from nested dictionaries and retrieve inner values.
2.14 Create a new dictionary using the fromkeys() method with default values.
2.15 Demonstrate the use of popitem() to remove the last inserted key-value pair.
2.16 Apply the setdefault() method to fetch or insert a key with a default value.
2.17 Combine dictionaries using the update() method to merge key-value pairs.

3.0 OPERATORS, INPUT/OUTPUT, AND CONTROL STRUCTURES

3.1 Use the range() function to generate sequences of numbers for iteration.
3.2 Demonstrate the use of the assignment operator = to store values in variables.
3.3 Apply compound assignment operators like +=, -=, *=, /= for updating variable values.
3.4 Explain the usage of logical operators and, or, and not to form complex conditions.
3.5 Illustrate bitwise logical operations using &, |, ^, ~, <<, and >> on integers.
3.6 Convert numbers between binary, octal, decimal, and hexadecimal systems using built-in functions.
3.7 Apply the bitwise complement operator ~ to invert bits of an integer.
3.8 Use built-in mathematical functions (like sqrt(), pow(), round(), sin(), etc.) from the math module.
3.9 Demonstrate accepting input from the user using the input() function.
3.10 Convert string input to numeric data types using int() along with input().
3.11 Evaluate expressions entered by the user using eval() and input() together.
3.12 Use the sys.argv list to retrieve command-line arguments in a Python script.
3.13 Construct decision-making logic using if, elif, and else statements.
3.14 Develop loop structures using while loops to repeat execution based on a condition.
3.15 Write for loops to iterate over sequences such as lists, strings, or ranges.
3.16 Apply break and continue statements to control loop execution flow.
3.17 Use for loops with range() to iterate over a series of numbers with defined steps.
3.18 Develop logic using for loops and conditionals to identify even and odd numbers within a range.

4.0 FUNCTIONS AND ARGUMENT HANDLING

4.1 Define a function and illustrate how to call it in a Python program.
4.2 Pass arguments to a function to supply input values during execution.
4.3 Return multiple values from a function using tuples, lists, or dictionaries.
4.4 Explain Python's argument passing mechanism (pass-by-object-reference).
4.5 Pass a list as an argument to a function and perform operations like accessing or modifying elements.
4.6 Construct functions that accept a variable number of arguments using *args.
4.7 Develop functions that accept keyword variable-length arguments using **kwargs.
4.8 Display the dictionary of **kwargs items inside a function.
4.9 Declare global variables that can be accessed and modified inside and outside functions.
4.10 Differentiate between local and global scope in a function context.

5.0 ARRAYS AND NUMPY LIBRARY

5.1 Access and print individual elements of an array using indexing or iteration.
5.2 Create copies of arrays using slicing or the copy() function to avoid modifying the original.
5.3 Accept multiple values from the user and store them in an array using input functions.
5.4 Construct arrays using NumPy’s array() function for efficient numerical data handling.

5.5 Generate evenly spaced arrays using NumPy's linspace(), arange(), and logspace() functions.
5.6 Initialize arrays filled with zeros or ones using NumPy's zeros () and ones () functions.
5.7 Perform element-wise arithmetic operations (addition, subtraction, multiplication, division) on NumPy arrays.
5.8 Apply mathematical operations like square root, exponentiation, and scalar addition to all elements in a NumPy array.
5.9 Concatenate arrays using NumPy functions to merge multiple arrays into one.
5.10 Copy elements from one array to another using slicing or NumPy's copy() method.
5.11 Create a shallow copy using the view() method where changes reflect in both arrays.
5.12 Create a deep copy using the copy() method where changes do not affect the original.
5.13 Construct and manipulate multidimensional arrays (2D or higher) using NumPy.
5.14 Flatten multidimensional arrays into 1D using flatten() or ravel().
5.15 Reshape 1D arrays into multi-dimensional arrays using reshape() by specifying dimensions.
5.16 Use array.ndim, array.view(), and array.copy() to inspect and manipulate array dimensions and copies.
5.17 Convert 1D or 2D arrays into matrices using NumPy's matrix() function or structured 2D arrays.
5.18 Extract diagonal elements and find minimum and maximum values in matrices using diagonal(), min(), and max() functions.
5.19 Perform matrix addition, subtraction, and multiplication using NumPy functions and operators.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1			1			3	1	1
CO2	3	2	2		1			3	2	2
CO3	3	2	2		1			3	2	2
CO4	3	2	2		1			3	2	2
CO5	3	2	2	2	1		2	3	2	2
Average	3	1.8	2	2	1		2	3	1.8	1.8

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. INTRODUCTION TO PYTHON AND BASIC DATA TYPES

Features of Python – Applications – Advantages – Python as a general-purpose language – Python shell and script mode – Identifiers – Keywords – Variables and Constants – Data types: int, float, bool, str, complex – print() function – Arithmetic operators – Expression evaluation – Type casting – Relational operators – Memory

address using id() – Introduction to set – String indexing and slicing – String methods: lower(), upper(), strip(), replace(), split() – Using underscore _ in Python shell.

2. LISTS, TUPLES, AND DICTIONARIES

List: Definition – Creation – Indexing – Mutability – List methods: append(), insert(), copy(), count(), index(), remove(), pop(), del, extend(), sort(), min(), max(), clear(), reverse() – Tuple: Definition – Features – Accessing elements – Immutability – Dictionary: Creation – Accessing items – Methods: copy(), clear(), get(), keys(), values(), pop(), popitem(), setdefault(), fromkeys(), update() – Creating dictionary using zip() – Nested dictionaries – Accessing multiple values using lists inside dictionary.

3. OPERATORS, INPUT/OUTPUT, AND CONTROL STRUCTURES

Assignment operator – Compound assignment operators – Logical operators: and, or, not – Bitwise operators: &, |, ^, ~, <<, >> – Number system conversion – Math functions from math module – Input using input() – int() with input – eval() function – Command-line arguments using sys.argv – Conditional statements: if, if-else, elif – Loops: while, for, range() – Loop control: break, continue – Even/Odd number using loop and condition.

4. FUNCTIONS AND ARGUMENT HANDLING

Function definition and calling – Passing arguments – Returning values – Returning multiple values using tuple/list/dictionary – Argument passing: object-reference model – Passing lists to functions – Variable-length arguments: *args, **kwargs – Accessing **kwargs inside function – Global and local variables – Using global keyword – Scope of variables.

5. ARRAYS AND NUMPY LIBRARY

Array basics – Accessing and copying elements – Accepting multiple inputs into array – Creating arrays using array() – NumPy array creation methods: linspace(), arange(), logspace(), zeros(), ones() – Element-wise operations – Applying math functions – Concatenation – Shallow and deep copy: view(), copy() – Multidimensional arrays – Flattening and reshaping – Attributes like ndim – Matrix creation: matrix() – Matrix functions: diagonal(), min(), max() – Matrix operations: addition, subtraction, multiplication – Array-to-matrix conversion.

REFERENCES

1. K. Nageswara Rao and S. Akbar, *Python Programming*. Hyderabad: Scitech Publications (India) Pvt. Ltd.
2. V. Kurama, *Python Programming: A Modern Approach*. Delhi: Pearson Education.
3. M. Lutz, *Learning Python*. Sebastopol, CA: O'Reilly Media.
4. A. Downey, *Think Python*. Needham, MA: Green Tea Press.
5. W. J. Chun, *Core Python Programming*. Delhi: Pearson Education.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.8
Unit Test-II	From 3.9 to 5.19

SWAYAM COURSE IN ENGINEERING & TECHNOLOGY WITH 2 CREDITS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC406E	Swayam Course in Emerging Technologies with 2 Credits	-	-	2	-	-

Note: A student may opt for any SWAYAM course in Engineering & Technology worth 2 credits, with prior approval from the HoS.

ARTIFICIAL INTELLIGENCE

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC407A	Artificial Intelligence	2	30	-	-	-

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Introduction to Artificial Intelligence and Python Programming Basics	8	CO1
2	Eyes of Artificial Intelligence – Sensors and Data	6	CO2
3	Basics of Machine Learning (ML)	7	CO3
4	AI applications in Electronics and Communication Engineering	6	CO4
5	Ethics in AI, Future Scope of AI and Career awareness in AI	3	CO5
Total		**30**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	understand the basics of Artificial Intelligence and essential Python programming concepts
(ii)	acquire knowledge on Sensors, data and collection of data
(iii)	understand Basics of Machine Learning
(iv)	acquire knowledge on applications of AI in Electronics and Communication engineering
(v)	understand ethical issues, limitations, future scope, and career opportunities in AI

COURSE OUTCOMES

CO1	EC407.1	Understand the basic concepts, evolution, scope of Artificial Intelligence and apply basic Python programming for AI applications
CO2	EC407.2	Explain different types of data, sensors, and their role in AI-based systems, including basic data collection using microcontroller platforms
CO3	EC407.3	Understand the fundamentals of Machine Learning, including learning methods and simple ML algorithms
CO4	EC407.4	Identify and interpret major applications of AI and ML in Electronics and Communication Engineering domains

CO5	EC407.5	Describe ethical issues, limitations, future scope of AI, and explore career opportunities in the field of AI

LEARNING OUTCOMES

1.0 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

1.1 Define Artificial Intelligence (AI)
1.2 Explain Evolution of AI
1.3 List Features of AI & Goals of AI
1.4 List Differences between AI, Machine Learning (ML) and Deep Learning (DL)
1.5 List Different types of AI models
1.6 Explain the Impact of AI on various industries
1.7 List Different AI tools in the market and their use
1.8 Define Python and explain its importance in AI
1.9 Explain Python programming environment (IDLE / Anaconda / Jupyter)
1.10 Explain Python syntax, variables, and data types
1.11 Use operators, conditional statements, and loops
1.12 Explain Python data structures (list, tuple, dictionary)
1.13 Write simple Python programs for numerical computation and data handling

2.0 EYES OF ARTIFICIAL INTELLIGENCE – SENSORS AND DATA

2.1 Definition of Data
2.2 List types of Data
2.3 List Importance of Data in AI
2.4 List different types of Data Collection methods
2.5 Define Sensor
2.6 List Types of Sensors and their applications
2.7 Explain the Role of Sensors in AI
2.8 Simple practical on Collection of data using Arduino/Raspberry Pi with Sensors

3.0 BASICS OF MACHINE LEARNING (ML)

3.1 Define Machine Learning
3.2 Importance of ML in AI
3.3 Application of ML
3.4 List different Learning methods
3.5 Explain different Learning methods
3.6 List Simple ML Algorithms and their significance use in ML

4.0 AI APPLICATIONS IN ELECTRONICS AND COMMUNICATION ENGINEERING

4.1 Interpret the Role of AI &ML in Smart systems and Automation
4.2 Interpret the Role of AI &ML in Signal processing and Analysis
4.3 Interpret the Role of AI &ML in Communication systems
4.4 Interpret the Role of AI &ML in Embedded systems and IoT
4.5 Interpret the Role of AI &ML in Biomedical engineering
4.6 Interpret the Role of AI &ML in Security and fraud detection
4.7 Interpret the Role of AI &ML in Control systems & Robotics,
4.8 Interpret the Role of AI &ML in VLSI and Chip Design

5.0 ETHICS IN AI, FUTURE SCOPE OF AI AND CAREER AWARENESS IN AI

5.1 Explain Bias and Fairness in AI
5.2 List Privacy concerns of AI
5.3 List the essential Government regulations on use of AI
5.4 List the drawbacks of AI
5.5 List the Importance of development of responsible AI,
5.6 List the Future applications and advancements in AI
5.7 List the various Career opportunities in AI.

CO-PO/PSO MAPPING MATRIX

COs / POs / PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	2	1	1
CO2	3	2	2	2	3	1	1	3	2	1
CO3	3	3	2	2	3	1	1	3	3	2
CO4	3	2	2	2	3	1	2	3	3	3
CO5	2	2	1	1	2	3	3	1	1	1
Average	2.8	2.2	1.6	1.6	2.6	1.4	1.6	2.4	2	1.6

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Definition and evolution of AI, goals and features of AI, differences between AI, ML, and DL, types of AI models, impact of AI on industries, introduction to Python, Python programming environment, syntax, variables, data types, operators, conditional statements, loops, data structures, and simple Python programs for AI applications.

2.0 EYES OF ARTIFICIAL INTELLIGENCE – SENSORS AND DATA

Definition of Data, Types of Data, Importance of Data in AI, Data Collection methods, Sensors, Types of Sensors, Role of Sensors in AI, Collection of data using Arduino/Raspberry Pi with Sensors

3.0 BASICS OF MACHINE LEARNING (ML)

Definition of ML, Importance of ML in AI Application of ML, Learning methods and Overview, Simple ML Algorithms

4.0 AI APPLICATIONS IN ELECTRONICS AND COMMUNICATION ENGINEERING

Role of AI &ML in Smart systems and Automation, Signal processing and Analysis, Communication systems, Embedded systems and IoT, Biomedical engineering, Security and fraud detection, Control systems, Robotics, VLSI and Chip Design

5.0 ETHICS IN AI, FUTURE SCOPE OF AI AND CAREER AWARENESS IN AI

Bias and Fairness in AI, Privacy concerns, Government regulations, Misinformation and Deep fakes, Job displacements, Importance of development of responsible AI, Future applications and advancements in AI, Career in AI.

REFERENCES

1. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Hoboken, NJ: Pearson, 2021.
2. T. M. Mitchell, *Machine Learning*. New York: McGraw-Hill, 1997.
3. A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd ed. Sebastopol, CA: O'Reilly Media, 2023.
4. J. M. Hughes, *Arduino: A Technical Reference*. Sebastopol, CA: O'Reilly Media, 2016.
5. G. Halfacree and E. Upton, *Raspberry Pi User Guide*, 4th ed. Hoboken, NJ: Wiley, 2016.
6. S. Haykin, *Neural Networks and Learning Machines*, 3rd ed. Upper Saddle River, NJ: Pearson, 2008.

COMMUNICATION AND EMPLOYABILITY SKILLS (PRACTICUM -PRACTICAL)

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC408L	Communication and Employability Skills	4	60	2	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	ABC of Communication	6	CO1
2	Let's Learn to Listen	6	CO2
3	I am...	4	CO4
4	Let's Talk About...	4	CO4
5	JAM	6	CO4
6	Interpreting Data	6	CO3
7	Your Perfect Profile	4	CO5
8	Group Discussion	8	CO4
9	Interview Skills	8	CO5
10	Making Presentations	8	CO3
	Total	**60**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	impart verbal and non-verbal communication skills
(ii)	foster employability skills among the students for career building

COURSE OUTCOMES

CO1	EC408.1	Practice appropriate body language and etiquette
CO2	EC408.2	Listen and comprehend the listening inputs related to different genres effectively
CO3	EC408.3	Interpret data and give oral and written presentations in academic and professional contexts
CO4	EC408.4	Communicate effectively in interpersonal interactions, interviews, and group discussions
CO5	EC408.5	Exhibit employability skills: job hunting, resume writing, and attending interviews

LEARNING OUTCOMES

1.0 ABC of Communication

1.1. Understand and practice the process of communication.
1.2. Demonstrate appropriate body language traits for better communication.
1.3. Apply appropriate strategies to minimize various barriers of communication.
1.4. Communicate effectively in a given situation.

2.0 Let's Learn to Listen

2.1. Identify and distinguish different phonic sounds in English language.
2.2. Practice active listening techniques for better comprehension.
2.3. Comprehend diverse listening inputs in academic, professional and everyday situations using appropriate strategies.

3.0 I am...

3.1. Prepare an organised self-introduction for formal and informal situations.
3.2. Introduce yourself in job interviews effectively.
3.3. Demonstrate appropriate body language while introducing yourself.

4.0 Let's Talk About...

4.1. Describe objects, places, events and people using appropriate adjectives.
4.2. Use appropriate sentences and expressions while describing.
4.3. Use suitable adjectives to convey mood or tone.

5.0 JAM

5.1. Generate ideas on a given topic.
5.2. Organise the ideas sequentially for an effective JAM speech.
5.3. Speak spontaneously and fluently on a given topic within the stipulated time.

6.0 Data Interpretation

6.1. Understand different forms of graphs, charts, diagrams and tables.
6.2. Analyse and interpret data.
6.3. Present the inferences and findings in spoken and written communication.

7.0 Your Perfect Profile

7.1. Draft a customised professional resume.
7.2. Create a professional Applicant Tracking System (ATS) compliant Resume.
7.3. Draft a cover letter to communicate with prospective employers.

8.0 Group Discussion

8.1. Understand the significance of group discussion and differentiate the various stages involved.
8.2. Practice various roles and skills involved in group discussion.
8.3. Demonstrate appropriate body language for effective participation in group discussion.

9.0 Interview Skills

9.1. Practice proper interview demeanour.
9.2. Respond effectively to frequently asked interview questions (FAQs).
9.3. Demonstrate readiness for job opportunities.

10.0 Making Presentations

10.1. Practise the principles of good presentation.
10.2. Use appropriate presentational aids.
10.3. Prepare and give presentations on various topics effectively.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO1	POs 1 to 5 are not directly applicable to the English course.							Programme Specific Outcomes are branch-specific, with technical aspects that are not directly applicable to the English Language course.		
CO2										
CO3						2	2			
CO4						2	2			
CO5						2	2			
Average						2	2			

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

REFERENCES

1. T. Balasubramaian, "*A Textbook of English Phonetics for Indian Students"*, Macmillan (2009)
2. J.D. O'Connor, "*Better English Pronunciation"*, Cambridge (1980)
3. Anand. S. Ganguly, *Group Discussion for Admissions and Jobs* (2010)
4. E. Suresh Kumar and P. Sreehari, *Communicative English*, Orient Blackswan (2019)

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TEST I & II

Unit Tests	Learning Outcomes to be Covered
Unit test– I	From 1.1 to 5.3
Unit test – II	From 6.1 to. 10.3

INDUSTRIAL ELECTRONICS LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC409L	Industrial Electronics Lab	6	90	2	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Power electronic devices	30	CO1
2	Transducers & Timers	18	CO2
3	Opto- electronic Devices	18	CO3
4	UPS & Inverters	9	CO4
5	Programmable Logic Controllers	15	CO5
	Total	**60**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with power electronic devices
(ii)	familiarize with Transducers & Timers
(iii)	familiarize with Opto electronic devices
(iv)	familiarize with UPS & Inverters
(iii)	familiarize with PLCs

COURSE OUTCOMES

CO1	EC409.1	Plot V-I characteristics of Power Electronic devices
CO2	EC409.2	Plot the characteristics of Transducers & obtain the output waveform of an Astable Multivibrator
CO3	EC409.3	Plot V-I characteristics of Opto Electronic Devices
CO4	EC409.4	Study the performance of UPS & Inverter
CO5	EC409.5	Implementation of logic gates & counters using PLC

LEARNING OUTCOMES

I. POWER ELECTRONIC DEVICES

1. Perform an experiment to obtain VI characteristics of SCR
2. Perform an experiment to obtain VI characteristics of TRIAC
3. Perform an experiment to obtain VI characteristics of DIAC
4. Perform an experiment to obtain VI characteristics of UJT
5. Construct UJT relaxation oscillator circuit and observe the output waveforms on CRO
6. Construct a circuit to trigger SCR by UJT and control output Power
7. Conduct an experiment for speed control of DC motor using SCR

II. TRANSDUCERS & TIMERS

8. Obtain the performance characteristics of LVDT by conducting an experiment
9. Obtain the performance characteristics of thermocouple by conducting an experiment
10. Construct and verify the output waveforms of Monostable Multivibrator using IC 555
11. Construct and verify the output waveforms of Bistable Multivibrator using IC 555
12. Construct and verify the output waveforms of an Astable Multivibrator using IC 555

III. OPTO ELECTRONIC DEVICES

13. Obtain VI characteristics of photo diode.
14. Obtain the VI characteristics of Photo transistor.
15. Obtain VI characteristics of LDR.
16. Obtain VI Characteristics of a LED
17. Obtain the characteristics of a Opto-Coupler

IV. UPS & INVERTERS

18. Study the performance of a given UPS by connecting a lamp load and verify its automatic switchover functionality between AC mains and inverter mode
19. Measure and adjust the PWM waveform to control the output voltage of inverter.

V. PROGRAMMABLE LOGIC CONTROLLERS

20. Familiarise with PLC tutor or PSIM
21. Implement basic gates and universal gates using PLC tutor/PSIM
22. Implement XOR and XNOR gates using PLC tutor/PSIM
23. Implement a counter using PLC

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	3	3	3	3
CO2	3	2	3	2	3	2	3	2	3	3
CO3	3	3	2	3	2	1	3	3	3	3
CO4	3	2	2	3	3	1	2	3	3	2
CO5	2	2	3	3	3	1	2	2	3	3
Average	2.8	2.2	2.6	2.8	2.6	1.4	2.6	2.6	3	2.8

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TEST – I & UNIT TEST – II

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From Experiment 1 to 12
Unit Test – II	From Experiment 13 to 23

IOT AND SENSORS LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC410L	IOT and Sensors Lab	6	90	1.5	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Familiarize with Arduino Uno Board, Arduino IDE and Tinker cad	9	CO1
2	Basic Interfacing, Programming using Arduino Uno Board, Arduino IDE and Tinker cad	45	CO2
3	Familiarize with Esp8266 Board (or equivalent Board) and Blynk IoT	6	CO3
4	Basic Interfacing and programming using ESP8266 and Blynk IoT App	30	CO4
	Total	**90**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with Arduino Uno Board, Arduino IDE and Tinker cad
(ii)	practice and learn the concepts of Interfacing, Programming using Arduino Uno Board, Arduino IDE and Tinker cad
(iii)	familiarize with Esp8266 Board (or equivalent Board) and Blynk IoT
(iv)	practice and learn the concepts of basic Interfacing and programming using ESP8266 and Blynk IoT App

COURSE OUTCOMES

CO1	EC410.1	Demonstrate familiarity with the Arduino UNO board, its layout, Arduino IDE, and Tinkercad simulation environment
CO2	EC410.2	Apply the concepts of basic interfacing and programming using the Arduino UNO board through practical exercises on Arduino IDE and Tinkercad
CO3	EC410.3	Demonstrate understanding of the ESP8266 (or equivalent IoT board) and the Blynk IoT platform
CO4	EC410.4	Apply basic interfacing and programming concepts using the ESP8266 and Blynk IoT app for real-time IoT applications

LEARNING OUTCOMES

I. FAMILIARIZE WITHARDUINO UNO BOARD, ARDUINO IDE AND TINKERCAD

1. Familiarize with the Arduino UNO board by understanding the layout and functions of its key components, including the microcontroller, I/O pins, power ports, USB interface, and reset button.
2. Familiarize with the Arduino IDE by understanding its interface, features, and how to write, compile, and upload code to the Arduino board.
3. Familiarize with Tinkercad software to build simple Arduino based projects

II. INTERFACING, PROGRAMMING USING ARDUINO UNO BOARD, ARDUINO IDE AND TINKERCAD

4. Interface an LED with Arduino UNO by connecting it to a digital pin and write a program to turn it ON and OFF with a specific delay (Ex: one second)
5. Interface an LED and a switch with Arduino UNO by connecting them to digital I/O pins and write a program to turn it ON /OFF when switch is ON/OFF
6. Interface a seven-segment display and a push button switch with Arduino UNO and write a program to display number from 0 to 9. The number must be incremented each time when push button is pressed.
7. Interface a 16x2 LCD display and a 4x4 keypad with Arduino UNO, and write a program to display the key pressed on the LCD screen.
8. Interface PIR Sensor and a buzzer with Arduino Uno and write a program to turn on an LED or buzzer whenever motion is detected in the sensor's range.
9. Interface an analog potentiometer with Arduino UNO and glow the LEDs on LED bar graph based on the analog voltage reading.
10. Interface a DC motor and two push button switches with Arduino UNO, and write a program to rotate the motor clockwise when switch 1 is pressed and counter clockwise when switch 2 is pressed.
11. Interface a stepper motor and two push button switches with Arduino UNO, and write a program to rotate the motor clockwise in steps when switch 1 is pressed and counter clockwise in steps when switch 2 is pressed
12. Interface an 8x8 LED matrix with Arduino UNO and write a program to incrementally display alphabets (A to Z) on the matrix with each key press.
13. Interface a flame sensor and a buzzer with Arduino UNO to detect fire and trigger an alert when flame is detected.
14. Interface an LDR and an LED with Arduino UNO to turn the LED ON when light is detected and OFF when there is no light.
15. Use Tinkercad to build the practical exercises No 4. To 14 above and test them

III. FAMILIARIZE WITH THE ESP8266 BOARD(NODEMCU) AND BLYNK IOT

16. Familiarize with the ESP8266 Board (NodeMCU) by understanding the layout and functions of its key components, including the microcontroller, I/O pins, power ports, USB interface, and reset button.
17. Familiarize with Blynk IoT (or equivalent software) by understanding its interface, features, and how to create projects for remotely monitoring and controlling devices using a smartphone.

IV. BASIC INTERFACING, PROGRAMMING USING ESP 8266 AND BLYNK IOT

18. Interface a DHT11 sensor with ESP8266 to monitor temperature and humidity, and write a program to display the readings in real-time on the Blynk IoT app.

19. Interface an ultrasonic sensor with ESP8266 and write a program to measure the distance between the sensor and an obstacle, and display the calculated distance in centimetres on Blynk IoT app.
20. Interface a soil moisture sensor with ESP8266 to measure the percentage of soil moisture and display the readings in the Blynk IoT app.
21. Interface a temperature sensor with ESP8266 to turn on a fan when the temperature exceeds a threshold level, and monitor the status of both temperature and fan through on the Blynk IoT app.
22. Interface MQ-2 sensor with NodeMCU to detect gas leaks and transmit real-time data to on the Blynk IoT app.
23. Interface a relay module with ESP8266 to control appliances by turning the relay ON or OFF using a smartphone over Wi-Fi.
24. Control LED brightness using PWM by interfacing it with ESP8266 board and adjusting the brightness through a virtual slider on the Blynk app.
25. Interface with ESP8266 to Control a door lock (or simulate one using a servo motor) remotely via the Blynk app, and to read the real-time door status (open/closed) using a reed switch or limit switch**.**
26. Create a password-protected lock system using the ESP8266 (NodeMCU)**,** where a user enters a password via the Blynk app, and the ESP8266 verifies it to unlock a door (simulated using a servo motor or relay).
27. Monitor home safety by interfacing a smoke sensor, gas sensor, and motion sensor with an ESP8266 (NodeMCU) and display real-time alerts/statuses on the Blynk IoT app.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	2	3	2	1
CO2	3	3	3	3	1	1	2	3	3	2
CO3	3	2	2	3	2	1	3	3	3	2
CO4	3	3	3	3	3	2	3	3	3	3
Average	3	2.5	2.25	2.75	1.75	1.25	2.5	3	2.75	2

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TEST – I & UNIT TEST – II

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From Experiment 1 to 13
Unit Test – II	From Experiment 14 to 27

V SEMESTER

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
V SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods/ Semester	Credits	Scheme of Examination			
		Theory	Practical / Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26EC501T	Industrial Management and Entrepreneurship	6	-	N	90	4	3	30	70	100
26EC502T	Optical and Mobile Communications	6	-	Y	90	4	3	30	70	100
26EC503T	Data Communication and Computer Networks	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EC504E	PLC & SCADA	3	-	N	45	2	3	30	70	100
26EC505E	Embedded Systems									
26EC506E	Digital Signal Processing									
AUDIT COURSE										
26EC507A	Emerging Technologies in Electronics and Communication Engineering	2	-	N	30					
PRACTICAL COURSESS										
26EC508L	Data Communication and Computer Networks Lab		6	N	90	2	3	40	60	100
26EC509L	DLD Through Verilog HDL		6	Y	90	2	3	40	60	100
26EC510P	PROJECT WORK		4	N	60	1.5	3	40	60	100
26EC511C	Student Centric Activities		3	-	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note: 0.5 credits will be awarded for student centric activities based on the participation in the extracurricular activities like NSS/NCC/Clean and Green or Sports/ Games

INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC501T	Industrial Management and Entrepreneurship	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No.of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Basics of Industrial Management, Organization structure, & Organizational behaviour	15	22	2	2	CO1
2	Electronic Product design and Development stages	20	25	3	2	CO2
3	Electronic Product testing & documentation	20	25	3	2	CO3
4	Entrepreneurship Development	15	14	2	1	CO4
5	Industrial Safety and E-waste management	20	14	2	1	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize the concepts of management, ownership styles, organisation structure, and Industrial safety
(ii)	get exposure to organisational behavioural concepts, basics of electronic product design, development, testing, and documentation stages in electronic industries
(iii)	understand the concept entrepreneurship development in industries. role of MSME, industrial safety& E-waste management

COURSE OUTCOMES

CO1	EC501.1	Explain the basics of management, Organisation structure & Organizational behaviour as applied to industry
CO2	EC501.2	Explain Product Design and Development Stages applied to electronic industries

CO3	EC501.3	Analyse the testing standardisation for electronic products.
CO4	EC501.4	Describe the role of entrepreneur and MSMEs in economic development
CO5	EC501.5	Explain about Industrial Safety and E-waste Management

LEARNING OUTCOMES

1. Basics of Industrial Management, Organization Structure & organizational behaviour

1.1 Define Industry, Commerce (Trade) and Business.
1.2 State the need for Management.
1.3 State the functions of Management.
1.4 Explain the principles of scientific management.
1.5 Differentiate: i) management and administration.
ii) Supervisory, middle and top level management.
1.6 Explain the line, staff, and functional organization structures.
1.7 State motivation theories.
1.8 Explain Maslow's Hierarchy of needs.
1.9 List out different leadership models.
1.10 Explain the trait theory of leadership and behavioural theory of Leadership
1.11 Explain the process of decision making.
1.12 Explain the process of recruitment and selection.
1.13 Explain assessment of Human Resources requirements.
1.14 State the necessity of Employee participation.
1.15 Explain different types of Business ownerships and compare them.
1.16 Define social responsibilities and Corporate social responsibility.

2. Electronic Product design and Development stages

2.1 Explain the concept of product development with a block diagram.
2.2 Classify different types of Electronic Products.
2.3 Explain the Techno Commercial Feasibility of a product.
2.4 Explain customer requirements
2.5 Explain R&D prototype Assessment of reliability.
2.6 Explain factors for reliability of equipment.
2.7 Explain quality considerations.
2.8 List the reasons for failure of an electronic product.
2.9 Explain Bathtub curve.
2.10 Explain the concept of ergonomic and aesthetic considerations of pilot production.
2.11 Explain Product packaging and storage.
2.12 Estimate power supply requirements of an electronic product.
2.13 List two types of power supply protection devices.
2.14 Define noise reduction.
2.15 Explain grounding, shielding, and guarding techniques.
2.16 Explain Thermal management.

3. Electronic Product testing & documentation

3.1 State the importance of product testing and Environmental testing.
3.2 Explain dry heat testing, vibration testing, random testing, and bump testing.
3.3 Explain temperature extreme testing for linear and step stress profiles.
3.4 Explain vibration & temperature cycling.

3.5 Explain EMI and EMC compliance testing standardization.
3.6 Explain UL and CE Certification of industrial electronic products.
3.7 State the importance of documentation.
3.8 List different types of documentation.
3.9 Explain different types of documents.
3.10 List rules for preparation of effective document.
3.11 Explain PCB documentation.
3.12 Explain assembly and fabrication related documentation for laminate grade.
3.13 Explain the preparation of a manual document.
3.14 Explain the details of service manual.
3.15 Explain test report/manuals.
3.16 Explain product documentation, Bill of materials, Production test specifications.

4. Entrepreneurship Development.

4.1 Define the word entrepreneur.
4.2 Explain the requirements of an entrepreneur.
4.3 State the role of entrepreneurs in promoting Small Scale Industries.
4.4 Explain the details of self-employment schemes.
4.5 List the financial assistance programmes.
4.6 List out the organisations that help an entrepreneur.
4.7 Explain the use of EDP Programmes.
4.8 Explain the concept of make in India, zero defect, and zero effect.
4.9 Explain the importance for start-ups and incubators.
4.10 State need of MSMEs in the economic development of the nation.
4.11 State the Functions and objectives of MSMEs.
4.12 Explain the procedure to start an enterprise under MSME.
4.13 List the benefits of MSME registration in India.
4.14 State importance of feasibility study in project management
4.15 Explain the steps involved in Preparing feasibility study report

5. Industrial Safety and E-waste management

5.1 State the importance of safety in the industry.
5.2 Explain the principles of 5'S safety system.
5.3 Explain the major hazards which may arise from the use of electrical equipment
5.4 Explain the precautions to be taken to prevent accidents while using Machines
5.5 Explain method of first aid treatment for someone suffering from electric shock.
5.6 State general electrical safety rules
5.7 Draw the various electrical safety symbols and state their meaning.
5.8 Explain the causes of Fire and fire accidents in industry.
5.9 List four types of Portable fire extinguishers
5.10 Define E-waste and list the sources of E-waste
5.11 Explain the environmental risks of E-waste
5.12 State the need for E-waste management
5.13 Explain the process of E-waste recycling

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1							1		
CO2	3	2	3		2		2	3	2	2
CO3	3	2	3	3	2		2	3	2	2

CO4	1				1			1		3
CO5	3	2		2	2		0	2		2
Average	2.20	3.00	3.00	2.50	1.75		1.33	2.00	1.33	2.25

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. Basics of Industrial Management, Organisation Structure & organisational behaviour

Industry, commerce (trade), and business – concepts and definitions – need and importance of management – functions of management – principles of scientific management – management and administration: comparison – levels of management: supervisory, middle, and top level – organizational structures: line, staff, and functional organizations – motivation theories – Maslow's hierarchy of needs – leadership models – trait theory and behavioural theory of leadership – decision making process – recruitment and selection process – assessment of human resource requirements – employee participation: necessity and benefits – types of business ownerships and their comparison – social responsibility and corporate social responsibility (CSR)

2. Electronic Product design and Development stages

Concept of electronic product development – block diagram representation – classification of electronic products – techno-commercial feasibility analysis – customer requirements analysis – R&D prototype development and reliability assessment – factors affecting reliability of electronic equipment – quality considerations in product design – causes for failure of electronic products – bathtub curve and its significance – ergonomic and aesthetic considerations in pilot production – product packaging and storage methods – estimation of power supply requirements – power supply protection devices – noise reduction techniques – grounding, shielding, and guarding techniques – thermal management methods in electronic products

3. Electronic Product testing and Documentation

Importance of product testing and environmental testing – dry heat testing – vibration testing – random testing – bump testing – temperature extreme testing: linear and step stress profiles – vibration and temperature cycling tests – EMI and EMC compliance testing and standardization – UL and CE certification of industrial electronic products – importance of documentation – types of documentation – technical documents and their purpose – rules for preparation of effective documents – PCB documentation – assembly and fabrication documentation including laminate grades – preparation of manuals – service manuals – test reports and test manuals – product documentation including bill of materials and production test specifications

4. Entrepreneurship Development

Meaning and definition of entrepreneur – qualities and requirements of an entrepreneur – role of entrepreneurs in promoting small scale industries – self-employment schemes –

financial assistance programmes – organizations supporting entrepreneurs – entrepreneurship development programmes (EDPs) – concepts of Make in India, Zero Defect and Zero Effect – importance of start-ups and incubators – role of MSMEs in national economic development – functions and objectives of MSMEs – procedure for starting an enterprise under MSME – benefits of MSME registration in India – importance of feasibility study in project management – steps involved in preparing a feasibility study report

5. Industrial Safety and E-Waste management

Importance of safety in industries – principles of 5'S safety system – hazards associated with electrical equipment – precautions for accident prevention while using machines – first aid treatment for electric shock – general electrical safety rules – electrical safety symbols and their meanings – causes of fire and industrial fire accidents – types of portable fire extinguishers – definition and sources of E-waste – environmental risks associated with E-waste – need for E-waste management – process of E-waste recycling

REFERENCES

1. O. P. Khanna, *Industrial Engineering and Management*, 4th rev. ed., New Delhi: Dhanpat Rai, 1980.
2. E. S. Buffa and R. K. Sarin, *Modern Production/Operations Management*, 8th ed., New Delhi: Wiley, 1987.
3. T. R. Banga and S. C. Sharma, *Industrial Engineering and Management*, New Delhi: Khanna Publishing House.
4. T. R. Banga and S. C. Sharma, *Industrial Organization and Engineering Economics*, 25th ed., New Delhi: Khanna Publishers, 2006.
5. E. B. Flippo, *Personnel Management*, 5th ed., New York: McGraw-Hill, 1980.
6. S. N. Chary, *Production and Operations Management*.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.6
Unit Test-II	From 3.7 to 5.13

OPTICAL & MOBILE COMMUNICATIONS (PRACTICUM-THEORY)

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC502T	Optical and Mobile Communications	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No.of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Overview of Fibre Optic Communication	12	14	2	1	CO1
2	Fibre Optic components and Devices	20	18	2	1.5	CO2
3	Cellular system design fundamentals	20	25	3	2	CO3
4	Digital Cellular Mobile System and Multiplexing Techniques	20	25	3	2	CO4
5	Advanced Concepts in Digital Cellular Mobile system	18	18	2	1.5	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize the concepts of Fiber optic, Telephony, and Cellular communication systems
(ii)	equip with various issues related to Fiber optic, Telephony, and Cellular communication systems
(iii)	learn the practical importance, and applications of Fiber optic, Telephony and Cellular communication systems

COURSE OUTCOMES

CO1	EC502.1	Describe fiber optic communication techniques
CO2	EC502.2	Describe fiber optic components and devices
CO3	EC502.3	Analyze the cellular system design
CO4	EC502.4	Interpret Digital cellular systems and multiplexing Techniques
CO5	EC502.5	Describe the Advanced Digital cellular mobile systems

LEARNING OUTCOMES

1.0 Overview of Fibre Optic Communication

1.1 State the advantages of fiber optic communication system over EM wave systems.
1.2 Explain about different windows of wavelengths used in Fiber Optic Communication.
1.3 Explain the structure of optical fibre.
1.4 Explain the method of fiber drawing process.
1.5 Classify optical fibres based on refractive index profile.
1.6 List the types of fibres based on core diameter.
1.7 Define Single mode fibre (SMF) and multimode fibre (MMF)
1.8 Define Snell's law in optics.
1.9 Explain principle of light wave propagation in OFC.
1.10 Define critical angle and derive the its formula.
1.11 Define acceptance angle and cone of acceptance.
1.12 Derive the formula for acceptance angle.
1.13 Define numerical aperture (NA).
1.14 Derive the expression for NA in terms of refractive indices of core and cladding.

Lab Experiment

1.15 Demonstrate the procedure to measure NA of a fiber experimentally.

2.0 Fibre Optic Components and Devices

2.1 List various fibre optic components.
2.2 State the need of splicing in optical fibres.
2.3 Explain the experimental procedure to measure splice losses of a fiber.
2.4 State the need for optical coupler/splitter.
2.5 List two types of sources used in OFC.
2.6 List the salient features of an optical source.
2.7 List two types of detectors used in OFC.
2.8 List the salient features of an optical detector.
2.9 State the principle of LASER.
2.10 Explain the construction and working of LASER source (Fabry Perot Resonator Cavity)
2.11 Explain the construction and working of Avalanche Photo Diode (Reach Through APD).
2.12 Draw the block diagram of fibre optic communication system and explain each block.
2.13 Explain intrinsic and extrinsic losses in optical fibres.
2.14 Classify different types of dispersion losses occur in optical fibres.
2.15 State the limitations of TDM in fiber optic communications.
2.16 State the need for WDM in fibre optic communication.
2.17 Draw the block diagram of WDM system and explain.
2.18 Draw the block diagram of DWDM system and explain.

Lab Experiment

2.19 Establish an experimental setup for a fiber optic analog link and verify.
2.20 Establish an experimental setup for a fiber optic digital link and verify.
2.21 Establish an experimental setup for a fiber optic voice link and verify.
2.22 Perform an experiment to measure the attenuation of a fiber.
2.23 Perform an experiment to measure the bending losses of a fiber.

3.0 Cellular system design fundamentals

3.1 List the limitations of conventional mobile phone system.
3.2 Explain the evolution of cellular mobile communication system.
3.3 Draw the block diagram of a basic cellular system.
3.4 Define the terms mobile station and base station.
3.5 State the functions of Mobile Switching Centre (MSC).
3.6 Define forward and reverse channels in mobile communication.
3.7 Define voice and control channels in mobile communication.

3.8 Explain the process of call progress in a cellular telephone system.
3.9 State the need for hexagonal cell site.
3.10 Explain the concept of Frequency reuse.
3.11 Define the terms cell and cluster related to Mobile communications.
3.12 Define Co-Channel Reuse ratio and obtain its relation with cluster size.
3.13 Explain the capacity of a cellular system and derive its expression.
3.14 Define Hand-off in mobile communication.
3.15 Explain the radio subsystem of analog cellular system (AMPS).
3.16 List the drawbacks of analog cellular system.

4.0 Digital Cellular Mobile System and Multiple access Techniques

4.1 List the features of digital cellular system.
4.2 Explain the frequency spectrum of Global system for mobile communication (GSM) system
4.3 Explain the architecture of GSM.
4.4 List various interfaces in GSM architecture.
4.5 List the service and security aspects of GSM.
4.6 Explain the authentication and encryption process used in GSM security.
4.7 List the advantages of GSM.
4.8 List the draw backs of GSM system.
4.9 Distinguish between multiplexing and multiple access.
4.10 State the need for multiple access techniques.
4.11 List the types of multiple access techniques.
4.12 Explain FDMA and list its features.
4.13 Explain TDMA and list its features.
4.14 Explain the frame structure of a TDMA used in GSM.
4.15 Explain the concept of spread spectrum technique.
4.16 Explain CDMA and list its features.
4.17 Compare FDMA, TDMA and CDMA.
4.18 Explain the concept of OFDM.

5.0 Advanced Concepts in Digital Cellular Mobile system

5.1 List the features of GPRS and EDGE systems.
5.2 Compare the features of GSM, GPRS, and EDGE systems.
5.3 List the salient features of 3G system.
5.4 List the advantages of 3G over earlier versions.
5.5 Explain the architecture of 3G Cellular System (UMTS).
5.6 Explain briefly about soft-handoff and power control in CDMA.
5.7 Distinguish between hard-off and soft-hand-off.
5.8 List the salient features of 4G Cellular system.
5.9 Explain the VoLTE architecture of IP Multimedia Subsystem (IMS).
5.10 List different IMS applications.
5.11 List the salient features of 5G Cellular System.
5.12 Explain the architecture of 5G Cellular system.
5.13 Explain 5G NR technology.
5.14 List the applications of 5G technology.

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1		2			3		2
CO2	3	3	1		2		2	3	2	2
CO3	3	3	3	2	3		2	3	2	2
CO4	3	3	3	2	3		2	3	2	2
CO5	3	3	3	2	3		3	3	3	2
Average	3	3	2.2	2	2.6		2.25	3	2.25	2

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. Overview of Fibre Optic Communication

Advantages of Light wave communication system over EM wave systems- structure of optical fibre- fiber drawing process- Classification of optical fibres based on refractive index profile - types of fibres based on core diameter - Single mode (SMF) and Multimode fibre (MMF) -Snell's law in optics -light wave propagation in OFC critical angle - acceptance angle and Cone of acceptance-numerical aperture (NA) – experimental measurement of NA.

2.Fibre Optic Components and Devices

List of fibre optic components- function of splice in optical fibres-need for optical coupler/splitter-sources used in OFC- two types of detectors used in OFC- feature of an optical detector-principle of LASER-construction and working of LASER source-construction and working of APD- block diagram of fibre optic communication system and explain each block - intrinsic and extrinsic losses-Classification of different types of dispersion losses occur in optical fibres- WDM in fibre optic communication- block diagram of WDM system – DWDM System

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3. Cellular system design fundamentals

Conventional mobile phone system-Evolution of cellular mobile communication system-mobile station and base station-functions of Mobile switching centre (MSC)- Voice and control channels in mobile communication-Block diagram of a basic cellular system- call progress in a cellular telephone system- hexagonal cell site- Frequency reuse-Cell and cluster- Cluster size and co-channel reuse ratio - capacity of a cellular system-Hand-off in mobile communication-drawbacks of analog cellular system

4. Digital Cellular mobile system and Multiplexing Techniques

Need for multiple access techniques-three types of multiple access techniques TDMA, FDMA and CDMA -Compare FDMA, TDMA and CDMA-OFDM-Features of digital cellular system-Global system for mobile communication (GSM) with block diagram-interfaces in GSM architecture-service and security aspects of GSM-advantages of GSM-draw backs of GSM system

5. Advanced Digital Cellular mobile system

GPRS and EDGE-salient features of 3G system-advantages of 3G over earlier versions-architecture of 3G cellular system – soft hand-off – power control in CDMA -basic concepts of 4G aspects –VoLTE architecture of IP Multimedia Subsystem (IMS) - IMS applications-Salient features of 5G-architecture of 5G

REFERENCES

1. R. Pandya, *Mobile and Personal Communication Systems and Services*, New Delhi: PHI, 2004.
2. T. S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd ed., New Delhi: Pearson Education, 2010.
3. W. C. Y. Lee, *Mobile Cellular Telecommunications: Analog and Digital Systems*, New York: McGraw-Hill, Year?.
4. J. Schiller, *Mobile Communications*, New Delhi: Pearson, Year?.
5. G. Keiser, *Optical Fiber Communications*, Singapore: Springer, 2021.
6. A. De, *Optical Fiber and Laser: Principles and Applications*, New Delhi: New Age International, Year?.
7. J. M. Senior, *Optical Fiber Communications: Principles and Practice*, Englewood Cliffs, NJ: Prentice-Hall, 1985.
8. S. C. Gupta, *Optical Fiber Communications and Its Applications*, New Delhi: PHI, 2004.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.8
Unit Test-II	From 3.9 to 5.14

DATA COMMUNICATION AND COMPUTER NETWORKS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC503T	Data Communication and Computer Networks	6	90	4	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No.of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Basics of Data communication and OSI Reference Model	18	17	3	1	CO1
2	Physical Layer and Data Link Layer	15	17	3	1	CO2
3	Network Layer, Transport Layer and Application Layer	30	30	2	3	CO3
4	Wireless Network Protocols	15	22	2	2	CO4
5	Wireless Security	12	14	2	1	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize with Basics of Data Communication and the layers of OSI Model
(ii)	analyse various wireless network protocols
(iii)	analyse wireless Security protocols

COURSE OUTCOMES

CO1	EC503.1	Describe data communication and OSI model
CO2	EC503.2	Describe Physical and data link layers
CO3	EC503.3	Analyse network layers
CO4	EC503.4	Describe Wireless Network Protocols
CO5	EC503.5	Describe Cyber Security

LEARNING OUTCOMES

1.0 Basics of Data communication and OSI Reference Model

1.1 Define data and information
1.2 Define data communication
1.3 State the characteristics of data communication

1.4 State the components of data communication
1.5 Explain the data representation of numbers, text, images, audio and video
1.6 Define the different modes of data flow (simplex, half duplex and full duplex)
1.7 Distinguish between serial communication and parallel communication
1.8 Define computer network and state its use
1.9 State the need for data communication networking.
1.10 Define network topology
1.11 List different network topologies
1.12 Explain Bus, Star, Ring, and network topologies
1.13 Compare the performances of the above three topologies.
1.14 Draw the ISO: OSI 7 layer reference model and State the functions of each layer.
1.15 Draw TCP/IP protocol stack, and state the functions of each layer
1.16 Compare ISO :OSI 7 layer reference model with TCP/IP protocol stack

2.0 Physical Layer and Data Link Layer

a) Physical Layer:

2.1 List the different types of physical transmission media used in networking
2.2 Explain the cross-sectional diagrams of UTP, STP, Coaxial and Fiber optic cables and their use in networking.
2.3 List the three types of switching techniques used in networking
2.4 Explain circuit switching and packet switching
2.5 Define virtual circuit and datagram approaches in packet switching
2.6 State the use of repeater/ hub

b) Data Link Layer:

2.7 Define the word protocol used in computer networks
2.8 State the need for protocols in computer networks.
2.9 Explain CSMA/CD, CSMA/CA
2.10 Explain Ethernet LAN
2.11 Draw the frame format for Ethernet and State the different fields in it.
2.12 Explain the working of token ring network

3.0 Network Layer, Transport Layer and Application Layer

a) Network Layer

3.1 Define the terms Internet and Intranet.
3.2 Explain classful addressing in IPv4.
3.3 Explain classless addressing (CIDR) in IPv4.
3.4 State the use of routers in networking
3.5 Explain the concept of routers and routing packets in computer networks
3.6 Distinguish among cut through, store-and-forward, and adaptive switch mechanisms.
3.7 Explain the packet transfer mechanism using routers and IP address.

b) Transport Layer

3.8 List the features of Transmission Control Protocol (TCP)
3.9 Explain the flow control in TCP
3.10 Explain error control in TCP
3.11 Explain the connectivity of systems using TCP (Three way hand shake)
3.12 Explain end-to-end connectivity in TCP using ports and sockets.
3.13 Explain the features of User Datagram Protocol (UDP)
3.14 Compare the features of TCP and UDP
3.15 State the use of Gateway Router.

c) Application Layer:

3.16 State the role of DNS server
3.17 Explain how email is transferred
3.18 Explain POP server and SMTP server
3.19 Explain file transfer operation using FTP
3.20 Explain the working of Web server
3.21 Explain the web browser architecture
3.22 Explain the internal architecture of ISP
3.23 State the purpose of proxy server
3.24 Explain remote login

4.0 Wireless Network Protocols

4.1 Define Wireless LAN.
4.2 List the advantages of WLAN over Ethernet LAN.
4.3 Explain the topology of wireless LAN
4.4 Explain the frame format of wireless LAN(IEEE 802.11)
4.5 State the features of Bluetooth technology.
4.6 State the applications of Bluetooth technology.
4.7 Compare the features of IEEE 802.11n, 802.11ac, and IEEE 802.11ax.
4.8 State the necessity of Low-rate WPAN(IEEE 802.15.4)
4.9 Explain the features of Zigbee Technology and its topologies.
4.10 Explain the architecture of 6LoWPAN and its protocol stack.
4.11 State the features of LoRaWAN
4.12 List the applications of LoRaWAN
4.13 Differentiate between WiFi and LoRaWAN
4.14 Explain the architecture of LoRaWAN
4.15 State the features and applications of Sigfox

5.0 Cyber Security

5.1 Define the term Cyber Security.
5.2 State the necessity of Cyber Security.
5.3 State the fundamentals of Cyber Security.
5.4 List the layers of Cyber Security.
5.5 Explain the active and passive attacks in Cyber-attacks.
5.6 Explain the functions of firewall
5.7 Define the terms: i) VIRUS, ii) Malware iii) Adware iv) Trojan v) Worm related to computer security
5.8 List the features of a typical "total security" tool
5.9 List different types of viruses and ways of removing viruses
5.10 List any six popular Anti-Virus Software available in market

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	2	3	2	1
CO2	3	3	2	3	1	1	2	3	3	1
CO3	3	3	3	3	1	1	2	3	3	2
CO4	3	2	2	3	2	1	3	3	3	2
CO5	3	2	2	2	3	2	3	3	2	3
Average	3	2.4	2	2.6	1.6	1.2	2.4	3	2.6	1.8

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 Basics of Data communication and OSI Reference Model

Need for data communication networking, network topology, different network topologies, Bus, Star, Ring network topologies, OSI 7-layer architecture- functions of each layer, TCP/IP reference model- functions of each layer

2.0 Physical Layer and Data Link Layer

a) Physical Layer:

Different physical transmission media-UTP, STP, Coaxial and Fiber optic cable, switching techniques - circuit switching, packet switching and message switching, virtual circuit and datagram approaches in packet switching, use of repeater/hub

b) Data Link Layer:

Protocol, need for protocols, need for framing, need for flow control and error control protocols, Medium access control (MAC) - its functions, CSMA/CD and CSMA/CA, Local area network – its' use, Ethernet and its frame format, working of token ring network.

3.0 Network Layer, Transport Layer and Application Layer

a) Network Layer:

Internet and Intranet, classful addressing and classless addressing in IPv4,use of routers in networking, concept of routers and routing, cut through & store-and-forward and adaptive switch mechanism, packet transfer mechanism using routers and IP address.

b) Transport Layer

Features of Transmission Control Protocol (TCP), flow control in TCP, error control in TCP, connectivity of systems using TCP (Threeway hand shake), end-to-end connectivity in TCP using ports and sockets, features of User Datagram Protocol (UDP), use of Gateway Router

c) Application Layer:

Role of DNS server, how email is transferred, POP server and SMTP server, FTP working of Web server, web browser architecture, internal architecture of ISP, purpose of proxy server, remote login

4. Wireless Network Protocols

Wireless Network technologies- IEEE802.11, IEEE802.11 architecture, frame format, features and applications of Bluetooth technology, Zigbee Technology topologies, 6LoWPAN architecture-Protocol stack.

5. Cyber Security

Basic Cyber Security Concepts, fundamentals and layers of security, Cyber attacker actions, active attacks, passive attacks, functions of firewall, definition-VIRUS-Malware-Adware-Trojan-Worm related to computer security, Features of a typical "total security" tools , Types of viruses - Ways of removing viruses - Anti-Virus Software available in market

REFERENCES

1. Ata Elahi Thomson, Network communication Technology
2. Godbole, Data Communication and Networking,TMH
3. William Stallings ,Data and Computer Communications, 7th edition.PHI
4. BehrouzForouzan, Data Communication and Networking, 3rdedition.TMH
5. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
6. B.B.Gupta, D.P.Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press
7. Wayne Tomasi, Introduction to data communication and networking, Pearson India Publications
8. Thomas Robertazzi, Basics of computer networking, Springer publishers

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.7
Unit Test-II	From 3.8 to 5.10

PLC and SCADA

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC504E	PLC & SCADA	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No.of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Introduction to PLC	10	17	3	1	CO1
2	PLC Hardware	10	25	3	2	CO2
3	PLC Programming and applications	10	22	2	2	CO3
4	Introduction to SCADA	5	11	1	1	CO4
5	SCADA interfacing and applications	10	25	3	2	CO5
Total		**45**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize students with the fundamentals of Programmable Logic Controllers (PLC) their hardware components, and programming basics
(ii)	provide exposure to the applications of PLC and SCADA systems in industrial automation and process control
(iii)	understand SCADA interfacing techniques, monitoring, and supervisory control applications in modern industries

COURSE OUTCOMES

CO1	EC504.1	Identify different components of PLC
CO2	EC504.2	Select appropriate PLC modules for given application
CO3	EC504.3	Develop PLC ladder program for given application
CO4	EC504.4	Test simple SCADA application
CO5	EC504.5	Test simple PLC-SCADA application

LEARNING OUTCOMES

1.0 Introduction to PLC

1.1 State the need for automation in industries and its major benefits.
1.2 List the various tools used in industrial process automation (PLC, SCADA, HMI, DCS, Drives)
1.3 Compare a Personal Computer (PC) and a Programmable Logic Controller (PLC).
1.4 Explain the working principle of a PLC with the help of a block diagram.
1.5 Define the terms CPU function, scanning cycle, and execution speed in a PLC.
1.6 Explain the memory organization and its functions in a PLC.
1.7 Explain the role of analog I/O, digital I/O, and special-purpose I/O modules in a PLC.
1.8 Explain the power supply block diagram and its working in a PLC system.
1.9 Differentiate between a Fixed PLC and a Modular PLC.
1.10 State the concept of redundancy in PLC systems and its importance.
1.11 List the advantages and limitations of using PLCs.

2.0 PLC Hardware

2.1 Explain the working principle, block diagram, wiring details, and specifications of an AC input module.
2.2 Explain the working principle, block diagram, wiring details, and specifications of a DC input module.
2.3 Explain the block diagram, description, interfacing of input devices, and specifications of an analog input module.
2.4 Explain the working principle, block diagram, wiring details, and specifications of an AC output module.
2.5 Explain the working principle, block diagram, wiring details, sinking and sourcing concepts, and specifications of a DC output module.
2.6 Differentiate between relay output modules and isolated output modules.
2.7 Explain the block diagram, description, wiring details, and specifications of an analog output module.

3.0 PLC Programming and applications

3.1 List different PLC I/O Addressing modes.
3.2 Explain the following PLC Programming Instructions:
- i) Relay type Instruction
- ii) Timer instructions on delay, off delay and retentive
- iii) Counter instructions (up, down)
- iv) Logical instructions
- v) Comparison instructions
- vi) Data handling instructions
- vii) Arithmetic instructions
- viii) Sequencer instructions

3.3 Explain PLC Programming using functional block diagram.
3.4 Explain Sequential function chart (SFC)
3.5 Explain Ladder programming.
3.6 Explain simple PLC programs on PLC instructions
3.7 Explain the following PLC Based Applications
- i) Motor sequence control
- ii) Traffic light control
- iii) Stepper motor control

4.0 Introduction to SCADA

4.1 State the need of SCADA

4.2 List the application areas of SCADA
4.3 Explain the Block diagram of SCADA
4.4 Classify the types of SCADA systems
4.5 Explain the single master single remote, single master multiple remote and multiple master multiple remote SCADA systems.
4.6 Explain the SCADA System Hardware units
i) Remote terminal units (RTUs)
ii) Master terminal units (MTUs)
iii) Communication system
4.7 State the difference between SCADA and PLC

5.0 SCADA interfacing and applications.

5.1 Explain the interfacing of SCADA with PLC:
i) Connection diagram
ii) Object linking and embedding for process control (OPC) Architecture
5.2 Explain the Steps for creating SCADA screen for simple object.
5.3 Explain the Steps for linking SCADA object.
5.4 Explain the concept of Tag, types of Tags, and addressing of Tags
5.5 Explain Alarm generation and trend types
5.6 Explain the applications SCADA System
i) On/Off Control of Lamp
ii) Level Control system

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	1	1		1	3	1	
CO2	3	3	3	1	1			3	1	1
CO3	3	3	3	1	1			3	1	1
CO4	3	3			1		1	3	1	1
CO5	3	3	3	3	3		1	3	3	3
Average	3	3	2.5	1.5	1.4		1	3	1.4	1.5

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

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COURSE CONTENT

1.0 Introduction to PLC

Parts of PLC identification-Functions of PLC- Programming devices- Comparison-Redundancy concept of PLC.

2.0 PLC Hardware

Discrete AC input-DC input modules - Analog input modules- Discrete Ac output-DC output modules - Analog output modules-relay-isolated output modules

3.0 PLC Programming and applications

I/O addressing modes-Instruction set-Elements of programming language-PLC Ladder program

4.0 Introduction to SCADA

Applications of SCADA-block diagram of SCADA—SCADA configuration-Differentiate between SCADA and PLC.

5.0 SCADA interfacing and applications.

Interfacing of SCADA with PLC—steps required for creating SCADA screen-Concept of tag and types of tags-Block diagram of SCADA system for Industrial applications.

REFERENCES

1. Dunning G, Introduction to Programmable Logic Controllers, Thomson/Delmar learning
2. Bailey David,Wright Edwin , Programmable Logic Controllers, Prentice hall publications
3. Jadhav, V.R , Programmable Logic Controllers, Khanna publisher
4. Petruzella,F.D , Programmable Logic Controllers, Tata-McGraw-Hill India.
5. Stenerson Jon, Industrial automation and process control, Prentice hall publications
6. Boyar,S.A,S upervisory control and Data acquisition, ISA Publication

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TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.2
Unit Test-II	From 3.3 to 5.6

EMBEDDED SYSTEMS

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC505E	Embedded Systems	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No.of Periods	Weightage of Marks	No. of Short Answer Questions	No. of Essay Questions	COs Mapped
1	Introduction to Embedded systems	8	14	2	1	CO1
2	Communication Standards and Real Time Operating System	9	22	2	2	CO2
3	ARM Cortex M3 Architecture	10	25	3	2	CO3
4	ARM - Instruction set and programming	9	25	3	2	CO4
5	ARM Interfacing	9	14	2	1	CO5
Total		**45**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	introduce Embedded Systems, Communication Standards, and RTOS concepts
(ii)	understand ARM Cortex M3 architecture, memory, and peripherals
(iii)	learn ARM instruction set, programming, and interfacing techniques

COURSE OUTCOMES

CO1	EC505.1	Know about Embedded systems and its importance.
CO2	EC505.2	Understand Communication Standards and RTOS fundamentals.
CO3	EC505.3	Explain ARM Cortex M3 Architecture.
CO4	EC505.4	Learn ARM Instruction Set and Programming.
CO5	EC505.5	Understand ARM Interfacing with peripherals.

LEARNING OUTCOMES

1.0. INTRODUCTION TO EMBEDDED SYSTEMS

1.1. Define an Embedded System and explain its' importance.
1.2. Differentiate between Embedded System and General-Purpose Computing System with suitable examples.
1.3. List major application areas of Embedded Systems (at least five domains).

1.4. Draw and explain a simplified block diagram of an embedded system
1.5. Explain the basic computer architectures (Harvard vs Von-Neumann)
1.6. State key features of RISC and CISC architectures and summarize their differences.
1.7. Classify Embedded Systems based on complexity and application.

2.0 COMMUNICATION STANDARDS AND REAL TIME OPERATING SYSTEM

2.1 Explain SPI, I2C, UART communication protocols
2.2 Compare general OS and RTOS
2.3 List three Types of RTOS
2.4 List the features of RTOS
2.5 Explain Real Time Operating System
2.6 Explain Tasks, Process, and Threads
2.7 Explain task management and scheduling
2.8 Explain interrupt handling

3.0 ARM CORTEX M3 ARCHITECTURE

3.1. List ARM Cortex families and compare different Cortex series (A, R, M).
3.2. State the key features and applications of ARM Cortex-M3.
3.3. Draw and explain the architecture of ARM Cortex-M3.
3.4. Identify general-purpose and special-purpose registers of Cortex-M3.
3.5. Explain processor operating modes and illustrate mode switching.
3.6. Differentiate exceptions and interrupts.
3.7. Explain the pipeline architecture and data path of Cortex-M3.
3.8. Explain memory concepts in Cortex-M3: endianness, bit-banding, and memory address mapping.

4.0 ARM - INSTRUCTION SET AND PROGRAMMING

4.1. Draw and explain the general instruction format of ARM Cortex-M3.
4.2. Classify the instruction set of ARM cortex M3
4.3. Explain the major instruction categories: Data processing instructions, Multiply and divide instructions , Branch and control instructions
4.4. Write simple programs to demonstrate data processing operations.
4.5. Write programs for arithmetic operations (addition, subtraction, multiplication, division).
4.6. Write a program using branch control instructions.

5.0 ARM INTERFACING

5.1 Explain GPIO interfacing of ARM cortex M3
5.2 Explain ARM peripherals: i) Timer, ii) Watchdog timer, iii) Sys Tick, and iv) PWM v)Internal RTC
5.3 Explain Interfacing LEDs and switches of ARM cortex M3
5.4 Explain interfacing seven segment display of ARM cortex M3
5.5 Explain keypad interfacing of ARM cortex M3

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3						3	3		
CO2	3	3					3	3		
CO3	3	3	3		3		3	3	3	3
CO4	3	3	3		3		2	3	3	3
CO5	3	3	3		3		3	3	3	3
Average	3	3	3		3		2.5	3	3	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. INTRODUCTION TO EMBEDDED SYSTEM AND RTOS

Definition and importance of embedded systems – embedded systems versus general-purpose computing systems with suitable examples – major application areas of embedded systems such as consumer electronics, automotive, industrial automation, medical, and communication – basic block diagram of an embedded system and its explanation – basic computer architectures: Harvard and Von-Neumann architectures and their comparison – RISC and CISC architectures: features and differences – classification of embedded systems based on complexity and application

2. COMMUNICATION STANDARDS AND REAL TIME OPERATING SYSTEM

Serial communication standards: SPI, I^2C, and UART protocols – general purpose operating system and real time operating system: comparison – types of RTOS – features and characteristics of RTOS – concept and working of real time operating system – tasks, processes, and threads – task management and scheduling mechanisms – interrupt handling in real time systems

3. ARM CORTEX M3 ARCHITECTURE

ARM Cortex processor families and comparison of Cortex-A, Cortex-R, and Cortex-M series – key features and applications of ARM Cortex-M3 – architecture of ARM Cortex-M3 with block diagram – general purpose and special purpose registers – processor operating modes and mode switching – exceptions and interrupts: concepts and differences – pipeline architecture and data path of Cortex-M3 – memory concepts including endianness, bit-banding, and memory address mapping

4. ARM - INSTRUCTION SET AND PROGRAMMING

General instruction format of ARM Cortex-M3 – classification of ARM Cortex-M3 instruction set – data processing instructions – multiply and divide instructions – branch and control instructions – assembly language programs for data processing operations – programs for

arithmetic operations such as addition, subtraction, multiplication, and division – programs using branch and control instructions.

5. ARM INTERFACING

GPIO interfacing of ARM Cortex-M3 – ARM on-chip peripherals: timer, watchdog timer, SysTick timer, PWM, and internal RTC – interfacing LEDs and switches with ARM Cortex-M3 – interfacing seven-segment display – keypad interfacing with ARM Cortex-M3.

REFERENCES

1. Joseph Yiu," The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Elsevier, 3rd Edition, 2014.
2. Trevor Martin, "The Designer's Guide to the Cortex-M Processor Family", 2th edition, Elsevier 2016.
3. Muhammad Tahir and Kashif Javed, "ARM Microprocessor Systems - Cortex-M Architecture, Programming, and Interfacing", CRC Press, 2017.
4. Joseph Yiu," The Definitive Guide to ARM Cortex" Prentice Hall, 3rd Edition, Elsevier 2010.
5. Jonathan W. Valvano, "Embedded Systems: Real-Time Interfacing to Arm Cortex-M Microcontrollers", Volume-2, 4th edition, 2014.
6. James A. Langbridge, "Professional Embedded Arm Development", John Wiley & Sons, 2014

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.5
Unit Test-II	From 3.6 to 5.5

DIGITAL SIGNAL PROCESSING

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC506E	Digital Signal Processing	3	45	2	30	70

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of Marks	No of Short answer Questions	No of Essay Questions	COs Mapped
1	Discrete Time signals	08	14	2	1	CO1
2	LTI Systems and Z Transforms	09	25	3	2	CO2
3	DTFT, DFT and FFT	10	25	3	2	CO3
4	Digital Filters	10	22	2	2	CO4
5	Applications of DSP	09	14	2	1	CO5
Total		**45**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	representing and characterizing Discrete time signals, learning about LTI discrete systems, Z transform and its applications in the System analysis
(ii)	understanding the concept of DTFT, DFT, and FFT for efficient spectral analysis
(iii)	learning and understanding the FIR and IIR Filters and applications of DSP

COURSE OUTCOMES

CO1	EC506.1	Represent the discrete signals mathematically and graphically
CO2	EC506.2	Understand the discrete LTI system behaviour by using the z-transform
CO3	EC506.3	Understand and apply the DTFT, DFT and FFT for discrete signals
CO4	EC506.4	Understand the Digital filter specifications and responses in FIR and IIR filters
CO5	EC506.5	Know Real world applications of digital signal processing

LEARNING OUTCOMES

1. DISCRETE TIME SIGNALS

1.1. State the need for Digital signal Processing
1.2. List applications of DSP
1.3. Define Sampling and state the sampling theorem
1.4. Define Nyquist rate
1.5. Define Aliasing
1.6. Define the Discrete time signal
1.7. Distinguish between Continuous time signal, Discrete time signal, and Digital signal
1.8. Illustrate and represent basic elementary Discrete time signals like Impulse Function, Step Function, Ramp, Exponential signals and periodic signals mathematically and graphically
1.9. Express the discrete time signal x(n) as a summation of Impulses
1.10. Explain the Basic Operations with examples on the discrete time signals with examples –(i) Scaling, (ii) Folding and (iii) Time shifting

2. LTI SYSTEMS AND Z TRANSFORMS

2.1. Define Discrete time system and classify different Discrete time systems
2.2. Explain the properties of System (i)Linearity, (ii) Stability, (iii) Causality, and (iv)Time Invariance
2.3. Define LTI System
2.4. Explain the convolution theorem of Discrete time signals and write the properties
2.5. Define the Z transform
2.6. Find Z transform of following functions: i) Delta function, ii) Unit step function, iii) Ramp function, iv) Exponential function, and v) Sine and Cosine functions
2.7. State Inverse Z Transform
2.8. Explain the impulse response of a system using Z Transform

3. DTFT, DFT AND FFT

3.1. Define the Fourier series of periodic discrete time signal
3.2. Explain the frequency spectrum of a periodic discrete time signal in terms of Fourier series coefficients
3.3. Define the Discrete Time Fourier Transform (DTFT) of non-periodic discrete time signal
3.4. Explain the frequency spectrum of a non-periodic discrete time signal in terms of Discrete Time Fourier Transform (DTFT)
3.5. Mention the drawbacks in DTFT and Explain how to overcome the drawbacks.
3.6. Define Discrete Fourier Transform (DFT)
3.7. Explain the frequency spectrum of a DFT of a Discrete time Sequence
3.8. State the relation between DTFT and DFT
3.9. Define FFT
3.10. State the need for FFT
3.11. Compare the DIT radix-2 FFT and the DIF radix-2 FFT

4. DIGITAL FILTERS

4.1. Compare the Analog filters and Digital filters
4.2. List the advantages and disadvantages of digital filters
4.3. Define FIR System
4.4. List the different types of structures for realization of FIR Systems
4.5. Explain the realization of cascade structure of FIR systems
4.6. Mention the advantages and disadvantages of FIR Filters
4.7. Define an IIR Filter?
4.8. List the different types of structures for realization of IIR Systems

4.9. Explain the realization of the cascade structure of IIR systems
4.10. Compare IIR and FIR Filters

5. APPLICATIONS OF DSP

5.1. Mention the key components of typical DSP system for speech processing
5.2. Explain the various stages of speech processing using DSP
5.3. Explain the signal processing in radar system
5.4. Define OFDM
5.5. Explain how an OFDM signal generated
5.6. Explain the function of OFDM system with suitable block diagram
5.7. State the function of Digital signal processor
5.8. List the Basic characteristics of DSP processor
5.9. List the advantages of DSP Processors
5.10. List 16-bit and 32-bit digital signal processors

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1				1	3		
CO2	3	2	2	1			1	3	2	
CO3	3	2	2	1			1	3	1	2
CO4	3	3	3	2			2	3	1	2
CO5	3	3	3	2			3	3	2	2
Average	3	2.4	2.2	1.2			1.6	3	1.2	2

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1. **DISCRETE TIME SIGNALS**
   Understanding the concept of signals in discrete time - classification of signals (e.g., energy, power, periodic, and aperiodic) - basic signal operations.
2. **LTI SYSTEMS AND Z-TRANSFORMS**
   Characterizing systems based on linearity and time-invariance – convolution - Introduction to the Z-transform -impulse response.
3. **DTFT, DFT AND FFT**
   Discrete time Fourier series; DTFT-Definition-Explanation – Drawbacks; DFT-Definition, Explanation; FFT-Definition-Need of Radix-2 FFT
4. **DIGITAL FILTERS**
   Digital filters-Definition-Advantages and disadvantages; FIR-definition, types, cascade structure; IIR-Definition-types-realization; Comparison of IIR & FIR
5. **APPLICATIONS OF DSP**
   Speech processing, signal processing in radar, OFDM, applications and advantages of DSP Processors

REFERENCES

1. P. Ramesh Babu, *Digital Signal Processing*. New Delhi: Scitech Publications.
2. S. Nagoor Kani, *Digital Signal Processing*. New Delhi: Tata McGraw-Hill.
3. A. Anand Kumar, *Digital Signal Processing*. New Delhi: PHI Learning.
4. A. Ambardar, *Digital Signal Processing: A Modern Introduction*. Stamford, CT: Cengage Learning.
5. V. K. Ingle and J. G. Proakis, *Digital Signal Processing Using MATLAB*. Stamford, CT: Cengage Learning.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning outcomes to be covered
Unit Test-I	From 1.1 to 3.5
Unit Test-II	From 3.6 to 5.10

EMERGING TECHNOLOGIES IN ELECTRONICS AND COMMUNICATION ENGINEERING

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC507A	Emerging Technologies in Electronics and Communication Engineering	2	30	-	-	-

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	5G and Beyond Wireless Communications	6	CO1
2	Quantum Technology, Edge and Cloud Computing and Advanced VLSI and Semiconductor Technologies	18	CO2
3	Industrial IOT	6	CO3
Total		**30**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize students with the concepts, technologies, and applications of 5G and beyond wireless communication systems
(ii)	provide knowledge on emerging technologies such as Quantum Computing, Edge and Cloud Computing, Advanced VLSI, and Semiconductor Technologies
(iii)	understand the fundamentals and industrial applications of the Internet of Things (IoT) with emphasis on Industrial IoT systems

COURSE OUTCOMES

CO1	EC507.1	Familiarize with 5G and Beyond Wireless Communications
CO2	EC507.2	Familiarize with Quantum Technology, Edge and Cloud Computing, Advanced VLSI, and Semiconductor Technologies
CO3	EC507.3	Know about Industrial IOT

LEARNING OUTCOMES

1.0 5G and Beyond Wireless Communications

1.1. List the key features of 5G Technology

1.2. Explain about i)Enhanced Mobile Broadband (eMBB), ii)Ultra-Reliable Low-Latency Communications (URLLC), and iii) Massive Machine-Type Communications (mMTC).

1.3. List the key features of 6G Technology
1.4. List the important differences between 5G and 6G Technologies
1.5. State the basic concept of Holographic communication
1.6. State the basic concept of Digital twins.

2.0 Introduction to Quantum Technology

2.1 Define Quantum Technology
2.2 Difference between classical and quantum technologies
2.3 State the significance of quantum technology for the future.
2.4 Define Qubit and Superposition referred to Quantum Technology
2.5 Define Quantum Entanglement
2.6 State the concept of Quantum Cryptography and Quantum Key Distribution (QKD)
2.7 State the concept of Quantum Sensors
2.8 State the concept of Quantum Teleportation
2.9 List the applications of Quantum Technology

Introduction to Edge and Cloud Computing

2.10 Define edge computing and state its need.
2.11 Define cloud computing
2.12 List the differences between cloud computing and edge computing
2.13 List the applications of cloud computing.
2.14 List the applications of edge computing.

Advanced VLSI and Semiconductor Technologies

2.15 Define FinFET and state the applications of FinFET.
2.16 Define Gate-All-Around FETs (GAAFETs) and state the applications of GAAFETs
2.17 State the importance and applications of Silicon-on-Insulator (SOI) Technology
2.18 State the need for Carbon Nanotube FETs (CNTFETs) and list their applications.
2.19 State the need for Wide Bandgap Semiconductors and List their applications.

3.0 Industrial Internet of Things (IIOT)

3.1 Define IIoT and how it differs from regular IoT
3.2 List the Key components of IIOT
3.3 List the important communication Protocols in IIoT.
3.4 List the security challenges in IIoT
3.5 List the Applications IIoT

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3							3		
CO2	3	3						3		
CO3	3	3	3		3			3	3	3
Average	3	3	3		3			3	3	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 5G and Beyond Wireless Communications

Overview of 5G wireless communication technology – key features of 5G such as high data rates, low latency, massive connectivity, and network slicing – service categories of 5G: Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communications (URLLC), and Massive Machine-Type Communications (mMTC) – overview of 6G technology and its key features – comparison between 5G and 6G technologies – basic concepts of holographic communication – introduction to digital twins and their role in future communication systems.

2.0 Quantum Technology, Edge and Cloud Computing and Advanced VLSI and Semiconductor Technologies

Quantum Technology:

Definition of quantum technology – differences between classical and quantum technologies – significance of quantum technology for future computing and communication – concept of qubit and superposition – quantum entanglement – quantum cryptography and quantum key distribution (QKD) – quantum sensors – quantum teleportation – applications of quantum technology.

Edge and Cloud Computing:

Definition and need of edge computing – concept of cloud computing – differences between cloud computing and edge computing – applications of cloud computing – applications of edge computing.

Advanced VLSI and Semiconductor Technologies:

Introduction to advanced semiconductor technologies – FinFET: concept and applications – Gate-All-Around FETs (GAAFETs): concept and applications – Silicon-on-Insulator (SOI) technology: importance and applications – Carbon Nanotube FETs (CNTFETs): need and applications – wide bandgap semiconductors: need and applications.

3.0 Industrial Internet of Things (IIOT)

Definition of Industrial Internet of Things (IIoT) and its distinction from conventional IoT – key components of IIoT systems – communication protocols used in IIoT – security challenges in IIoT – applications of IIoT in industrial automation, manufacturing, smart grids, predictive maintenance, and process control.

REFERENCES

1. K. Saini, *Introduction to 5G and Beyond: Concepts and Applications*, New Delhi, India: BPB Publications, 2022.
2. P. Sharma, *5G Technology: The Next Generation Wireless Networks*, New Delhi, India: Khanna Publishing House, 2023.
3. P. K. Gupta and A. Yadav, *Fundamentals of Quantum Information*, New Delhi, India: Narosa Publishing House, 2023.
4. S. Das and R. S. Dey, *Quantum Computing and Communications: Principles and Applications*, New Delhi, India: Narosa Publishing House, 2022.
5. A. Verma, *Edge Computing: An Introduction*, New Delhi, India: BPB Publications, 2022.
6. S. S. Thakur and P. B. Khope, *Cloud and Edge Computing for Beginners*, New Delhi, India: Khanna Publishing House, 2023.
7. P. Agarwal and B. Singh, *Nanotechnology and Nanoelectronics*, New Delhi, India: Khanna Book Publishing Co., 2023.
8. V. P. Agrawal, *Industrial Internet of Things: Principles and Applications*, New Delhi, India: Khanna Publishing House, 2022.
9. P. K. Sinha and B. N. Chatterji, *Industrial Automation and IIoT*, New Delhi, India: Narosa Publishing House, 2022.

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DATA COMMUNICATION & COMPUTER NETWORKING LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC508L	Data Communication and Computer Networks Lab	6	90	2	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Computer Hardware	24	CO1
2	Fundamentals of Computer Networking	27	CO2
3	Network Simulation using Cisco Packet Tracer	24	CO3
4	Advanced communication technologies and Applications	15	CO4
	Total	**90**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarization with Computer hardware assembling and networking
(ii)	handle network simulation tool Cisco Packet Tracer
(iii)	explore the practical use of advanced communication technologies and applications

COURSE OUTCOMES

CO1	EC508.1	Conduct experiments on Computer hardware assembling and software
CO2	EC508.2	Conduct experiments on Computer network.
CO3	EC508.3	Develop and simulate different wired and wireless network topologies using Cisco Packet Tracer
CO4	EC508.4	Practice the usage of advanced communication gadgets

LEARNING OUTCOMES

I. Computer Hardware

1. a) Identify and note down mother board, components and chips
   b) Identify various Internal and external slots in the mother board and clean them with blower/brush
2. Practice Inserting and Removing RAM with care
3. Measure the Output voltages of SMPS
4. Disassemble the PC
5. Assemble the PC
6. Change the CMOS Setup

7. Install Windows Operating system
8. Perform Partition and format of hard disks.

II. Computer Networking

9. Identify and note down the specifications of various networking devices & Cables, Jacks , Connectors, and tools used in local area networks
10. Prepare the UTP cable for cross connection using crimping tool and test it with LAN tester
11. Prepare the UTP cable for direct connections using crimping tool and test it with LAN tester
12. Install a network switch/router and set up local area network
13. Configure Host IP, Subnet Mask, and Default Gateway in a system in LAN (TCP/IP Configuration).
14. Setup LAN and transfer files between systems in LAN
15. Share the printer in a LAN network
16. Test the network commands using ipconfig, ping / tracert, and netstat utilities and debug the network issues
17. Test the WIFI network performance using WIFI analyzer

III. Packet Tracer Simulations

18. Familiarize the CISCO Packet Tracer/ any equivalent Simulation tool for networking.
    i) Download and install Packet Tracer, ii) Open Packet Tracer, iii) Place devices on the workspace, iv) Use "Connections" to link devices, and v) Explore Simulation Mode vs Realtime Mode.
19. Establish a peer- peer network and simulate
    i) Connect two PCs using a crossover cable, ii) Assign IP addresses manually, and iii) Ping to test connectivity.
20. Simulate a Local Area network (Star Topology) using a) hub b) Switch
    i) Connect multiple PCs to a hub, ii) Assign IPs and check packet transmission using ping, iii) observe data broadcast behaviour, iv) Replace the hub with a switch, Repeat IP configuration and ping test, and v) Observe packet flow (unicast behaviour of switch)
21. Simulate BUS, Ring topologies.
    i) Use serial connection tools to simulate bus layout, ii) Create ring by connecting end-to-end, and iii) Assign IPs, and test communication.
22. Connect Two different LANs using Router with the help of Packet tracer and simulate.
    i) Create two separate LANs (using switches), ii) Connect each to a router via different interfaces, iii) Assign IPs and default gateways, iv) Configure routing (static or RIP), and v) Test with ping and traceroute.
23. Connect Two different portions of a LAN using Repeater with the help of Packet tracer and simulate.
    i) Place PCs in two different segments, ii) Use repeater to interconnect and iii) Assign IPs, connect, and ping.
24. Simulate wireless access point connection with PC, LAPTOP and smart Phone.
    i)Place Wireless Router or Access Point, ii) Connect PC (via Wi-Fi module), Laptop, and Smartphone, iii) Configure SSID, security settings, and iv) Connect to network and ping each other.
25. Simulate DHCP Server Configuration
    i)Configure a router to act as a DHCP server, ii) Assign IP addresses dynamically to clients, and iii) Use ip dhcp pool, default-router, dns-server, network.

IV. Advanced communication gadgets/apps

26. Perform video transfer from smart phone to internet connected to desktop PC/Laptop through IP based streaming
27. Perform file transfer from one smart phone to another through bluetooth based Shareit application
28. Perform Remote login using Team viewer/Anydesk
29. Know the usage and features of health band by performing an experiment
30. Perform audio conference through google duo

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	2	2	3	3	1
CO2	3	3	2	3	1	2	2	3	3	1
CO3	3	3	3	3	1	2	3	3	3	2
CO4	3	2	2	3	2	2	3	3	3	3
Average	3	2.5	2.25	3	1.25	2	2.5	3	3	1.75

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I & II

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From Experiment 1 to 17
Unit Test – II	From Experiment 18 to 30

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DIGITAL LOGIC DESIGN THROUGH VERILOG HDL LAB (PRACTICUM -PRACTICAL)

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC509L	DLD Through Verilog HDL	6	90	2	40	60

TIME SCHEDULE

S.No.	Chapter/Unit Title	No. of Periods	COs Mapped
1	Familiarization of basics of Verilog Programming and Xilinx ISE/Vivado/ MODEL SIM (or) similar software	18	CO1
2	Implementing logic gates	9	CO2
3	Implementing Combinational Circuits	24	CO3
4	Implementing Sequential Circuits	24	CO3
5	Implementing Logic gates, simple combinational and sequential circuits on FPGA board	15	CO4
	Total	**90**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	familiarize the basics of Verilog Programming and Xilinx ISE/Vivado (or) similar software
(ii)	Implement logic gates, Combinational Circuits, and Sequential Circuits
(iii)	implement logic gates, Combinational Circuits and Sequential Circuits on FPGA board

COURSE OUTCOMES

CO1	EC509.1	Familiarize the basics of Verilog Programming and work with Xilinx ISE/Vivado/model sim (or) similar software
CO2	EC509.2	Implement logic gates
CO3	EC509.3	Implement Combinational Circuits and Sequential Circuits
CO4	EC509.4	Implement logic gates, Combinational Circuits and Sequential Circuits on FPGA board

LEARNING OUTCOMES

I. a) Familiarize Xilinx ISE/Vivado/model sim (or) similar software
b) Familiarize the basics of Verilog HDL programming

Theory:

1.1 Explain the character set, lexical conventions of Verilog like number specifications, identifiers, keywords, value set, nets, register, vector, integer, real, and time registers.
1.2 Understand the arrays, memories, and strings
1.3 Explain the expression, operator, and operand
1.4 Explain the different types of operators and their usage
1.5 Explain the port declaration rules
1.6 Explain the module definition and its components in Verilog
1.7 Explain the module instantiation, inference of a component.
1.8 Demonstrate the different levels of abstractions in Verilog

II. Implementing logic gates using Gate Level and Data flow modelling

Theory:

2.1 Explain the gate symbols, Truth tables, gate instantiations, and syntaxes in Verilog
2.2 Explain the rise delay, fall delay, and turnoff delay in gate level modelling

Lab Experiments on gate level modelling:

2.3 Implement Basic Logic Gates
2.4 Implement Universal gates and special gates (Ex-or and Ex-nor)
2.5 Implement Multi input Logic Gates

Theory:

2.6 Explain assignment statements and types of delays in data flow modelling

Lab Experiments on dataflow modelling:

2.7 Implement Basic Logic Gates
2.8 Implement Universal gates and special gates (Ex-or and Ex-nor)
2.9 Implement Multi input Logic Gates

III. a) Combinational Circuits

Theory:

3.1 Explain the usage of conditional/decision making statements (if, if -else, if-else-if)
3.2 Explain the usage of multiway branching statements (case, casex, casez)
3.3 Explain the usage of Iterative statements (while, for, repeat, forever)

Lab Experiments on dataflow modelling using above concepts:

3.4 Implement Adders (Half adder and Full Adder)
3.5 Implement Subtractors (Half Subtractor and Full Subtractor)
3.6 Implement 4-bit Parallel Adder
3.7 Implement Multiplexers (2:1, 4:1 and 8:1 MUX)
3.8 Implement Demultiplexers (1:2, 1:4 and 1:8 DEMUX)
3.9 Implement Decoders (1:2, 2:4 and 3:8 Decoder)
3.10 Implement Encoders (2:1, 4:2 and 8:3 encoder)
3.11 Implement Comparator (2-bit and 4-bit)

3.12 Implement 4-bit ALU

b) Sequential Circuits using Behavioral modelling

Theory:

3.13 Explain the behavioral level programming concept structural procedures (initial and always statements)
3.14 Explain the procedural assignments (Blocking and non-blocking assignments)
3.15 Delay based timing control and event based timing control
3.16 Explain the structure of stimulus module / test bench

Lab Experiments on behavioral modelling using above concepts:

3.17 Implement NAND, NOR latch
3.18 Implement Flip Flops (JK- Flip Flop and SR-Flip flop) using edge triggering and level triggering
3.19 Implement Flip Flops (D- Flip Flop and T-Flip flop) using edge triggering and level triggering
3.20 Implement Shift Registers (SISO, SIPO)
3.21 Implement Shift Registers (PISO, PIPO)
3.22 Implement Counters (4-bit Synchronous counter and Decade counter)
3.23 Implement RAM and ROM

Note: All the above programs should be simulated by using test benches.

IV. Implement the following on FPGA board

Theory:

4.1 Explain the design steps for doing the experiment on FPGA KIT

Lab Experiments on behavioural modelling using above concepts:

4.2 Implement Basic gates (AND, OR, NOT)
4.3 Implement Half adder and Half Subtractor
4.4 Implement full adder and full Subtractor
4.5 Implement 4x1 MUX

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3		3	3	3	3	3	
CO3	3						3	3	3	
CO4	3	3	3	3			3		3	
Average	3	3	3	3	3	3	3	3	3	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED

FOR UNIT TESTS I & II

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From 1.1 to 2.9
Unit Test – II	From 3.1 to 4.5

PROJECT WORK

Course Code	Course Title	No. of Periods/Week	Total No. of Periods/ Semester	Credits	Marks for FA	Marks for SA
26EC510P	PROJECT WORK	4	60	1.5	40	60

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	enhance the knowledge by innovative learning and get the skills through the teamwork
(ii)	provide with the opportunity to synthesize knowledge from various areas of learning
(iii)	critically and creatively apply it to real life situations

COURSE OUTCOMES

CO1	EC510.1	Organising teamwork
CO2	EC510.2	Innovative learning
CO3	EC510.3	Apply theoretical knowledge to practical work situations
CO4	EC510.4	Practice technical project reports preparation and presentation

LEARNING OUTCOMES

Upon completion of the course the student shall be able to exhibit the following skill sets:

1. Problem solving and Critical Thinking

1.1 Identify different works to be carried out in the Project
1.2 Collect data relevant to the project work
1.3 Carryout need survey
1.4 Select the most efficient method from the available choices based on preliminary investigation
1.5 Design the required elements of the project work as per standard practices
1.6 Prepare the working modules/equipment required for the project work
1.7 Estimate the cost of project, technological need, computer skills, materials, and other equipment
1.8 Prepare the plan and schedule of starting time and sequence of operations to be carried out at various stages of the project work in detail
1.9 Prepare critical activities at various stages of the project work
1.10 Test various conditions with different electrical input parameters
1.11 Implement project work and record the results.
1.12 Draw Appropriate Conclusions
1.13 Preparation of project report.

2. Communication

2.1 Communicate effectively.
2.2 Present Ideas Clearly.
2.3 Present Ideas Coherently.
2.4 Report writing.

3. Collaboration

3.1. Discuss the ideas.

3.2. Coordinate with team members
3.3. Team work in accomplishing the task.

4. Independent Learning

4.1 Involves in the group task.
4.2 Analyse the appropriate actions.
4.3 Compares merits and demerits
4.4 Analyse the activities for sustainability
4.5 Analyse the activities to ensure ethics

5. Ethics

5.1 Give respect and value to all classmates, educators, colleagues, and others
5.2 Understand the health, safety, and environmental impacts of their work
5.3 Recognize the constraints of limited resources
5.4 Develop sustainable products and processes that protect the health, safety, and prosperity of future generations
5.5 Maintain integrity in all conduct and publications and give due credit to the contributions of others

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	2		2	2		1	3	2	2
CO2						3		3		2
CO3			3			3		3		2
CO4						3		3		2
Average	2	2	3	2	2	3	1	3	2	2

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in the CO-PO mapping matrix will be met by one or more appropriate activities from the following: (i) assignments, (ii) tutorials, (iii) seminars, (iv) guest lectures, (v) group discussions, (vi) quizzes, (vii) industrial visits, (viii) tech fests, (ix) mini-project works, (x) library visits, etc.

COURSE CONTENT

1.0 Design/Assembling/Analysis/Case Study Projects in the areas of Electronics & Communication Engineering

Weightage of marks for Assessment of Learning Outcomes of Project work

S.No	Item	Marks
1	**Internal Marks** Completion of Assigned task in the group/individual to complete the project	**40**

2	**End Exam Marks:** i) Demonstration of skill relevant to the project (30) ii) Project Report (20) iii) Viva Voce (10)	**60**
Total marks		**100**

- Each group should have a faculty supervisor assigned by the HOS/Principal.
- End Examination assessment shall be done by HECES, external examiner and faculty supervisor who guided the students during project work.
- The external examiner shall be from an industry/organisation/Head of ECE of other polytechnic/Senior faculty of other polytechnic.

Internal Assessment Guidelines:

- First Review: To be conducted after the completion of 4 weeks.
- Second Review: To be conducted after the completion of 10 weeks.
- Third Review: To be conducted after the completion of 14 weeks.

SCHEME OF EVALUATION

Internal marks

Review 1 **(10 Marks)**	**Review 2** **(15 Marks)**	**Review 3** **(15 Marks)**
COMMITTEE : 5 Marks SUPERVISOR : 5 Marks	COMMITTEE : 7.5 Marks SUPERVISOR : 7.5 Marks	COMMITTEE : 7.5 Marks SUPERVISOR : 7.5 Marks

VI SEMESTER

DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
VI Semester

INDUSTRIAL TRAINING

Assessment No	Upon completion of	Conducted by	Based on	Max Marks
Pre-Assessment	15 days to 30 days from the commencement of training	Mentor faculty member visits the industry 15 days to 30 days from the commencement of training and will submit a detailed report to the principal outlining the each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment after three months (at industry)	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned, 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
			TOTAL	300

The Industrial Training shall carry maximum 300 marks. Pass mark is 50% in first and second assessment put together and also 50% in final summative assessment at the institution level.

INDUSTRIAL TRAINING

Course Code	Course Title	Duration	Marks for FA	Marks for SA	Credits
26EC601I	Industrial Training	Semester	240	60	20

TIME SCHEDULE

S.No.	TOPICS	Duration
1	Practical training in Industry	Semester
2	Training Report Preparation Report Preparation: Title Page, Certificate, Acknowledgements, Abstract, Contents (introduction of Industry, Plant Layout, Organization Chart, List of Major Equipment, List of Processes: Skills Acquired, Conclusions, References	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	expose to real time working environment
(ii)	enhance knowledge and skill already learnt in the institution
(iii)	acquire the required skills of troubleshooting of various electronic devices, assembling, servicing, and supervising in the engineering fields
(iv)	install the good qualities of integrity, responsibility, and self confidence

COURSE OUTCOMES

CO1	EC601.1	Apply theory to practical work situations
CO2	EC601.2	Cultivate sense of responsibility and good work habits
CO3	EC601.3	Exhibit the strength, teamwork spirit and self-confidence
CO4	EC601.4	Write report in technical projects

CO-PO/PSO MAPPING MATRIX

COs / POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	2		2	2		1	3	2	2
CO2						3		3		2
CO3						3		3		2
CO4						3		3		2
Average	2	2		2	2	3	1	3	2	2

3=strongly mapped 2=moderately mapped 1=slightly mapped

LEARNING OUTCOMES

The student shall be able to display the following skill sets

1) Use appropriate tools/instruments for a given purpose and measure the values using instruments
2) Assembling and Disassembling of circuits
3) Coding and debugging
4) Troubleshoot/ Rectification of the problem
5) Design and Fabrication of the circuit
6) Soft skills and Reporting

SCHEME OF EVALUATION

26EC601I, INDUSTRIAL TRAINING

Assessment No	Upon completion of	Conducted by	Based on	Max Marks
Pre-Assessment	15 Days to 30 Days from the commencement of training	Mentor faculty member visits the industry one month after commencement of training and will submit a detailed report to the principal outlining each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment after three months (at industry	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned, 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
			TOTAL	300

Weightage of marks for Assessment of Skill sets during first and second assessment.

Skill Set Sl.No	SKILL SET	Max Marks Allotted For each parameter
1	Use appropriate tools/instruments for a given purpose and measure the values using instruments	15
2	Assembling and Disassembling of circuits	20
3	Programming/Coding/debugging	15
4	Troubleshoot/ Rectification of the problem	20
5	Design and Fabrication of the circuit	25
6	Softskills and Reporting Skills	25
	Total	120

During assessment the performance of the students shall be assessed in those skills in which the student has been trained and be awarded the marks as per the weightage assigned as above. In case the student has undergone training in a few skill sets then the total marks obtained shall be raised to 120 marks for the given assessment i.e. either assessment 1 or 2. However the performance of the student shall be assessed at the most skill sets listed above but not less than three skill sets.

Illustration

If the student has undergone training in only 4 skill sets (namely serial number 1, 3, 4, 5 of above skill sets) and marks awarded during assessment is 50 out of 80 marks, then the marks of 50 shall be enhanced to 120 proportionately as (50/80)*120=75.

GUIDELINES FOR INDUSTRIAL TRAINING

1. Duration of the training: Semester.
2. Eligibility: The As per SBTET norms
3. Training Area: Students may be trained in the fields Fabrication/Foundry/Manufacturing/Service/Drafting/Maintenance etc.
4. The candidate shall put a minimum of 90% attendance during Industrial Training.
5. If the student fails to secure 90% attendance during industrial training, the student shall reappear for 6 months industrial training.
6. Formative assessment at industry level shall be carried out by the Mentor from the industry, where the student is undergoing training and the faculty in charge (Guide) from the concerned section in the institution.
7. The Industrial training shall carry 300 marks and pass marks is 50% in assessments at industry (first and second assessment),50% in final summative assessment at institution level and put together i.e. 150 marks out of 300 marks.
8. If the student fails to secure 50% marks in final summative assessment at institution level, the student should reappear for final summative assessment in the subsequent board examination.
9. Final Summative assessment at institution level is done by a committee including Head of the ECE section, External examiner, and Faculty members who assessed the students during Industrial Training as members.

Guidelines and responsibilities of the faculty members who are assessing the students performance during industrial training:

- Shall guide the students in all aspects regarding training.
- Shall create awareness regarding safety measures to be followed in the industry during the training period, and shall check it scrupulously.
- Shall check the logbook of the students during the time of their visit for the assessment.

- Shall monitor progress at regular intervals and make appropriate suggestions for improvement.
- Shall visit the industry and make first and second assessments as per stipulated schedules.
- Shall assess the skill sets acquired by the students during their assessment.
- Shall award the marks for each skill set as per the marks allotted for that skill set during 1st and 2nd assessments
- Shall voluntarily supplement students learning through appropriate materials like photographs, articles, videos etc.
- Shall act as co-examiner along with other examiners in the final assessment at institution.
- Shall act as liaison between the student and mentor.
- Shall maintain a diary indicating his observations with respect to the progress of students learning in all three domains (Cognitive, Psychomotor and Affective).

Guidelines to the Training Mentor in the industry:

- Shall train the students in all the skill sets as far as possible.
- Shall assess and award the marks in both the assessments along with the faculty member.
- Shall check and approve the log books of the students.
- Shall approve the attendance of each student at the end of the training period.
- Shall report to the guide about student's progress, personality development or any misbehaviour as the case may be.
- **Every faculty (including HoS if not holding any FAC) shall be assigned a batch of students of 10 to 15 for industrial training irrespective of student's placements for training.**