

# **STUDENT HAND BOOK**

**(4-1)**

**A.Y:2023-24**

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### **Vision of the Institute**

To be recognized as a premier institution in offering the value based and futuristic quality technical education to meet the technological need of the society.

### **Mission of the the Institute**

- To impart value quality technical education through innovative teaching and learning methods.
- To continuously produce employable technical graduates with advanced technical skills to meet the current and future technological need of the society.
- To prepare the graduate for high learning with emphasis on academic and industrial research

### **Vision of the Department**

To promote excellence in technical education and scientific research in electronics and communication engineering for the benefit of society.

### **Mission of the Department**

- To impart excellent technical education with state of art facilities inculcating values and lifelong learning attitude.
- To develop core competence in our students imbibing professional ethics and team spirit.
- To encourage research benefiting society through higher learning

### **PEOs:**

PEO 1: Establish themselves as successful professionals in their career and higher education in the field of Electronics & Communication Engineering and allied domains through rigorous quality education.

PEO 2: Develop Professionalism, Ethical values, Excellent Leadership qualities, Communication Skills and teamwork in their Professional front and adapt to current trends by engaging in lifelong learning

PEO 3: Apply the acquired knowledge & skills to develop novel technology and products for solving real life problems those are economically feasible and socially relevant

PEO 4: To prepare the graduates for developing administrative acumen, to adapt diversified and multidisciplinary platforms to compete globally.

**Quality Policy**

Our quality policy is to continuously strive for over-all development of the department and the students. Our policy is to provide best inputs to the students and to develop them to imbibe the spirit of professionalism, dedication & commitment.

**Dress Code**

We encourage our students to be formally dressed on and off campus. This nurtures the feeling of equality and belongings among the students fraternity.

All students are required to carry Photo Identity card at all the time while in the campus

**POs:**

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

**PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

**PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

**PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for

i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

#### **PSOs:**

- Ability to apply concepts of Electronics & Communication Engineering to associated research areas of electronics, communication, signal processing, VLSI, Embedded systems
- Ability to design, analyze and simulate a variety of Electronics & Communication functional elements using hardware and software tools along with analytic skills

#### **A Bird's Eye view about the Institution**

CMR Engineering College, popularly known as CMREC is the brain child of the clairvoyant CH.Narasihma Reddy. CMR Engineering College is one of the best engineering Colleges for aspiring engineering students. It is one of the newly established Colleges by CMR Engineering Educational Society. CMR Engineering College was established in 2010 in 10 Acres and built up area of 4,785.78 Sq.m. with a single - minded aim to provide a perfect platform to students in the field of Engineering, Technology for their academic and overall personality development. The college has a very good academic activity which focuses for the campus placement.

The college is approved by the All India Council for Technical Education, New Delhi and is affiliated to JNT University Hyderabad. The CMREC is offering the three under graduate courses in ECE, CSE and MECH, and post graduate course in ECE and CSE.

Today, CMREC has grown in leaps and bounds and it is no wonder that CMREC has become cynosure of the eyes of many, hankering for the distinguished centre of technological learning.

Discipline, Character and Education are the three tenets for which CMREC stands, is certainly the haven where values blend seamlessly to churn out engineers for future.

- Collaborating with Institutions and Industries.
- Promoting research and development programme for the growth of economy.
- Disseminating technical knowledge in the region by continuing education programmes.
- Aiming at continual improvement of all round development of student

### **Department Profile**

The Department of Electronics and Communication engineering of CMR Engineering College was established in the academic year 2010-11 with an annual intake of 120. The intake was increased to 180 from the academic year 2012-13 and later the intake was increased to 240 from the academic year 2013-14. In addition to this intake, the Department has 20% lateral entry students at II B.Tech level.

M.Tech programme was started with 24 intake in the specialization of Embedded Systems from the year 2013-14 and VLSI System Design from the year 2014-15.

The B.Tech (ECE) program is duly approved by the AICTE and Government of Telangana and affiliated to Jawaharlal Nehru Technological University (JNTUH), Hyderabad. Three batches have graduated so far.



Department have 56 faculty and are members of professional bodies like ISTE, IEEE, IETE. Some of the students are the members of IETE student forum and IEEE student branch of the existing Department. A technical association (ECMRON) of ECE has been formed by the senior students of the department for the benefits of students to impart additional knowledge in the field of E&C Engineering apart from prescribed curriculum.

The Department has well equipped state of art laboratories to gain good knowledge and technical skills in the field of Electronics, Communication, Microwave, VLSI, Digital Signal Processing & Microprocessors & Microcontrollers. The Department periodically organizes seminars, symposia, workshops and guest lectures for the benefit of both the students and the faculty.



BACHELOR OF TECHNOLOGY (B.TECH.)

(CMREC – R-20 Regulations)

(Applicable for the batch admitted from 2020-2021)

Academic Regulations, Course Structure and Detailed Syllabus under Autonomous Status

Established: 2010      EAMCET Code: CMRN

## **PRELIMINARY DEFINITIONS AND NOMENCLATURES**

**AICTE:** Means All India Council for Technical Education, New Delhi.

**Autonomous Institute:** Means an institute designated as Autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government of Telangana.

**Academic Autonomy:** Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

**Academic Council:** The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

**Academic Year:** It is the period necessary to complete an actual course of study within a year. It comprises two main semesters i.e., (one odd + one even) and supplementary semester.

**Branch:** Means specialization in a program like B.Tech. degree program in Electronics and communication Engineering, B.Tech degree program in Computer Science and Engineering, etc.

**Board of Studies (BOS):** BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

**Backlog Course:** A course is considered to be a backlog course, if the student has obtained a failure grade (F) in that course.

**Basic Sciences:** The courses offered in the areas of Mathematics, Physics, Chemistry etc., are considered to be foundational in nature.

**Commission:** Means University Grants Commission (UGC), New Delhi.

**Choice Based Credit System:** The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

**Compulsory course:** Course required to be undertaken for the award of the degree as per the program.

**Continuous Internal Examination:** It is an examination conducted towards sessional assessment.

**Core:** The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

**Course:** A course is a subject offered by a department for learning in a particular semester.

**Course Outcomes:** The essential skills that need to be acquired by every student through a course.

**Credit:** A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture/tutorial/lab hour per week.

**Credit point:** It is the product of grade point and number of credits for a course.

**Cumulative Grade Point Average (CGPA):** It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

**Curriculum:** Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

**Department:** An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff, and other resources in the process of study for a degree.

**Dropping from Semester:** Student who does not want to register for any semester can apply in writing in prescribed format before the commencement of that semester.

**Elective Course:** A course that can be chosen from a set of courses. An elective can be Professional Elective and or Open Elective.

**Evaluation:** Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

**Grade:** It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

**Grade Point:** It is a numerical weight allotted to each letter grade on a 10 - point scale.

**Honors:** An Honors degree typically refers to a higher level of academic achievement at an undergraduate level.

**Institute:** Means CMR Engineering, Hyderabad unless indicated otherwise by the context.

**Massive Open Online Courses (MOOC):** MOOC courses inculcate the habit of self- learning. MOOC courses would be additional choices in all the elective group courses.

**Minor:** Minor are coherent sequences of courses which may be taken in addition to the courses required for the B.Tech. degree.

**Pre-requisite:** A specific course or subject, the knowledge of which is required to complete before student register another course at the next grade level.

Professional Elective: It indicates a course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, UG degree program: Bachelor of Technology (B.Tech.) and PG degree program: Master of Technology (M.Tech.).

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research based work to be taken up by a student during his/her final year to achieve a particular aim. It is a credit based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a program.

Regulations: The regulations, common to all B.Tech. programs offered by Institute, are designated as – CMREC Regulations – R-20 and are binding on all the stakeholders.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. Odd semester commences usually in July and even semester in December of every year.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, is an affiliating University.

Withdraw from a Course: Withdrawing from a course means that a student can drop from a course within the first two weeks of odd or even semester. However, he / she can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

## FOREWORD

The autonomy is conferred to CMR Engineering College (CMREC), Hyderabad by University Grants Commission (UGC), New Delhi based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies including JNT University Hyderabad (JNTUH), Hyderabad and AICTE, New Delhi. It reflects the confidence of the affiliating University in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf. Thus, an autonomous institution is given the freedom to have its own examination system and monitoring mechanism, independent of the affiliating University but under its observance.

CMREC is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies such as Academic Council and Board of Studies (BOS) are constituted with the guidance of the Governing Body of the institute and recommendations of the JNTUH to frame the regulations, course structure, and syllabi under autonomous status.

The autonomous regulations, course structure, and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the institute in order to produce a quality engineering graduate to the society.

All the faculty, parents, and students are requested to go through all the rules and regulations carefully. Any clarifications needed are to be sought at appropriate time and from the principal of the institute, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The cooperation of all the stake holders is requested for the successful implementation of the autonomous system in the larger interests of the institute and brighter prospects of engineering graduates.

PRINCIPAL

## **ACADEMIC REGULATIONS FOR B.TECH. REGULAR STUDENTS WITH EFFECT FROM ACADEMIC YEAR 2020 – 21 (CMREC R-20)**

For pursuing four year under graduate Bachelor Degree Programme of study in Engineering (B.Tech.) offered by CMR Engineering College under Autonomous status is here in referred to as CMREC (An Autonomous Institution)

All the rules specified here in approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2020-21 onwards. Any reference to “Institute” or “College” in these rules and regulations shall stand for CMR Engineering College (An Autonomous Institution).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, CMR Engineering College shall be the chairman Academic Council.

### **1.0 Under-Graduate Degree Programme in Engineering & Technology (UGP in E&T)**

CMR Engineering College offers a 4-year (8 semesters) Bachelor of Technology (B.Tech.) degree programme, under Choice Based Credit System (CBCS) with effect from the academic year 2020-21.

## **ADMISSION**

Admission first year of four-year B. Tech. Degree Program of study in Engineering

### **Eligibility**

A candidate seeking admission into the first year of four year B. Tech. Degree Program should have:

Passed either Intermediate Public Examination (I.P.E.) conducted by the Board of Intermediate Education, Telangana, with Mathematics, Physics and Chemistry as optional subjects or any equivalent examination recognized by Board of Intermediate Education, Telangana or a Diploma in Engineering in the relevant branch conducted by the Board of Technical Education, Telangana or equivalent Diploma recognized by Board of Technical Education for admission as per guidelines defined by the Regulatory bodies of Telangana State Council for Higher Education (TSCHE) and AICTE.

Secured a rank in the EAMCET examination conducted by the Telangana State Government or on the university or in the basis of any other order of merit approved by the university, for allotment of a seat by the Convener, EAMCET.

## **Admission Procedure**

Admissions are made into the first year of four year B. Tech. Degree Program as per the stipulations of the TSCHE.

Category A seats are filled by the Convener, TSEAMCET (70%).

Category B seats are filled by the Management (30%).

Admission into the second year of four year B. Tech. degree Program in Engineering

### **Eligibility**

A candidate seeking admission under lateral entry into the II year I Semester B. Tech. degree Program should have passed the qualifying exam (B.Sc. Mathematics or Diploma in concerned course) and based on the rank secured by the candidate in Engineering Common Entrance Test ECET (FDH) in accordance with the instructions received from the Convener, ECET and Government of Telangana allotted the seats.

### **Admission Procedure**

Admissions are made into the II year of four year B. Tech. Degree Program through Convener, ECET (FDH) against the sanctioned strength in each Program of study as lateral entry students.

## **B. TECH. PROGRAMME STRUCTURE**

### **Programs Offered**

CMR Engineering College, an autonomous institution affiliated to JNTUH, offers the following B. Tech. Programs of study leading to the award of B. Tech. degree under the autonomous scheme.

B.Tech. Computer Science and Engineering

B.Tech. Computer Science and Engineering (Artificial Intelligence & Machine Learning)

B.Tech. Computer Science and Engineering (Data Science)

B.Tech. Computer Science and Engineering (Cyber Security)

B.Tech. Electronics and Communication Engineering

B.Tech. Information Technology

B.Tech. Mechanical Engineering

### **Duration of the Programs**

A student after securing admission shall complete the B.Tech. programme in a minimum period of four academic years (8 semesters), and a maximum period of eight academic years (16 semesters) starting from the date of commencement of first year first semester, failing which student shall forfeit seat in B.Tech. course. Each student shall secure 160 credits (with CGPA  $\geq 5$ ) required for the completion of the under graduate programme and award of the B.Tech. Degree.



UGC / AICTE specified definitions / descriptions are adopted appropriately for various terms and abbreviations used in these academic regulations / norms, which are listed below.

#### Semester Scheme

Each under graduate programme is of 4 academic years (8 semesters) with the academic year divided into two semesters of 22 weeks ( $\geq 90$  instructional days) each, each semester having - Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).

#### Credit Courses

All subjects / courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject / course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

One credit for one hour / week / semester for theory / lecture (L) courses or Tutorials.

One credit for two hours / week / semester for laboratory / practical (P) courses. Courses like Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab are mandatory courses. These courses will not carry any credits.

#### Subject Course Classification

All subjects / courses offered for the under graduate program in E&T (B. Tech. degree programs) are broadly classified as follows.

S. No.	Broad Course Classification	Course Group Category	Course Description
1	Foundation Courses (FnC)	BS – Basic Sciences	Includes mathematics, physics and chemistry subjects
2		ES - Engineering Sciences	Includes fundamental engineering subjects
3		HS – Humanities and Social sciences	Includes subjects related to humanities, social sciences and management
4	Core Courses (CoC)	PC – Professional Core	Includes core subjects related to the parent Discipline / department / branch of Engineering
5	Elective Courses (ElC)	PE – Professional Electives	Includes elective subjects related to the parent Discipline / department / branch of Engineering.
6		OE – Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline / department / branch of Engineering.
7	Core Courses	Project Work	B.Tech. project or UG project or UG major project or Project Stage I & II
8		Industrial training / Mini- project	Industrial training / Summer Internship / Industrial Oriented Mini-project /Mini-project
9		Seminar	Seminar / Colloquium based on core contents related to parent discipline / department / branch of Engineering.
10		-	Mandatory courses (non-credit)

## **COURSE REGISTRATION**

A faculty advisor or counselor shall be assigned to a group of 20 students, who will advise the students about the under graduate programme, its course structure and curriculum, choice / option for subjects / courses, based on their competence, progress, pre-requisites and interest.

The academic section of the college invites “registration forms” from students before the beginning of the semester through “on-line registration”, ensuring “date and time of starting”. The on-line registration requests for any “current semester” shall be completed before the commencement of SEEs (Semester End Examinations) of the ‘preceding semester’.

A student can apply for on-line registration, only after obtaining the ‘written approval’ from faculty advisor / counselor, which should be submitted to the college academic section through the Head of the Department. A copy of it shall be retained with Head of the Department, faculty advisor / counselor and the student.

If the student submits ambiguous choices or multiple options or erroneous entries during on-line registration for the subject(s) / course(s) under a given / specified course group / category as listed in the course structure, only the first mentioned subject / course in that category will be taken into consideration.

Subject / course options exercised through on-line registration are final and cannot be changed or inter-changed further and alternate choices also will not be considered. However, if the subject / course that has already been listed for registration by the Head of the Department in a semester could not be offered due to any unforeseen or unexpected reasons, then the student shall be allowed to have alternate choice either for a new subject (subject to offering of such a subject), or for another existing subject (subject to availability of seats). Such alternate arrangements will be made by the head of the department, with due notification and time-framed schedule, within the first week after the commencement of class-work for that semester.

Dropping of subjects / courses may be permitted, only after obtaining prior approval from the faculty advisor/ counselor with in a period of 15days “from the beginning of the current semester”.

Open Elective Course: Students can choose One Open Elective Course (OEC-I) during VI Semester, one (OEC-II) during VII Semester and one (OEC-III) in VIII Semester from the list of Open Elective Courses given. However, Students cannot op

for an Open Elective Courses offered by their own (parent) Department, if it is there in the already listed under any category of the Subjects offered by parent Department in any Semester.

Professional Electives: The students have to choose six professional electives (PE-I to PE-VI) from the list of professional electives.

### **SUBJECTS / COURSES TO BE OFFERED**

A typical section (or class) strength for each semester shall be 60.

A subject / course may be offered to the students, only if a minimum of 20 students ( $\frac{1}{3}$  of the section strength) opt for it. The maximum strength of a section is limited to 80 ( $60 + \frac{1}{3}$  of the section strength).

More than one faculty member may offer the same subject (lab / practical may be included with the corresponding theory subject in the same semester) in any semester. However, selection of choice for students will be based on – “first come first serve basis and CGPA criterion” (i.e., the first focus shall be on early on-line entry from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

If more entries for registration of a subject comes into picture, then the Head of the Department concerned shall decide, whether or not to offer such a subject / course for two (or more) sections.

In case of options coming from students of other departments / branches / disciplines (not considering open electives), first priority shall be given to the student of the “Parent Department”.

### **ATTENDANCE REQUIREMENTS**

A student shall be eligible to appear for the semester end examinations, if the student acquires a minimum of 75% of attendance in aggregate of all the subjects / courses (excluding attendance in mandatory courses like Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab) for that semester. Two periods of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject. This attendance should be included in the fortnight attendance.

The attendance of Mandatory Non-Credit courses should be uploaded separately.

Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be condoned by the college academic committee on genuine and valid grounds, based on the students representation with supporting evidence.

A stipulated fee shall be payable for condoning of shortage of attendance.

Shortage of attendance below 65% in aggregate shall in no case be condoned.

Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the next semester. They may seek re-registration for all

those subjects registered in that semester, in which the student is detained, by seeking re-admission into that semester as and when offered; if there are any professional electives and / or open electives, the same may also be re-registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the same set of elective subjects offered under that category.

A student fulfilling the attendance requirement in the present semester shall not be eligible for readmission into the same class.

## **ACADEMIC REQUIREMENTS**

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no. 6.0.

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject / course, if student secures not less than 35% (25 marks out of 70 marks) in the semester end examination, and a minimum of 40% (40 marks out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of letter grades, this implies securing “C” grade or above in that subject / course.

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Industrial Oriented Mini Project / Summer Internship and seminar, if the student secures not less than 40% marks (i.e., 40 out of 100 allotted marks) in each of them. The student is deemed to have failed, if he/she (i) does not submit a report on Industrial Oriented Mini Project / Summer Internship, or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) does not present the seminar as required in the IV year I Semester, or (iii) secures less than 40% marks in Industrial Oriented Mini Project / Summer Internship and seminar evaluations.

A student may reappear once for each of the above evaluations, when they are scheduled again; if the student fails in such “one reappearance” evaluation also, the student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

If a student registers for “extra subjects” (in the parent department or other departments / branches of Engg.) other than those listed subjects totaling to 160 credits as specified in the course structure of his / her department, the performances in those “extra subjects” (although evaluated and graded using the same procedure as that of the required 160 credits) will not be taken into account while calculating the SGPA and CGPA. For such ‘extra subjects’ registered, percentage of marks and letter grade alone will be indicated in the grade card as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations 6.0 and 7.1 – 7.4 above.

A student eligible to appear in the semester end examination for any subject / course, but absent from it or failed (thereby failing to secure “C” grade or above) may reappear for that subject / course in the supplementary examination as and when conducted. In such cases, internal marks (CIE) assessed earlier for that subject / course will be carried over, and added to the marks to be obtained in the SEE supplementary examination for evaluating performance in that subject.

A student detained in a semester due to shortage of attendance may be re-admitted in the same semester in the next academic year for fulfillment of academic requirements. The academic regulations under which a student has been readmitted shall be applicable. However, no grade allotments or SGPA / CGPA calculations will be done for the entire semester in which the student has been detained.

A student detained due to lack of credits, shall be promoted to the next academic year only after acquiring the required academic credits. The academic regulations under which the student has been readmitted shall be applicable to him / her.

## **EVALUATION - DISTRIBUTION AND WEIGHTAGE OF MARKS**

The performance of a student in every subject / course (including practical and Project Stage – I & II) will be evaluated for 100 marks each, with 30 marks allotted for CIE (Continuous Internal Evaluation) and 70 marks for SEE (Semester End-Examination).

For all Theory Courses as mentioned above, the distribution shall be 30 marks for CIE, and 70 marks for the SEE.

For Theory Subjects

Continuous Internal Evaluation (CIE)

During the Semester, there will be two mid-terms examinations for 30 marks each. Each mid-term examination consists of one subjective paper for 25 marks and assignment for 5 marks for each subject.

Question paper contains two Parts (Part-A and Part-B). The distribution of marks for PART- A and PART-B will be 10 marks & 15 marks respectively for UG programs.

## Promotion Rules

S. No.	Promotion	Conditions to be fulfilled
1	First year first semester to first year second semester	Regular course of study of first year first semester.
2	First year second semester to second year first semester	(i) Regular course of study of first year second semester.
		(ii) Must have secured at least 19 credits out of 39 credits i.e., 50% credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Second year first semester to second year second semester	Regular course of study of second year first semester.
4	Second year second semester to third year first semester	Regular course of study of second year second semester. Must have secured at least 47 credits out of 79 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Third year first semester to third year second semester	Regular course of study of third year first semester.
6	Third year second semester to fourth year first semester	Regular course of study of third year second semester. Must have secured at least 71 credits out of 119 credits i.e., 60% credits up

		to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
7	Fourth year first semester to fourth year second semester	Regular course of study of fourth year first semester.

A student (i) shall register for all courses / subjects covering 160 credits as specified and listed in the course structure, (ii) fulfils all the attendance and academic requirements for 160 credits, (iii) earn all 160 credits by securing SGPA > 5.0 (in each semester), and CGPA (at the end of each successive semester) >5.0, (iv) passes all the mandatory courses, to successfully complete the under graduate program. The performance of the student in these 160 credits shall be taken into account for the calculation of “the final CGPA” (at the end of under graduate program), and shall be indicated in the grade card of IV year II semester.

Pattern of the question paper is as follows.

#### **PART-A**

Consists of Five Short answer Questions each carrying two mark. The I-Mid-term examination shall be conducted for the 50% of the syllabus and II-Mid-term examination shall be conducted for remaining 50% of the syllabus.

#### **PART-B**

Consists of Three questions (out of which students have to answer three questions) carrying five marks each. Each question there will be an “either” “or” choice (that means there will be two questions from each unit and the student should answer any one question). The questions may consist of sub-questions also.

The first mid-term examination shall be conducted for the first 50% of the syllabus, and the second mid-term examination shall be conducted for the remaining 50% of the syllabus.

First Assignment should be submitted before the commencement of the first mid-term examinations, and the Second Assignment should be submitted before the commencement of the second mid-term examinations. The assignments shall be specified / given by the concerned subject teacher.

The total marks secured by the student in each mid-term examination are evaluated for 30 marks, and the average of the two mid - term examinations shall be taken as the final marks secured by each student in Continuous Internal Evaluation.



If any student is absent for any subject of Mid-term examination, an online test (CBT - Computer Based Test) will be conducted for him / her by the institute.

### **Semester End Examination (SEE)**

The Semester End Examination (SEE) will be conducted for 70 marks consisting of Two parts i). Part - A for 20 marks ii). Part - B for 50 marks.

Part - A is compulsory question consisting of ten sub-questions. Two sub-questions from each unit and carry 2 marks each.

Part - B consist of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from one unit may contain sub-questions. For each question there will be "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

For Practical Courses

### **Continuous Internal Evaluation (CIE)**

There shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 marks with a distribution of 20 marks for day-to-day evaluation and 10 marks for internal lab exam. One internal practical test shall be conducted by the concerned laboratory teacher.

### **Semester End Examination (SEE)**

SEE shall be conducted for 70 marks with an external examiner and the laboratory teacher concerned. The external examiner shall be appointed by the Chief Controller of Examinations of the college. The external examiner should be selected from the outside college among the autonomous / reputed institutions from a panel of three examiners submitted by the concerned BOS Chairman of the Department.

### **Engineering Graphics**

For the Subjects having Design and / or Drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing, Production Drawing Practice, and Estimation), the distribution shall be 30 marks for CIE (20 marks for day-to-day work and timely submission of drawing sheets and 10 marks for internal tests). There shall be two internal tests in a semester and the average of the two shall be considered for the award of marks for CIE.

The distribution of marks for SEE shall be 70 marks. SEE shall consist of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub - questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

There shall be an Internship / Mini Project, in collaboration with an industry of their specialization. Students will register for this immediately after III year II semester (VI Semester) end examinations and pursue it during summer vacation. The evaluation of Mini project will be done at the end of IV Year I semester (VII semester). It shall be evaluated internally for 100 marks. The committee

consisting of Project Coordinator, Supervisor of the project and one senior faculty of the department will evaluate the mini Project and award appropriate Grade, based on the report submitted to the department and presentation provided by the student in front of the committee.

### **Major Project - It shall be carried out in two stages**

Project Stage – I shall be evaluated internally during IV Year I Semester, Project Stage – II shall be evaluated externally during IV Year II Semester. Each stage will be evaluated for 100 marks. Student has to submit project work report at the end of each semester. First report includes project work carried out in IV Year I semester and second report include project work carried out in IV Year I & II Semesters. SEE for both project stages shall be completed before the commencement of SEE Theory examinations.

For Project Stage – I, the departmental committee consisting of Head of the Department, project supervisor and a senior faculty member shall evaluate the project work for 70marks and project supervisor shall evaluate for 30 marks. Two reviews shall be conducted. Review-I will be conducted within a month from the commencement of class work (problem definition, objective, literature survey) and Review-II will be conducted before second mid examination (brief description and sample case study, progress of work, presentation and report submission). Average of the two reviews will be taken for 100 marks.

The student is deemed to have failed, if he (i) does not submit a report on Project Stage

- I or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) secures less than 40% marks. A student who has failed may reappear once for the above evaluation, when it is scheduled again; if he fails in such “one reappearance” evaluation also, he has to reappear for the same in the subsequent

semesters, as and when it is scheduled. The topics for industrial oriented mini project, seminar and Project Stage – I shall be different from one another.

Project Stage – II is the continuation of Project Stage – I. It shall be evaluated by the external examiner for 70 marks and the project supervisor shall evaluate it for 30 marks. Two reviews should be conducted. Review-I will be conducted within a month from the commencement of class work (progress of work, discussion and presentation) and Review- II will be conducted before second mid examination (progress of work, results, discussion, presentation and report submission). Average of the two reviews will be taken for CIE. The Project Viva-voce (SEE) shall be conducted by a committee comprising of an External Examiner, Head of the Department and Project Supervisor. In SEE marks, 20% for working model / simulation / data collection, 20% for report preparation and 60% for presentation and viva-voce. The external examiner should be selected by Chief Controller of Examinations / Principal from outside the college among the autonomous / reputed institutions from a panel of three examiners submitted by the concerned Head of the Department.

The student is deemed to have failed, if he / she (i) does not submit a report on Project Stage II, or does not make a presentation of the same before the external examiner as per schedule, or (ii) secures less than 40% marks in the sum total of the CIE and SEE taken together. A student who has failed may reappear once for the above evaluation, when it is scheduled again; if student fails in such “one

reappearance” evaluation also, he / she has to reappear for the same in the next subsequent semester, as and when it is scheduled.

### **Seminar**

For Seminar presentation, the student shall collect the information on a specialized topic, prepare a Technical Report and submit to the department at the time of seminar presentation. The seminar presentation (along with the technical report) shall be evaluated by a committee consisting of Seminar coordinator and two senior faculty members with appropriate grade. The seminar report shall be evaluated internally for 100 marks. There shall be no semester end examination for the seminar.

### **Mandatory Non-Credit Courses**

Mandatory Non-Credit Courses offered in any semester, a “Satisfactory / Not Satisfactory” shall be awarded to the student based on the performance in both CIE and SEE.

### **AWARD OF GRADES**

Grades will be awarded to indicate the performance of students in each theory subject, laboratory / practicals, seminar, Industry Oriented Mini Project, and project Stage - I & II. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in item 8.0 above, a corresponding letter grade shall be given.

As a measure of the performance of a student, a 10-point absolute grading system using the following letter grades (as per UGC / AICTE guidelines) and corresponding percentage of marks shall be followed.

% of Marks Secured in a Subject/Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
Greater than or equal to 90%	O (Outstanding)	10
80 and less than 90%	A+ (Excellent)	9
70 and less than 80%	A (Very Good)	8
60 and less than 70%	B+ (Good)	7
50 and less than 60%	B (Average)	6
40 and less than 50%	C (Pass)	5
Below 40%	F (FAIL)	0
Absent	Absent	0

A student who has obtained an “F” grade in any subject shall be deemed to have “failed” and is required to reappear as a “supplementary student” in the semester end examination, as and when offered. In such cases, internal marks in those subjects will remain the same as those obtained earlier.

To a student who has not appeared for an examination in any subject, “Absent” grade will be allocated in that subject, and he / she is deemed to have “failed”. A student will be required to reappear as a “supplementary student” in the semester end examination, as and when offered next. In this case also, the internal marks in those subjects will remain the same as those obtained earlier.

A letter grade does not indicate any specific percentage of marks secured by the student, but it indicates only the range of percentage of marks.

A student earns grade point (GP) in each subject / course, on the basis of the letter grade secured in that subject / course. The corresponding “credit points” (CP) are computed by multiplying the grade point with credits for that particular subject / course.

Credit points (CP) = grade point (GP) x credits .... For a course

A student passes the subject / course only when  $GP > 5$  (“C” grade or above)

The Semester Grade Point Average (SGPA) is calculated by dividing the sum of credit points ( $\sum CP$ ) secured from all subjects / courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to two decimal places. SGPA is thus computed as

For each semester,

where “i” is the subject indicator index (takes into account all subjects in a semester), “N” is the number of subjects “registered” for the semester (as specifically required and listed under the

course structure of the parent department),  $C_i$  is the number of credits allotted to the  $i$ th subject, and  $G_i$  represents the grade points (GP) corresponding to the letter grade awarded for that  $i$ th subject.

The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the ratio of the total credit points secured by a student in all registered courses in all semesters, and the total number of credits registered in all the semesters. CGPA is rounded off to two decimal places. CGPA is thus computed from the I year II semester onwards at the end of each semester as per the formula

For all S semesters registered, (i.e., up to and inclusive of S semesters,  $S > 2$ ),

where “M” is the total number of subjects (as specifically required and listed under the course structure of the parent department) the student has “registered” i.e., from the 1st semester onwards up to and inclusive of the 8th semester, “j” is the subject indicator index (takes into account all subjects from 1 to 8 semesters),  $C_j$  is the number of credits allotted to the jth subject, and  $G_j$  represents the grade points (GP) corresponding to the letter grade awarded for that jth subject. After registration and completion of I year I semester, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

#### Illustration of calculation of SGPA

Course / Subject	Credits	Letter Grade	Grade Points	Credit Points
Course 1	4	A	8	$4 \times 8 = 32$
Course 2	4	O	10	$4 \times 10 = 40$
Course 3	4	C	5	$4 \times 5 = 20$
Course 4	3	B	6	$3 \times 6 = 18$
Course 5	3	A+	9	$3 \times 9 = 27$
Course 6	3	C	5	$3 \times 5 = 15$
	21			152

$$\text{SGPA} = 152 / 21 = 7.24$$

#### Illustration of calculation of CGPA up to 3rd semester

Semester	Course / Subject Title	Credits Allotted	Letter Grade Secured	Corresponding Grade Point (GP)	Credit Points (CP)
I	Course 1	3	A	8	24
I	Course 2	3	O	10	30
I	Course 3	3	B	6	18
I	Course 4	4	A	8	32
I	Course 5	3	A+	9	27

I	Course 6	4	C	5	20
II	Course 7	4	B	6	24
II	Course 8	4	A	8	32
II	Course 9	3	C	5	15

II	Course 10	3	O	10	30
II	Course 11	3	B+	7	21
II	Course 12	4	B	6	24
II	Course 13	4	A	8	32
II	Course 14	3	O	10	30
III	Course 15	2	A	8	16
III	Course 16	1	C	5	5
III	Course 17	4	O	10	40
III	Course 18	3	B+	7	21
III	Course 19	4	B	6	24
III	Course 20	4	A	8	32
III	Course 21	3	B+	7	21
	Total	69		Total Credit	518
	Credits			Points	

$$\text{CGPA} = 518 / 69 = 7.51$$

The above illustrated calculation process of CGPA will be followed for each subsequent semester until VIII semester. The CGPA obtained at the end of VIII semester will be the final CGPA secured for entire B. Tech. Program for the student.

For merit ranking or comparison purposes or any other listing, only the “rounded off” values of the CGPA’s will be used.

SGPA and CGPA of a semester will be mentioned in the semester Memorandum of Grades if all subjects of that semester are passed in first attempt. Otherwise the SGPA and CGPA shall be mentioned only on the Memorandum of Grades in which sitting he / she passed his

/ her last exam in that semester. However, mandatory courses will not be taken into consideration.

### **PASSING STANDARDS**

A student shall be declared successful or “passed” in a semester, if he / she secures a GP  $\geq 5.00$  (“C” grade or above) in every subject / course in that semester (i.e., when the student gets an SGPA

> 5.00 at the end of that particular semester); and he shall be declared successful or “passed” in the entire under graduate program, only when gets a CGPA > 5.00 for the award of the degree as required.

After the completion of each semester, a grade card or grade sheet shall be issued to all the registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, number of credits, grade earned, etc.), credits earned.

### **Declaration of results**

Computation of SGPA and CGPA are done using the procedure listed in 9.6 to 9.9.

For final percentage of marks equivalent to the computed final CGPA, the following formula may be used.

$$\% \text{ of Marks} = (\text{final CGPA} - 0.5) \times 10$$

## AWARD OF DEGREE

A student who registers for all the specified subjects / courses as listed in the course structure and secures the required number of 160 credits (with CGPA  $> 5.0$ ), within 8 academic years from the date of commencement of the first academic year, shall be declared to have “qualified” for the award of B.Tech. Degree in the chosen branch of Engineering selected at the time of admission.

A student who qualifies for the award of the degree as listed in item 12.1 shall be placed in the following classes.

Class Awarded	CGPA to be Secured	From the CGPA secured from 160 Credits
First Class with distinction	$\geq 7.50$	
First Class	$\geq 6.50$ and $< 7.50$	
Second Class	$\geq 5.50$ and $< 6.50$	
Pass Class	$\geq 5.00$ and $< 5.50$	
Fail	$< 5.00$	

## WITHHOLDING OF RESULTS

If the student has not paid the tuition fees to the institution at any stage, or has dues pending due to any reason whatsoever, or if any case of indiscipline is pending, the result of the student may be withheld, and the student will not be allowed to go into the next higher semester. The award or issue of the degree may also be withheld in such cases.

## STUDENT TRANSFERS

There shall be no branch transfers after the completion of admission process.

Transfer candidates (from non-autonomous college affiliated to JNTUH): A student who is following JNTUH curriculum, transferred from other college to this institute in third semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he / she had passed earlier and substitute courses are offered in their place as decided by the Board of Studies. The student has to clear all his backlog courses up to previous semester by appearing for the supplementary examinations conducted by JNTUH for the award of degree. The total number of credits to be secured for the award of the degree will be the sum of the credits up to the previous semester under JNTUH regulations and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.



Transfer candidates (from an autonomous college affiliated to JNTUH): A student who has secured the required credits up to previous semesters as per the regulations of other autonomous institutions shall also be permitted to be transferred to this institute. A student who is transferred from the other autonomous colleges to this institute in third semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he / she had passed earlier and substitute subjects are offered in their place as decided by the Board of Studies. The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester as per the regulations of the college from which he / she is transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous status. The class will be awarded based on the academic performance of a student in the autonomous pattern.

## **SCOPE**

The academic regulations should be read as a whole, for the purpose of any interpretation.

In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the College Academic Council is final.

Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

## **ACADEMIC REGULATIONS FOR B.TECH. (LATERAL ENTRY SCHEME) FROM THE ACADEMIC YEAR 2021 – 22**

### **Eligibility for award of B. Tech. Degree (LES)**

The LES students after securing admission shall pursue a course of study for not less than three academic years and not more than six academic years.

The student shall register for 121 credits and secure 121 credits with CGPA  $\geq 5$  from II year to IV year B.Tech. programme (LES) for the award of B.Tech. degree.

The students, who fail to fulfill the requirement for the award of the degree in six academic years from the year of admission, shall forfeit their seat in B.Tech.

The attendance requirements of B.Tech. (Regular) shall be applicable to B.Tech. (LES).

### **Promotion Rule**

S. No	Promotion	Conditions to be fulfilled
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1	Second year first semester to second year second semester	Regular course of study of second year first semester.
2	Second year second semester to third year first semester	Regular course of study of second year second semester.  Must have secured at least 24 credits out of 40 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Third year first semester to third year second semester	Regular course of study of third year first semester.
4	Third year second semester	Regular course of study of third year second semester.  Must have secured at least 48 credits out of 80 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Fourth year first semester to fourth year second semester	Regular course of study of fourth year first semester.

All the other regulations as applicable to B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

## MALPRACTICES RULES

### DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S. No	Nature of Malpractices / Improper conduct	Punishment
	If the student	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which student is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any student or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical)	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester.  The hall ticket of the student is to be

		cancelled and sent to the University.
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3	Impersonates any other student in connection with the examination.	<p>The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester. The student is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.</p>
4	Smuggles in the answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	<p>Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semesters. The student is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the student is subject to the academic regulations in connection with</p> <p>For feature of seat.</p>

5	Uses objectionable, abusive or offensive language in the answer papers or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	Refuses to obey the orders of the chief superintendent/ assistant superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination cancellation of their performance in subject and all other subjects  the student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinationsof  the subjects of that semester. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The student is also debarred for two consecutive semesters from class

		work and all University examinations. The continuation of the  Course by the student is subject to the
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		academic regulations in connection with forfeiture of seat.
8	Possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The student is also debarred and forfeits the seat.
9	If student of the college, who is not a student for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The student is also debarred and forfeits the seat.  Person(s) who do not belong to the college will be handed over to the police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared for including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester.
	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the student has appeared for including practical examinations and project work of that semester examinations.

11		
12	<p>If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award a suitable punishment.</p>	



## ACADEMIC CALENDER (2023-24)



**CMR ENGINEERING COLLEGE**  
UGC AUTONOMOUS  
(Approved by AICTE - New Delhi, Affiliated to JNTUH and Accredited by NAAC & NBA)  
Kandlakoya (V), Medchal (M), Medchal Malkajgiri (D) 501401



### ACADEMIC CALENDAR B.Tech IV-YEAR: ACADEMIC YEAR (2023-24)

IV B.Tech. I – SEMESTER				
S. No.	EVENT	DATE		DURATION
		FROM	TO	
1	Commencement of Class Work	03.07.2023		---
2	First Spell of Instructions	03.07.2023	26.08.2023	8 weeks
3	<b>First Mid Term Examinations (Theory &amp; Practical)</b>	28.08.2023	02.09.2023	1 Week
4	Submission of First Mid Term Marks to Exam Branch	09.09.2023		---
5	Parents Teacher's Meeting	16.09.2023		---
6	Second Spell of Instructions (Including Dusara Vacation)*	04.09.2023	04.11.2023	9 weeks
7	<b>Second Mid Term Examinations (Theory &amp; Practical)</b>	06.11.2023	11.11.2023	1 Week
8	Submission of Second Mid Term Marks to Exam Branch	18.11.2023		---
9	Preparation Holidays and Practical Examinations	13.11.2023	18.11.2023	1 week
10	<b>End Semester &amp; Supplementary Examinations</b>	20.11.2023	02.12.2023	2 Weeks
IV B.Tech. II – Semester				
S. No.	EVENT	DATE		DURATION
		FROM	TO	
1	Commencement of II-SEM Class work	04.12.2023		---
2	First Spell of Instructions	04.12.2023	27.01.2024	8 weeks
3	<b>First Mid Term Examinations**</b>	29.01.2024	31.01.2024	3 Days
4	Submission of First Mid Term Marks to Exam Branch	10.02.2024		---
5	Second Spell of Instructions	01.02.2024	27.03.2024	8 weeks
6	<b>Second Mid Term Examinations**</b>	28.03.2024	30.03.2024	3 Days
7	Submission of Second Mid Term Marks to Exam Branch	06.04.2024		---
8	Preparation and Project Evaluation	01.04.2024	06.04.2024	1 week
9	<b>End Semester &amp; Supplementary Examinations</b>	08.04.2024	20.04.2024	2 weeks

- \*Subject to declaration by JNTUH / Govt of TS
- \*\* IV-B.Tech II-Sem has only \* 3 \* Subjects

Controller of Examinations

**Controller of Examination**  
**CMR Engineering College**  
(Autonomous)  
Kandlakoya (V), Medchal Dist.,  
Hyderabad, T.S. - 501 401.

Principal  
**CMR Engineering College**  
(Autonomous)  
Kandlakoya (V), Medchal Dist.,  
Hyderabad, T.S. - 501 401.

**DEPARTMENT EVENT PLANER (2023-24)**

S.NO	DATE	NAME OF THE EVENT
1	03/07/2023	Commencement of Class Work for IV Year
2	21/08/2023	Commencement of Class Work for III Year
3	18/09/2023	Commencement of Class Work for II Year
4	03/07/2023- 26/08/2023	I Spell of instructions for IV Year
5	21/08/2023- 14/10/2023	I Spell of instructions for III Year
6	18/09/2023- 18/11/2023	I Spell of instructions for II Year
7	30/10/2023	IV B.Tech Mini Project Work Review I
8	11.08.23	Student Workshop-I for IV Year
9	08.09.2023	Student Workshop-I for III Year
10	07/08/2023	Industrial visit
11	28/08/2023 02/09/2024	- IV B.Tech Mini Project Work Review II
12	28/08/2023 02/09/2024	- I MID Exams for IV Year
13	28/08/2023- 31/08/2023	I MID Lab Internal Exam for IV Years
14	13/09/2024 14/09/2024	- IV B.Tech Major Project Work Review I
15	08/09/2023	Guest lecture for III year
16	09/09/2023	Submission of I mid marks for IV Years to University
17	10/11/2023	IV B.Tech Mini Project Work Review II
18	16/10/2023- 21/10/2023	I MID Exams for III Year
19	23/10/2023- 21/10/2023	I MID Lab Internal Exam for III Year
20	23/10/2023- 28/10/2023	Dussehra Recess
21	20/11/2023- 25/11/2023	I MID Exams for II Year
22	21/11/2023- 23/11/2023	I MID Lab Internal Exam for II Year
23	30/10/2023	Submission of I mid marks for III Years to University
24	02/12/2023	Submission of I mid marks for III Years to University
25	14/12/2023	Professional Body Activities
26	04/09/2023- 04/11/2023	II Spell of instructions for IV Years (Including I mid examinations)
27	30/10/2023- 23/12/2023	II Spell of instructions for III Years (Including I mid examinations)
28	27/11/2023- 20/01/2024	II Spell of instructions for II Years (Including I mid examinations)
29	11/01/2024	IV B.Tech Mini Project Work Review III
30	06/11/2023 11/11/2023	- II MID Exams for IV Years
31	06/11/2023 09/11/2023	- II MID Lab Internal Exam for IV Years

### **LIST OF SUBJECTS**

S.NO	SUBJECT NAME
1	DATA COMMUNICATION AND NETWORKS
2	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
3	OPEN ELECTIVE-II
4	PROFESSIONAL ELECTIVE-III
5	PROFESSIONAL ELECTIVE-IV
6	DATA COMMUNICATION AND NETWORKS LAB
7	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB
8	INDUSTRY ORIENTED MINI PROJECT
9	PROJECT-I



**ACADEMIC PLANNER**

**FOR THE**

**ACADEMIC YEAR 2023-2024**

**COURSE: IV YEAR B. TECH -I- SEM**

**Subject: Data Communications & Networks**

**CREDITS: 4**

Presented by

Dr.N.L.Aravinda, Assoc.Prof,

Dept.of ECE

## **ACADEMIC PLANNER**

**Subject: Data Communications and Networks**

### **S.NO**

### **CONTENT**

- (1) - Preamble/Introduction
- (2) - Prerequisites
- (3) - Objectives and Outcomes
- (4) - Syllabus
  - 1.R20-CMREC
  - 2.GATE
  - 3.IES
- (5) - List of Expert Details  
(Local/National/International with Contact details/Profile link/Blogs/their research Contribution towards the subject)
- (6) - Journals with min 5 ref paper for literature study
- (7) -Subject -Lesson plan
- (8) -Suggested Books (prescribed and References)
- (9) -Websites for self learning Resources like  
*www.schools.com, Coursera Udemy, NPTEL* etc along Registration procedures
  - Question Banks 1. JNTUH/Model papers
  - 2.GATE/IES
- (11) - Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications.
- (12) - Assignment Question/Innovative Assignments sets.
- (13) - List of topics for students Seminars with Guidelines
- (14) - STEP/Course material in softcopy
- (15) - Expert Lectures with topics & Schedules (if any)

## **1. INTRODUCTION TO DATA COMMUNICATIONS AND NETWORKING:**

- 1 Standards Organizations for Data Communications
- 2 Layered Network Architecture
- 3 Open Systems Interconnection (OSI)
- 4 Data Communications Circuits
- 5 Serial and parallel Data Transmission
- 6 Data communications Circuit Arrangements
- 7 Data communications Networks
- 8 Alternate Protocol Suites.

## **2. PREREQUISITES:**

Digital Communications

## **3. COURSE OBJECTIVES:**

1. To introduce the fundamentals of data communication networks
2. To demonstrate the functions of various protocols of the Data link layer.
3. To demonstrate the functioning of various Routing protocols.
4. To introduce the functions of various Transport layer protocols.
5. To understand the significance of application layer protocols

## **COURSE OUTCOMES:**

Upon completing this course, the student will be able to

CO 1: Know the Categories and functions of various Data communication Networks

CO 2: Design and analyze various error detection techniques.

CO 3: Demonstrate the mechanism of routing the data in the network layer

CO 4: Know the significance of various Flow control and Congestion Control Mechanisms

CO 5: Know the Functioning of various Application layer Protocols.

## **4) SYLLABUS:**

R20 B.Tech. ECE Syllabus  
IV YEAR B.TECH ECE-I SEM

L T/P/D  
C 3 1/0/-  
4

**Data Communications & Networks**

**UNIT - I:** Introduction to Data Communications: Components, Data Representation, Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol



Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture,

**Objective:**

- Introduction to Data communication
- Different types of Network models, Interconnection of Networks
- Internet protocol, standards, and organizations
- OSI model
- TCP/IP model

**UNIT - II:** Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols.

802.11 MAC Protocol, IEEE 802.11 Frames

**Objective:**

- Introduction to Link layer
- Types of Errors and Redundancy
- Error correction and Detection
- Parity check, Cyclic Redundancy Check (CRC)
- Flow control and Error control protocols
- HDLC
- Random access, ALOHA
- MAC protocols

**UNIT - III:** The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol (IP): Forwarding and Addressing in the Internet- Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6

**Objective**

- Forwarding and Routing
- Virtual circuit and datagram Networks
- Concept of Router
- Queuing
- Internet protocol (IP)
- IPv4
- IPv6
- ICMP

**UNIT - IV:** Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer- Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, GoBack-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control

**Objective:**

- Relationship Between Transport and Network Layer
- Multiplexing and Demultiplexing,
- UDP
- Reliable Data Transfer Protocol
- Go Back-N(GBN)
- Selective Repeat (SR)
- TCP
- Principles of Congestion Control

**UNIT - V:** Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages

**Objective:**

- Principles of Networking Applications
- FTP
- Electronic Mail in the Internet
- STMP
- HTTP
- DNS

***TEXTBOOKS:***

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6th Edition, Pearson.
2. Data Communications and Networking Behrouz A. Forouzan 4th Edition McGraw-Hill Education

***REFERENCES:***

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education
3. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

## ***SYLLABUS – GATE:***

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching;

Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT);

Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

## ***SYLLABUS – IES:***

Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT);

Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

## ***5. SUBJECT EXPERTS DETAILS:***

### **REGIONAL:**

1. Dr N.S Murthy (NIT WARANGAL), Professor, Electronics & Com. Engg.  
Department National Institute of Technology, Warangal - 506004, A.P, INDIA

E-Mail:

nsm@nitw.ac.in Phone

No: 0870-2462404

2. Dr.Kakarla Subba Rao, *Dept. of ECE, CBIT, Gandipet, Hyd-75.*

[kakarlasubbarao@yahoo.c](mailto:kakarlasubbarao@yahoo.com)

[om](mailto:kakarlasubbarao@yahoo.com) (H): (O): (M):

9440115130

### **NATIONAL:**

1. Dr. Ganapati Panda (IIT BHUBANESWAR),  
Professor, Contact no:+91 674 2306 205,

Mail id: gpanda@iitbbs.ac.in, [ganapati.panda@gmail.com](mailto:ganapati.panda@gmail.com)

2. Goutam Saha(IIT KHARGHPUR), Associate  
Professor, Electronics & Electrical

Communication Engineering  
Contact no:++91 - 3222 - 283557 (IIT Phone)

Mail id: gsaha @ ece.iitkgp.ernet.in,  
<http://www.ecdept.iitkgp.ernet.in/index.php/home/faculty/gsaha>

### **INTERNATIONAL:**

1. ***Behrouz Forouzan*** ,  
emeritus professor of the Computer Information Systems department of  
DeAnza College,  
Phone: (408)864-8902  
E-mail: [forouzan@fhda.edu](mailto:forouzan@fhda.edu)
2. **Andrew Stuart Tanenbaum**,

a Dutch-American computer scientist and professor emeritus of  
computer science at the [Vrije Universiteit Amsterdam](#) in the  
Netherlands..

[www.cs.vu.nl/~ast](http://www.cs.vu.nl/~ast)  
[www.pearsonhighered.com/tanenbaum](http://www.pearsonhighered.com/tanenbaum)

### **2. Journals**

IEEE Communications Surveys and Tutorials  
<https://www.igi-global.com/journal/international-journal-business-data-communications/1087>

### ***(7) . Lesson Plan***

Name of the topic	Sub topics	No. of classes	Text books	Teaching Methods
<b>UNIT I</b>				
	Components, Data Representation	L1	T2,R1	M1

Introduction to Data Communications	Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures,	L2,L3	T2,R1	M1
	Network Models, Categories of Networks Interconnection of Networks	L4,L5	T2,R1	M1
	The Internet - A Brief History, The Internet Today, Protocol and Standards	L6,L7	T2,R1	M2:PPT
	Protocols, Standards, Standards Organizations, Internet Standards	L8,L9	T2,R1	M1
	Network Models, Layered Tasks,	L10,L11	T2,R1	M1
	OSI model, Layers in OSI model,	L12	T2,R1	M2:PPT
	TCP/IP Protocol Suite, Addressing Introduction	L13	T2,R1	M2:PPT
	Wireless Links and Network Characteristics,	L14 ,L15	T2,R1	M1
	WiFi: 802.11 Wireless LANs - The 802.11 Architecture	L16,L17	T2,R1	M1
	No. of classes required: 17			
<b>UNIT II</b>				
Data Link Layer	Links, Access Networks	L18,L19	T1,R1,T2	M1
	LANs- Introduction to the Link Layer, The Services Provided by the Link Layer	L20,L21	T1,R1,T2	M1
	Types of errors, Redundancy, Detection vs Correction	L22	T1,R1,T2	M1
	Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks	L23,L24	T1,R1,T2	M1
	<b>Check summing Methods, Cyclic Redundancy Check (CRC) , Framing</b>	L25	T1,R1,T2	M2:PPT
	<b>Flow Control and Error Control protocols</b>	L26,L27	T1,R1,T2	M1
	<b>Flow Control and Error Control protocols</b>	L28,L29	T1,R1,T2	M1
	<b>Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols</b>	L30,L31	T1,R1,T2	M1

	<b>Random Access ,ALOHA, Controlled access, Channelization Protocols</b>	L32	T1,R1,T2	M1
	<b>802.11 MAC Protocol, IEEE 802.11 Frame</b>	L33	T1,R1,T2	M1
	No. of classes required:16			
<b>UNIT III</b>				
The Network Layer	Introduction, Forwarding and Routing, Network Service Models,	L34,L35	T1,R1	M1
	Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks	L36,L37	T1,R1	M2:PPT
	Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane	L38	T1,R1	M1
	The Internet Protocol(IP):Forwarding and Addressing in the Internet-Datagram format, Ipv4 Addressing	L39,L40	T1,R1	M1
	Internet Control Message Protocol(ICMP), IPv6	L41	T1,R1	M1
	No. of classes required:08			
<b>UNIT IV</b>				
Transport Layer	Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet	L42,L43,	T1,R1	M1
	Multiplexing and Demultiplexing, Connectionless Transport: UDP - UDP Segment Structure, UDP Checksum	L44,L45	T1,R1	M1
	Principles of Reliable Data	L46,L47	T1,R1	M1
	Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, GoBack-N(GBN), Selective Repeat(SR)			

	Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round- Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management	L48, L49	T1,R1	M1
	Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control	L50, L51	T1,R1	M1
	No. of classes required:11			
<b>UNIT V</b>				
Application Layer	Principles of Networking Applications – Network Application Architectures, Processes Communicating	L52, L53	T1,R1	M1
	Transport Services Available to Applications,	L54	T1,R1	M1
	Transport Services Provided by the File Transfer	L55	T1,R1	M1
	FTP,- FTP Commands and Replies	L56	T1,R1	M1
	Electronic Mail in the Internet- STMP	L57	T1,R1	M1
	Comparison with HTTP	L58	T1,R1	M2:PPT
	DNS-The Internet’s Directory Service	L59	T1,R1	M2:PPT
	Service Provided by DNS, Overview of How DNS Works, DNS Records and messages	L60	T1,R1	M2:PPT
		L61, L62	T1,R1	M1
	No. of classes required:10			
	<b>Total No. of Classes :54</b>			

### **(8) SUGGESTED BOOKS:**

#### ***TEXTBOOKS:***

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6th Edition,



Pearson.

2. Data Communications and Networking Behrouz A. Forouzan 4th Edition McGraw-Hill Education

### ***REFERENCES:***

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education
3. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

### ***9. WEBSITES and URL's:***

1. VIDEO LECTURES:

<https://www.youtube.com/watch?v=sG6WGvzmVaw>

2. IIT Bombay CN VIRTUAL LAB:

[http://vlabs.iitb.ac.in/vlabs-dev/labs\\_local/computer-networks/labs/explist.php](http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php)

3 .MIT OPEN COURSEWARE:

<https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-263j-data-communication-networks-fall-2002/lecture-notes/>

**4. TEXT BOOKS:** [https://eclass.teicrete.gr/modules/document/file.php/TP326/%CE%98%CE%B5%CF%89%CF%81%CE%AF%CE%B1%20\(Lectures\)/Computer\\_Networking\\_A\\_Top-Down\\_Approach.pdf](https://eclass.teicrete.gr/modules/document/file.php/TP326/%CE%98%CE%B5%CF%89%CF%81%CE%AF%CE%B1%20(Lectures)/Computer_Networking_A_Top-Down_Approach.pdf)

<http://widi.lecturer.pens.ac.id/Teori/Komunikasi%20Data/Data%20Communications%20and%20Networking%20By%20Behrouz%20A.Forouzan.pdf>

***Code No: 135AE***

***R18***

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

***B. Tech III Year I Semester Examinations, May/June - 2019 DATA  
COMMUNICATION AND NETWORKS***

**(Common to ECE, IT)**

***Time: 3 hours***

***Max. Marks: 75***

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit.  
Each question carries

10 marks and may have a, b, c as sub questions.

***PART - A***  
**(25 Marks)**

List out the topologies used in networks. [2]

- b) Differentiate circuit switched networks and datagram networks. [3]
- c) Explain flow control. [2]
- d) Describe the differences between PPP and HDLC. [3]
- e) Differentiate broadcasting and flooding. [2]
- f) Define tunneling. [3]
- g) Differentiate between TCP and UDP. [2]
- h) Why three way handshake is used in TCP. [3]
- i) What is the use of FTP? [2]
- j) What is the header format of HTTP reply message? [3]

***PART - B***  
**(50 Marks)**

- 2.a) Explain the ATM reference model and describe the functions performed by each layer.  
b) What are the advantages and disadvantages of ring topology? [5+5]

**OR**

- 3.a) Elicit types of transmission media with their merits and demerits.  
b) Describe the characteristics of layered architecture. [5+5]

- 4.a) What are the different types of error detection methods? Explain the CRC error detection technique using generator polynomial  $x^4 + x^3 + 1$  and data 11100011.  
b) Explain the CSMA schemes with diagrams. [5+5]

**OR**

- 5.a) Elucidate PCF and DCF in 802.11 format.  
b) A very heavily loaded 1 km long, 10-Mbps token ring has propagation speed of 200m/μsec. Fifty stations are uniformly spaced around the ring. Data frames are 256-bits, including 32 bits of overhead. Acknowledgements are piggybacked onto the data frames and are included as spare bits within the data frames and are effectively free. The token is 8 bits. Is the effective data rate of this higher or lower than the effective data rate of a 10-Mbps CSMA/CD NETWORK? [5+5]
- 6.a) Differentiate DVR and OSPF.  
b) How count to infinity problem is resolved in DVR. [5+5]
- 7.a) Explain ARP and RARP with examples.  
b) What is purpose of ICMP? Explain its messages in detail. [5+5]
- 8.a) Explain the features and applications of UDP.  
b) Elucidate congestion control in datagram subnets. [5+5]
- 9.a) Elucidate the congestion prevention policies.  
b) Explain the TCP header fields in detail. [5+5]
- 10.a) What is an Electronic mail? Explain the two scenarios of architecture of E-Mail.  
b) Explain the architecture of WWW. Discuss client and server side functionality of this

architecture.

[5+5]

**OR**

11.a) What is SNMP? Briefly discuss the SNMP model components.

b) What is the use of DNS? Explain how it works?

[5+5]

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**Code No: 135AE**

**R18**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, November/December - 2018**

**DATA COMMUNICATION AND NETWORKS**

*(Common to ECE, IT)*

**Time: 3 hours**

**Max. Marks: 75**

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A**

**(25 Marks)**

- 1.a) List various components in a network. [2]
  - b) List and define different network topologies. [3]
  - c) Define bit stuffing and character stuffing. [2]
  - d) Briefly discuss about ALOHA. [3]
  - e) Why the class C is most commonly used Network class? [2]
  - f) Discuss how address mapping is performed. [3]
  - g) Mention Congestion Prevention Policies and how does it work. [2]
    - h) Flow control and Error control both are properties of Transport Layer and Data Link Layer. What you think is it duplicity of properties in both layer or is it ok? Comment.
- [3]
- i) Define SNMP protocol. [2]
  - j) Discuss the properties of file transfer protocol. [3]

**PART - B**  
**(50 Marks)**

2. With a neat diagram explain the OSI reference model in detail? Explain the functions performed in each layer. [10]

**OR**

3. What is multiplexing? Explain in detail about various types of multiplexing. [10]

4. Describe various error detection and correction technique. The generator polynomial is  $x^3+x+1$ . A sender want to send data 1001. Generate CRC code. Also describe error checking process if 3<sup>rd</sup> bit is inverted from the left. [10]

**OR**

5. What is high level data link control (HDLC)? Explain HDLC frame format in detail. [10]
6. What is classful addressing? Discuss class A, class B, class C, class D, class E address with its range in decimal dotted notation and example. [10]
- OR**
7. Give an example to explain any one of the multicasting routing algorithm. [10]
8. Discuss the transport layer service primitives. What do you understand by 3 way hand shake Technique? Also discuss the TCP connection management. [10]
9. Compare and contrast between integrated services and Differential Services. [10]
10. Explain name – address and address – name resolution process. [10]
- OR**
11. Describe the various parts of e-mail address and show the process of sending and receiving e-mails. [10]

**Code No: 135AE**

**R18**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD**

***B. Tech III Year I Semester Examinations, November/December - 2018***

***DATA COMMUNICATION AND NETWORKS***

**(ECE)**

- 1 Answer the following: (10 X 02 = 20 Marks)
- (a) Differentiate simplex and duplex communication systems.
  - (b) How data is represented in case of ASCII coding system?
  - (c) Describe the functions of session and application layers.
  - (d) Describe unipolar and bipolar signal representation codes.
  - (e) If the bit rate = 3000 and each signal element carries 6 bits. Find the baud rate.
  - (f) Differentiate between wireless LAN and Bluetooth.
  - (g) State modem specifications.
  - (h) Mention the QOS parameters of network service.

- (i) What is congestion and how it occurs?
- (j) Explain the principle of datagram.



**PART-B**

(Answer all five units, 5 X 10 = 50 Marks)

- 2 (a) What are the applications and advantages of data communication networks?  
(b) Explain the classification of data communication networks.

**OR**

- 3 (a) What are the principles used in layer architecture?  
(b) What are the merits and demerits of TCP/IP model over ISO OSI model?
- 4 (a) Describe various modes of data transmission.  
(b) Explain the need for flow control in the data link layer.

**OR**

- 5 (a) What are the advantages of burst codes and how this is achieved?  
(b) Discuss about error control protocol with diagram.

- 6 What are the differences between frequency division multiple access & code division multiple access and discuss them?

**OR**

- 7 Classify wireless LANs & wired LANs and give LAN standards.
- 8 Explain the various methods used by TCP for congestion control.

**OR**

- 9 (a) Describe the distance vector routing algorithm.  
(b) Discuss IP addressing procedure and its advantages.
- 10 (a) List the transport layer's quality of service parameters and explain them.  
(b) Under what conditions of delay, bandwidth, load and packet loss will TCP retransmit significant volume data unnecessarily.

**OR**

- 11 (a) How web security can be achieved? What are the different mechanisms?  
(b) Explain the operation of any one authentication protocol with a neat diagram.

**12. Assignment Question :**

**Unit -1**

1. Explain how OSI and ISO related to each other are
2. Explain ISO/OSI reference model with neat diagram?
3. Define topology and explain and explain the topologies of networks?
4. Explain the transmission modes in details?
5. Define circuit switching networks in details?.
6. Define virtual circuit networks in details?

## Unit-II

- 1.State the functions of MAC?.
2. How performance is improved in CSMA/CD protocol compared to CSMA protocol? Explain?
3. How CSMA/CA differ from CSMA/CD .explain in brief?. How performance is improved in CSMA/CD.
4. Discuss the MAC layer functions of IEEE 802.11?.
4. Discuss the MAC layer functions of IEEE 802.11?.
5. Explain the frames format ,operation and ring maintenance fracture of IEEE 802.5 MAC protocol

## Unit-III

- 1.Explain network layer logical addressing?.
- 2.Illustrate internetworking and tunneling?.
- 3.Explain in details of ICMP,IGMP?
- 4.Explain uni-cast routing protocols in details?.
- 5.Explain multicast routing protocols in details?.

## Unit-IV

- 1.Explain in detail about process to process delivery?.
- 2.Difference between UDP and TCP protocols?.

3. Illustrate the congestion control in details?.
4. Explain quality of services in switching networks?.
5. Explain data traffic congestion in detail?.

### **Unit-V**

1. Explain in details of domain name space?.
2. Explain in details of electronic mails?.
3. Explain in details of SMTP?.
4. Explain in details of WWW?.
5. Explain in details of SNMP?.

### **13) List of topics for student's seminars:**

- Biometric authentication and algorithms.
- Fuzzy Systems.
- Network Security.
- Scientific and Engineering Computing.
- Applications of Computer Science in Modelling.
- Neural Networks.
- Cryptography.

(14) - STEP/Course material in softcopy



DCN MATREILS.rar

## 15 . Expert Lectures & Schedules

Si No	Lecture Name	Dept	College	Contact no	Schedules
1	Dr T. Pothalayya	ECE	VBIT	9966933132	Aug-2023
2	Dr K Pradeep Reddy	CSE	CMRIT	9848843987	Sept-2023

### CO-PO Matrix:

Course Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
EC603P C.1	3	3	2	2	-	-	-	-	-	-	3	-
EC603P C.2	3	3	3	2	-	-	-	-	-	-	3	-
EC603P C.3	3	3	3	2	-	-	-	-	-	-	3	2
EC603P C.4	3	3	3	2	-	-	-	-	-	-	3	2
EC603P C.5	3	3	2	2	-	-	-	-	-	-	3	2

### Course Outcome (CO)-Program Specific Outcome (PSO) Matrix:

Course Outcomes (CO's)	PSO 1	PSO2
EC603PC.1	3	3
EC603PC.2	3	3
EC603PC.3	3	3
EC603PC.4	3	3
EC603PC.5	3	3



ACADEMIC PLANNER

For

***“PYTHON PROGRAMMING”***

Department of  
**Electronics and Communication Engineering**

IV B.Tech I-SEM

D.NAGESH

**CMR ENGINEERING COLLEGE  
UGC AUTONOMOUS**

(Approved by AICTE-New Delhi, Affiliated to J.N.T.U, Hyderabad)  
Kandlakoya(v), Medchal Road, Hyderabad-501 401, Telangana State, India .Website: [www.cmrec.ac.in](http://www.cmrec.ac.in)  
**(2023-24)**

## **ACADEMIC PLANNER**

**Subject: Python Programming**

<b><u>S.NO</u></b>	<b><u>CONTENT</u></b>
(1) -	<b>Preamble/Introduction</b>
(2) -	<b>Prerequisites</b>
(3) -	<b>Objectives and Outcomes</b>
(4) -	<b>Syllabus</b> <b>R20 CMREC</b>
(5) -	<b>List of Expert Details</b> (Local/National/International with Contact details/Profile link/Blogs/their research Contribution towards the subject)
(6) -	<b>Journals with min 5 ref paper for literature study</b>
(7) -	<b>Subject -Lesson plan</b>
(8) -	<b>Suggested Books</b> (prescribed and References)
(9) -	<b>Websites for self learning</b> <b>Resources like</b> <i>www.geeksforgeeks.org, www.schools.com, Coursera,edX, Udemy, Khan Academy, NPTEL etc along Registration procedures)</i>
(10) -	<b>Question Banks</b> <b>1.JNTUH/Model papers</b> <b>2.GATE</b>
(11) -	<b>Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications.</b>
(12) -	<b>Assignment Question/Innovative Assignments sets.</b>
(13) -	<b>List of topics for students Seminars with Guidelines</b>
(14) -	<b>STEP/Course material in softcopy</b>
(15) -	<b>Expert Lectures with topics &amp;Schedules (if any)</b>

### **1. Introduction**

Python is a widely used general-purpose, high level programming language. It was created by Guido van Rossum in 1991 and further developed by the Python Software Foundation. It was designed with an emphasis on code readability, and its syntax allows programmers to express their concepts in fewer lines of code.

### **2. Prerequisites:**

Prerequisites to learn python is having a basic knowledge of any programming language concepts like basic 'C' language and some concepts of OOPS in addition. If you have strong command over the basics of any programming language, you can learn Python quickly.

### **3. Course Objectives:**

1. This course will enable students to Learn Syntax and Semantics and create Functions in Python.

2. Handle Strings and Files in Python.
3. Understand Lists, Dictionaries and Regular expressions in Python.
4. Implement Object Oriented Programming concepts in Python.
5. Build Web Services and introduction to Network and Database Programming in Python.

#### **Course Outcomes:**

1. **Examine** Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. **Demonstrate** proficiency in handling Strings and File Systems.
3. **Create**, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
4. **Interpret** the concepts of Object-Oriented Programming as used in Python.
5. **Implement** exemplary applications related to Network Programming, Web Services and Databases in Python

## **4. Syllabus**

### **UNIT - I**

Python Basics, Objects- Python Objects, Standard Types, Other Built-in Types, Internal Types, Standard Type Operators, Standard Type Built-in Functions, Categorizing the Standard Types, Unsupported Types

Numbers - Introduction to Numbers, Integers, Floating Point Real Numbers, Complex Numbers, Operators, Built-in Functions, Related Modules

Sequences - Strings, Lists, and Tuples, Mapping and Set Types

### **UNIT - II**

FILES: File Objects, File Built-in Function [ open() ], File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments, File System, File Execution, Persistent Storage Modules, Related Modules

Exceptions: Exceptions in Python, Detecting and Handling Exceptions, Context Management,\*Exceptions as Strings, Raising Exceptions, Assertions, Standard Exceptions,

\*Creating Exceptions, Why Exceptions (Now)?, Why Exceptions at All?, Exceptions and the sys Module, Related Modules

Modules: Modules and Files, Namespaces, Importing Modules, Importing Module Attributes, Module Built-in Functions, Packages, Other Features of Modules

### **UNIT - III**



Regular Expressions: Introduction, Special Symbols and Characters, Res and Python Multithreaded Programming: Introduction, Threads and Processes, Python, Threads, and the Global Interpreter Lock, Thread Module, Threading Module, Related Modules

#### UNIT - IV

GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs

WEB Programming: Introduction, Web Surfing with Python, Creating Simple Web Clients, Advanced Web Clients, CGI-Helping Servers Process Client Data, Building CGI Application Advanced CGI, Web (HTTP) Servers

#### UNIT – V

Database Programming: Introduction, Python Database Application Programmer's Interface (DB-API), Object Relational Managers (ORMs), Related Modules

#### 6.Expert Details (Guest Lectures. / Seminars)

##### INTERNATIONAL:

1. **Jen Walraven**, data science and engineering manager at [Netflix](https://www.linkedin.com/in/jen-walraven)  
<https://www.linkedin.com/in/jen-walraven>

2. **David Mertz**

*Consultant, Trainer, Data Scientist, Senior Developer*

**Dexter, Maine, United States**

<https://www.linkedin.com/in/dmertz>

3. **Nikita Sobolev**

*Data Specialist at Priogen Energy*

**Amsterdam, North Holland, Netherlands**

<https://nl.linkedin.com/in/nikita-sobolev>

##### NATIONAL

1. **PROF. SUDARSHAN IYENGAR**, Department of Computer Science and Engineering IIT Ropar, **Email:** sudarshan@iitrpr.ac.in

2. **Dr. Rizwan Rehman** is an Assistant Professor from the Centre for Computer Science and Applications, Dibrugarh University.

Email - rizwan@dibru.ac.in. Phone No. - 9435058617.

3. **Reema Thareja**, Assistant Professor, Department of Computer Science, Shyama Prasad Mukherji College for Women, University of Delhi.

## REGIONAL

1. **Mrs. A. Sravanthi**, Associate Professor, Department of CSE in NREC.  
(E-mail-id: [sravaanthi.a@nrcmec.org](mailto:sravaanthi.a@nrcmec.org) , ph.no. 9628938890)

### 2. Nageswara Rao

*Chief Executive Officer, Founder, Director at NageswaraRao Datatechs*  
datatechsonline@gmail.com

## 6. Journals with min 5 ref paper for literature study

[http://ijirt.org/master/publishedpaper/IJIRT149340\\_PAPER.pdf](http://ijirt.org/master/publishedpaper/IJIRT149340_PAPER.pdf)

1. Python: The Programming Language of Future

[http://ijaerd.com/papers/special\\_papers/IT032.pdf](http://ijaerd.com/papers/special_papers/IT032.pdf)

2. Python Programming-Applications and Future

<https://www.irjet.net/archives/V4/i12/IRJET-V4I1266.pdf>

3. Python – The Fastest Growing Programming Language

[http://ijariie.com/AdminUploadPdf/PROGRAMMING\\_LANGUAGE\\_PYTHON\\_\\_A\\_REVIEW\\_ijariie11892.pdf](http://ijariie.com/AdminUploadPdf/PROGRAMMING_LANGUAGE_PYTHON__A_REVIEW_ijariie11892.pdf)

4. PROGRAMMING LANGUAGE PYTHON: A REVIEW

<https://www.ijsr.net/archive/v8i2/ART20194929.pdf>

5. Python – Using Database and SQL

## 7. Subject -Lesson plan

S.NO	Topic (JNTU syllabus)	Sub-Topic	NO. OF LECTURES REQUIRED	Suggested Books	Teaching Methods
UNIT – I					
1	Python Objects, Numbers & Sequences	Python basics	L1	T1,R1	M1
2		Python Objects, Standard Types	L2-L3	T1	M1
3		Other Built-in Types, Internal Types	L4	T1	M1
4		Standard Type Operators, Standard Type Built-in Functions	L5-L6	T1,R1	M1,M5
5		Categorizing the Standard Types, UnsupportedTypes	L7	T1	M1
6		Introduction to Numbers, Integers, Floating Point Real Numbers	L8	T1	M1,M5
7		Complex Numbers, Operators, Built-in Functions, Related Modules	L9	T1	M1,M5
8		Sequences - Strings, Lists, and Tuples	L10-L11	T1,R1	M1,M5
9		Mapping and Set Types	L12	T1,R2	M1,M5
UNIT – II					
10	Files, Exceptions	File Objects, File Built-in	L13	T1,R3	M1

	<b>&amp; Modules</b>	Function [ open() ]			
<b>11</b>		File Built-in Methods, File Built-in Attributes, Standard Files	<b>L14</b>	<b>T1</b>	<b>M4(PPT)</b>
<b>12</b>		Command-line Arguments, File System, File Execution	<b>L15-L16</b>	<b>T1</b>	<b>M1</b>
<b>13</b>		Persistent Storage Modules, Related Modules	<b>L17</b>	<b>T1</b>	<b>M1</b>
<b>14</b>		Exceptions in Python, Detecting and Handling Exceptions	<b>L18,L19</b>	<b>T1,R3</b>	<b>M1</b>
<b>15</b>		Context Management,*Exceptions as Strings	<b>L20,L21</b>	<b>T1,R3</b>	<b>M1</b>
<b>16</b>		RaisingExceptions,Assertions	<b>L22</b>	<b>T1,R3</b>	<b>M1</b>
<b>17</b>		Standard Exceptions, Creating Exceptions	<b>L23,L24</b>	<b>T1</b>	<b>M1,M5</b>
<b>18</b>		Why Exceptions (Now)?, Why Exceptions at All?, Exceptions and the sys Module, Related Modules	<b>L25,L26</b>	<b>T1</b>	<b>M1</b>
<b>19</b>		Modules: Modules and Files, Namespaces	<b>L27</b>	<b>T1</b>	<b>M1</b>
<b>20</b>		Importing Modules, Importing Module Attributes	<b>L28</b>	<b>T1</b>	<b>M1</b>
<b>21</b>		Module Built-in Functions, Packages, Other Features of	<b>L29,L30</b>	<b>T1</b>	<b>M1</b>

		Modules			
UNIT-III					
22	Regular Expressions & Multithreaded Programming	Introduction to Regular Expressions, Special Symbols and Characters	L31	T1	M1,M5
23		Res and Python	L32	T1	M1,M5
24		Introduction to Multithreaded programming , Threads and Processes	L33	T1	M1
25		Threads, and the Global Interpreter Lock	L34	T1	M1
26		Thread Module, Threading Module, Related Modules	L35	T1	M1
UNIT-IV					
27	GUI Programming & Web Programming	Introduction GUI, Tkinter and Python Programming	L36	T1,R1	M1,M5
28		Brief Tour of Other GUIs, Related Modules and Other GUIs	L37	T1,R1	M1
29		Introduction to Web Programming, Web Surfing with Python	L38,L39	T1,R1	M4
30		Creating Simple Web Clients, Advanced Web Clients	L40	T1	M4
31		CGI-Helping Servers Process Client Data	L41	T1	M4
32		Building CGI Application Advanced CGI	L42	T1	M1

33		Web (HTTP) Servers	L43	T1	M1
<b>UNIT –V</b>					
34	<b>DATABASE PROGRAMMING</b>	Introduction	L44	T1	M1
35		Python Database Application Programmer's Interface (DB-API)	L45	T1	M1,M5
36		Object Relational Managers (ORMs)	L46-L47	T1	M1
37		Related Modules	L48	T1	M1

#### **METHODS OF TEACHING:**

<b>M1 : Lecture Method</b>	<b>M4 : Presentation /PPT</b>	<b>M7 : Assignment</b>
<b>M2 : Demo Method</b>	<b>M5 : Lab/Practical</b>	<b>M8 : Industry Visit</b>
<b>M3 : Guest Lecture</b>	<b>M6 : Tutorial</b>	<b>M9 : Project Based</b>

#### **8. Suggested Books (Prescribed and References)**

##### **Prescribed Book**

1. Core Python Programming, Wesley J. Chun, Second Edition, Pearson

##### **Reference Books**

1. Core Python Programming by R.Nageshwar Rao, Second Edition, Dreamtech press.
2. Python for Programmers by Paul Deitel ,Harvey Deital
3. Python Programming Using Problem Solving Approach by Reema Thareja

#### **9. Websites for self learning Resources like**

1. <https://www.python.org/>
2. <https://www.programiz.com/python-programming>
3. <https://www.geeksforgeeks.org/python-programming-examples/>

4. <https://www.w3schools.com/python/default.asp>
5. <https://www.tutorialspoint.com/python/index.htm>
6. <https://www.javatpoint.com/python-tutorial>
7. [https://onlinecourses.swayam2.ac.in/cec23\\_cs06/preview](https://onlinecourses.swayam2.ac.in/cec23_cs06/preview)

## 10.Question Bank. (JNTUH)

### PART-A

1. a) State any four applications where python is more popular.
- b) List out the main differences between lists and tuples.
- c) What are the uses of file object?
- d) Give a brief description of several built in attributes related to File objects.
- e) Summarize the purpose of pipe and dot symbols used for pattern matching
- f) Explain the basic functionality of match() function.
- g) What is the need of Tkinter module in python?
- h) How to Label widget in Python?
- i) State the need of persistent storage.
- j) Discuss the SQL commands/statements used for creating, using and dropping a database.

### PART-B

2. a) How to declare and call functions in python programs? Illustrate with an example script.
- b) List and explain few most commonly used built-in types in python.

OR

3. Summarize various operators, built-in functions and standard library modules that deals with python numeric types.
4. Explain the following file built-in functions and methods with clear syntax, description and illustration:  
a) open()    b) file()    c) seek()    d) tell()    e) read()

OR

5. a) How does try-except statement work? Demonstrate with example python code.
- b) Illustrate the concept of importing module attributes in python scripts.
6. Examine how python supports regular expressions through the 're' module with brief introduction and various built-in methods related to it.

OR

7. What is the motivation behind parallelism and state how python achieves parallelism?

### Objective Type:

S.No	Question	ANSWER
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1.	Python is invented by__. A. Dennis Ritchie B. Mark Zuckerberg C. Bjame Stroustrup D. Guido van Rossum	D
2.	Maximum possible length of identifier in Python is A. 25 characters B. 64 characters C. 255 characters D. None of the above	D
3.	Which of the following is not a core data type ? A. Lists B. Dictionary C. class D. tuple	C
4.	Which of the following data types is not supported in python A. String B. Numbers C. Slice D. List	C
5.	All the keywords in Python are A. Upper case B. Lower case C. beginning with underscore D. None of these	D
6.	Which of the following is not a keyword ? A. eval B. elif C. except D.with	A
7.	Various internal types in Python are A. code B. frame C. both a and b D. none of the above	C
8.	Standard types in Python are A. Number B. Scalar C. Mutable D. all of the above	D
9.	which of the following commands will create a list?  A. mylist = list.  B. mylist = []  C. mylist = list([10, 20, 30])	D



	D. all of the mentioned	
10.	Suppose list1 is [2, 4, 6, 8, 10], What is mylist[-1]? A. Error B. 10 C. 0 D. 2	B
11.	Suppose mylist is [1, 2, 3], What is mylist * 2 ? A. [2, 4, 6] B. [1,2,3,1, 2] C. [1,2, 3, 1, 2, 3] D. [1,2,3,2, 2, 2]	C
12.	To add a new element to a list we use which command ? A. mylist.append(10) B. mylist.add(10) C. mylist.addLast(10) D. mylist.addEnd(10)	A
13.	Suppose the list 11 is [1, 3, 5, 3, 1], the result of 11.pop(1)? A. error B. [1,5,3, 1] C. [3, 5, 3, 1] D. [1, 3,5, 3]	B
14.	Which of the following is a Python tuple? A. [1,2, 3] B. (1, 2, 3) C. (1,2,3) D. {}	C
15.	What will be the output of the following Python code ?  >>>t=(1,2,4,3)	D

	<p>&gt;&gt;&gt;t1:3)</p> <p>A. (1, 2)</p> <p>B. (1,2,3)</p> <p>C. (2,4,3)</p> <p>D. (2,4)</p>	
16.	<p>Which of the following statements create a dictionary ?</p> <p>A. d= ()</p> <p>B. d = ("AAA":10, "BBB" :20)</p> <p>C. d = (10:" AAA", 20:"BBB")</p> <p>D. All of the mentioned</p>	D
17.	<p>Which of the following is not a declaration of the dictionary?</p> <p>A. (10: 'AAA', 20: BBB']</p> <p>B. dict([[10,"A"), (20,"B"]])</p> <p>C. {10, "AAA",20, "BBB"}</p> <p>D. {}</p>	C
18.	<p>What will be the output of the following Python code ?</p> <pre>&gt;&gt;&gt;a={10:" AAA",20:"BBB",30:"CCC"}</pre> <pre>&gt;&gt;&gt; del a</pre> <p>A. method del doesn't exist for the dictionary</p> <p>B. del deletes the values in the dictionary</p> <p>C.del deletes the entire dictionary</p> <p>D.del deletes the keys in the dictionary</p>	C
19.	<p>What will be the output of the following Python statement?</p> <pre>&gt;&gt;&gt;"ab"+"cd"</pre> <p>A. ab</p> <p>B. cd</p>	D

	<p>C. bc</p> <p>D. abcd</p>	
20.	<p>What will be the output of the following Python statement?</p> <pre>&gt;&gt;&gt;"abcd"[2:]</pre> <p>A. b</p> <p>B. ab</p> <p>C. bc</p> <p>D. error</p>	C
21.	<p>Which of the following statements is used to create an empty set?</p> <p>A. {}</p> <p>B. set()</p> <p>C. []</p> <p>D. ()</p>	B
22.	<p>list, tuple, and range are the _ of Data Types.</p> <p>A. Sequence Types</p> <p>B. Binary Types</p> <p>C. Boolean Types</p> <p>D. None of the mentioned above</p>	A
23.	<p>Amongst which of the following is / are the logical operators in Python?</p> <p>A. and</p> <p>B. or</p> <p>C. not</p> <p>D. All of the mentioned above</p>	D
24.	<p>The % operator returns the _.</p> <p>A. Quotient</p>	C

	<p>B. Divisor</p> <p>C. Remainder</p> <p>D. None of the mentioned above</p>	
25.	<p>Python Dictionary is used to store the data in a _ format.</p> <p>A. Key value pair</p> <p>B. Group value pair</p> <p>C. Select value pair</p> <p>D. None of the mentioned above</p>	A
26.	<p>Following is the file object attribute_____</p> <p>A. name</p> <p>B. mode</p> <p>C. closed</p> <p>D. all of the above</p>	D
27.	<p>To open a file d: \ test. txt for writing, we use_____</p> <p>A. fout = open("d: \test.txt", "w")</p> <p>B. fout = open("d:\\test.txt", "w")</p> <p>C. fout = open(file = "d:\test.txt", "w")</p> <p>D. fout = open(file = "d:\\test. txt", "W")</p>	B
28.	<p>To read the entire remaining contents of the file as a string from a file object f1, we use_____</p> <p>A. f1.read()</p> <p>B. f1.read(all)</p> <p>C. f1.readline()</p> <p>D. f1.readlines()</p>	A
29.	<p>Which function is used to read single line from file?</p> <p>A. readline()</p> <p>B. readlines()</p> <p>C. readstatement()</p> <p>D. readfulline()</p>	A
30.	<p>Which function is used to close a file in python?</p>	A

	A. Close() B. Stop() C. End() D. Closefile()	
31.	Which of the following are the modes of both writing and reading in binary format in file? A. w B. wb+ C. wb D. w+	B
32.	For deleting a file we use following function. A.del B. remove C. delete D. all of the above	B
33.	The module used as persistent storage module is A. pickle B. marshal C. shelve D. all of the above	D
34.	To obtain an information about the exception we use _ function. A. exc_info() B. exection_info() C. info() D. None of the above	A
35.	How many except statements can a try-except block have ? A. zero B. one C. more than one D. more than zero	D
36.	When is the finally block executed ? A. always	A

	<p>B. when there is an exception</p> <p>C. only if some condition that has been specified is satisfied</p> <p>D. when there is no exception</p>	
37.	<p>Following is not an advantage or a module</p> <p>A. It uses the program code</p> <p>B. It reduces the size of the program code</p> <p>C. It breaks the program into small tasks D. It helps in testing each module of the program code</p>	B
38.	<p>Which statement will read 5 characters from a file(file object 'f')?</p> <p>A. f.read()</p> <p>B. f.read(5)</p> <p>C. f.reads(5)</p> <p>D. None of the above</p>	B
39.	<p>Which of the following is not an exception handling keyword in Python?</p> <p>A. try</p> <p>B. except</p> <p>C. accept</p> <p>D. finally</p>	C
40.	<p>When is the finally block executed?</p> <p>A. when there is no exception</p> <p>B. when there is an exception</p> <p>C. only if some condition that has been specified is satisfied</p> <p>D. always</p>	D
41.	<p>Which exception raised in case of failure of attribute reference or assignment?</p> <p>A. AttributeError</p> <p>B. EOFError</p> <p>C. ImportError</p> <p>D. AssertionError</p>	A
42.	<p>Which block lets you test a block of code for errors?</p> <p>A. try</p> <p>B. except</p> <p>C. finally</p> <p>D. None of the above</p>	A
43.	<p>_____ function returns the current position of file pointer.</p> <p>A. get()</p> <p>B. tell()</p> <p>C. cur()</p> <p>D. seek()</p>	B
44.	<p>Which of the following function takes two arguments?</p>	B

	A. load( ) B. dump( ) C. both of the above D. none of the above	
45.	What error is returned by the following statement if the file does not exist? f=open("A.txt") A. FileNotFoundError B. NotFoundError C. FileNotFoundA D. FoundError	A
46.	Which module to be imported to make the following line functional? sys.stdout.write("ABC") A. system B. sys C. stdout D. stdin	B
47.	Which statement will open file "data.txt" in append mode? A. f = open("data.txt", "a") B. f = Open("data.txt", "ab") C. f = new("data.txt", "a") D. open("data.txt", "a")	A
48.	What is full form of CSV A. Comma Separation Value B. Comma Separated Value C. Common Syntax Value D. Comma Separated Variable	B
49.	_____ module is used for serializing and de-serializing any Python object structure. A. pickle B. unpickle C. pandas D. math	A
50.	Which function is used to force transfer of data from buffer to file? A. flush( ) B. save( ) C. move( ) D. None of the above	A
51.	Which module in Python supports regular expressions? A. re B. regex C. pyregex D. none of the mentioned	A
52.	Which of the following creates a pattern object? A. re.create(str) B. re.regex(str)	C

	C. re.compile(str) D. re.assemble(str)	
53.	<p>The difference between the functions re.sub and re.subn is that re.sub returns a _____ whereas re.subn returns a _____</p> <p>A. tuple, list  B. string, list  C. list, tuple  D. string, tuple</p>	D
54.	<p>What does the function re.search do?</p> <p>A. such a function does not exist  B. matches a pattern at the start of the string  C. matches a pattern at any position in the string  D. none of the mentioned</p>	C
55.	<p>What does the function re.match do?</p> <p>A. such a function does not exist  B. matches a pattern at the start of the string  C. matches a pattern at any position in the string  D. none of the mentioned</p>	B
56.	<p>Which function returns a list containing all matches?</p> <p>A. findall  B. search  C. split  D. find</p>	A
57.	<p>Which character stand for Starts with in regex?</p> <p>A. &amp;  B. ^  C. \$  D. #</p>	B
58.	<p>Which character stand for Zero or more occurrences in regex?</p> <p>A. *  B. #  C. @</p>	A



	D.	
59.	<p>In Regex, s stands for?</p> <p>A. Returns a match where the string DOES NOT contain digits</p> <p>B. Returns a match where the string DOES NOT contain a white space character</p> <p>C. Returns a match where the string contains a white space character</p> <p>D. Returns a match if the specified characters are at the end of the string</p>	C
60.	<p>In Regex, [a-n] stands for?</p> <p>A. Returns a match for any digit between 0 and 9</p> <p>B. Returns a match for any lower case character, alphabetically between a and n</p> <p>C. Returns a match for any two-digit numbers from 00 and 59</p> <p>D. Returns a match for any character EXCEPT a, r, and n</p>	B
61.	<p>Which Python library runs a function as thread?</p> <p>A. thread</p> <p>B. threading</p> <p>C. _threading</p> <p>D. None</p>	A
62.	<p>How does run() method is invoked?</p> <p>A. By Thread.run()</p> <p>B. By Thread.start()</p> <p>C. By Thread.create()</p> <p>D. None</p>	B
63.	<p>How to terminate a blocking thread?</p> <p>A. thread.stop()</p> <p>B. thread.terminate()</p> <p>C. thread.stop() &amp; thread.wait()</p> <p>D. None</p>	C
64.	<p>Which method is used to identify a thread?</p> <p>A. getName()</p> <p>B. get_ident()</p> <p>C. getThread()</p> <p>D. None</p>	A
65.	<p>What are the libraries in Python that support threads?</p> <p>A. th</p>	B

	B. thread C. _threading D. None	
66.	How does global value mutation used for thread-safety? A. via Mutex B. via Locking C. via GIL (Global Interpreter Lock) D. None	C
67.	What is the method to retrieve the list of all active threads? A. getList() B. threads() C. enumerate() D. getThreads()	C
68.	Which thread method is used to wait until it terminates? A. join() B. wait() C. waitforthread() D. None	A
69.	Multithreading is also called as _____ A. Recurrent B. Crosscurrent C. Concurrency D. Simultaneity	C
70.	A single sequential flow of control within a program is _____ A. Task B. Thread C. Process D. Structure	B
71.	What is the output of the following? sentence = 'we are humans' matched = re.match(r'(.*) (.*) (.*)', sentence)print(matched.groups()) A.('we', 'are', 'humans') B.(we, are, humans) C.('we', 'humans') D.'we are humans'	A
72.	The Minterms for four variables A. 8 B. 16 C. 2 D. 14	B
73.	The character Dot (that is, '.') in the default mode, matches any character other than _____ A. caret B. ampersand C. percentage symbol D. newline	D
74.	Which module in Python supports regular expressions? A. re	A

	B. regex C. pyregex D. none of the mentioned	
75.	Point out the correct combination with regards to kind keyword for graph plotting. A. 'hist' for histogram B. 'box' for boxplot C. 'area' for area plots D. all of the mentioned	C
76.	The Python GUI library is based on____ A. Tk B. Tcl C. Tkinter D. all of the above	D
77.	For developing the GUI application we need add following line at the beginning____ A. import python B. import tkinter C. from tkinter import* D. none of these	C
78.	For displaying message using MessageBox in Tkinter we use following method____ A. show B. showinfo C. msg D. showMsg	B
79.	Following is a Tk related Module in Python____ A. tkinter B. PMW C. EasyGUI D. all of the above	D
80.	HTTP is____ protocol. A. application layer B. transport layer C. network layer D. none of the mentioned	A
81.	HTTP client requests by establishing a __ connection to a particular port on the server. A. user datagram protocol B. transmission control protocol C. broader gateway protocol D. none of the mentioned	B
82.	To achieve reliable transport in TCP, is used to check the safe and sound arrival of data. A. Packet B. Buffer C. Acknowledgment D. Segment	C
83.	Various forms of web client software are____ A. web browsers	C

	B. browser running on mobile phone C. both a and b D. none of these	
84.	For using the function urlopen in a Python program we need to import A. url B. urllib C. urlparse D. none of these	B
85.	Following web server module is available in Python 3 A. http.server B. BaseHTTPServer C. SimpleHTTPServer D. CGIHTTPServer	A
86.	Which of the following tool provides a GUI in python A. Numpy B. Tkinter C. Scipy D. Opencv	B
87.	What protocol can be used to retrieve web pages using python? A. urllib B. bs4 C. HTTP D. GET	C
88.	What provides two way communication between two different programs in a network. A. socket B. port C. http D. protocol	A
89.	What is a python library that can be used to send and receive data over HTTP? A. http B. urllib C. port D. header	B

90.	What is the process by which search engines retrieve webpages and build a search index called? A. scrape B. parse C. BeautifulSoup D. spider	D
91.	In python context, what does GUI stand for? A. General User Interface B. Graphical Unit Interface C. Golfing Union of Ireland A. D. Graphical User Interface	A
92.	Which of the following are valid Tkinter widgets? A. Entry B. button C. Label D. ColorPicker	B
93.	Which of the following geometry managers are available in Tkinter? A. .grid() B. .place() C. .pack() D. .button()	A
94.	Config() in python Tkinter are used for? A. Place the widget B. Destroy the widget C. Configure the widget D. Change the property of the widget	D

95.	<p>Creating lines are come in which type of thing?</p> <p>A. GUI B. Canvas C. Both of the above D. None of the above</p>	B
96.	<p>For user entry data, which widget we use in Tkinter?</p> <p>A. Entry B. Text C. Both of the above D. None of the above</p>	B
97.	<p>How we import Tkinter in the python program?</p> <p>A. import Tkinter B. import Tkinter as t C. from Tkinter import * D. All of the above</p>	D
98.	<p>Title() is used for</p> <p>A. Give a title name to a widget B. Give a title name to the button C. Give a title name to the window D. None of the above</p>	C
99.	<p>What is Tk() in Tkinter python?</p> <p>A. It is a widget B. It is a function C. It is a constructor D. All of the above</p>	D

100.	From which keyword we import the tkinter in program? A. call B. from C. import D. All of the above	C
101.	SQL stands for. A. Structured Query Language B. Super query Language C. Simple Query Language D. Server Query Language	A
102.	Following is a commercial RDBMS package A. Informix B. Sybase C. Oracle D. all of the above	D
103.	What is the name of the SQL database the comes distributed with Python? A. MySQL B. SQLite C. PostgreSQL D. PySQL	B
104.	Which of the following is connection object method in Python A. execute() B. executeMany() C. close() D. all of the above	C

105.	<p>Which of the following code snippets creates and connects to a new SQLite Database?</p> <p>A. <code>from sqlite3 import Connection</code>  <code>connection = Connection("test database.db")</code></p> <p>B. <code>import sqlite3</code> <code>connection = sqlite3. create("test _database.db")</code></p> <p>C. <code>import sqlconnection</code> <code>= sql.connect("test _database.db")</code></p> <p>D. <code>import sqlite3</code> <code>connection = sqlite3.connect("test _database.db")</code></p>	D
106.	<p>Mandatory arguments required to connect any database from Python</p> <p>A. Username, Password, Hostname, Database Name</p> <p>B. Username, Password, Hostname</p> <p>C. Username, Password, Hostname, Database Name, Port</p> <p>D. Username, Password</p>	A
107.	<p>Which of the following are valid Cursor methods used to execute SOL statments and retrieve query results? Select all that apply.</p> <p>A. <code>Cursor.run()</code></p> <p>B. <code>Cursor. Fetchall()</code></p> <p>C. <code>Cursor fetchone()</code></p> <p>D. <code>Cursor.execute()</code></p>	B



108.	Which method of cursor class is used to insert or update multiple rows using a single query A. cursor.executemany(query, rows) B. cursor. execute(query, rows) C. cursor. executmultiple(query, rows) D. all of the above	A
109.	The following code cursor. execute("SELECT * FROM Student _table") results = cursor. fetchallo will return A. dict B. tuple C. queryset D. list	D
110.	Which method of cursor class is used to execute database function or stored procedure in Python A.cursor.callprocedure(procedureName' ,[parameters,]) B. cursor. callproc(procedureName' [parameters,]) C. cursor. callfun(procedure Name' [parameters,]) D. c cursor.callfunction(procedure Name' , [parameters,])	B

111.	What is default value of host A. host B. localhost C. global host D. None of these	B
112.	User can write Python script using A. mysql.connector library B. sql.connect library C. mysql.connect library D. None of the above	A
113.	Which method returns the next row from the result set astuple? A. fetchone() B. fetchmany() C. fetchall() D. rowcount	A
114.	To get all the records from the result set,you may use _____ A. cursor.fetchmany() B. cursor.fetchall() C. select*from<table name> D. cursor.execute()	B
115.	Commit command is used for A. To restore the old values B. To save the current table C. To save the current transaction D. To recover the old table	C
116.	The value of Primary key A. can be duplicated B. can be null C. cannot be null D. none of these	C

117.	Drop table structure is A. DML Statement B. DDL Statement C. Query Statement D. None of the above	B
118.	A relational database consists of a collection of A. Table B. Fields C. Records D. Keys	A
119.	Create table employee (name varchar ,id integer) What type of statement is this ? A. DML B. View C. DDL D. Integrity constraint	C
120.	To remove a relation from an SQL database, we use the _____ command. A. Delete B. Purge C. Remove D. Drop table	D
121.	The term attribute refers to a _____ of a table. A. Record B. Column C. Tuple D. Key	B
122.	Which of the following is used to delete an entire MYSQL database? A. drop entiredb dbname B. drop database dbname C. drop db dbname D. drop dbase dbname	B
123.	Which clause is used to sort the result of SELECT statement? A. SORT BY B. ORDER BY C. ARRENGE BY	B

	D. None of the above	
124.	TCL is used for _____? A. Manage the changes made by DML statements B. Defining database schema C. Control access to data stored in a database D. None of the above	A
125.	Which is right statement to insert multiple records? A. INSERT INTO job_question VALUES ('col1', 'col2'), ('col1', 'col2'), ... B. INSERT INTO job_question VALUES ('col1', 'col2'), VALUES ('col1', 'col2'), ... C. A and B Both D. None of the above	A

## **11. Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications.**

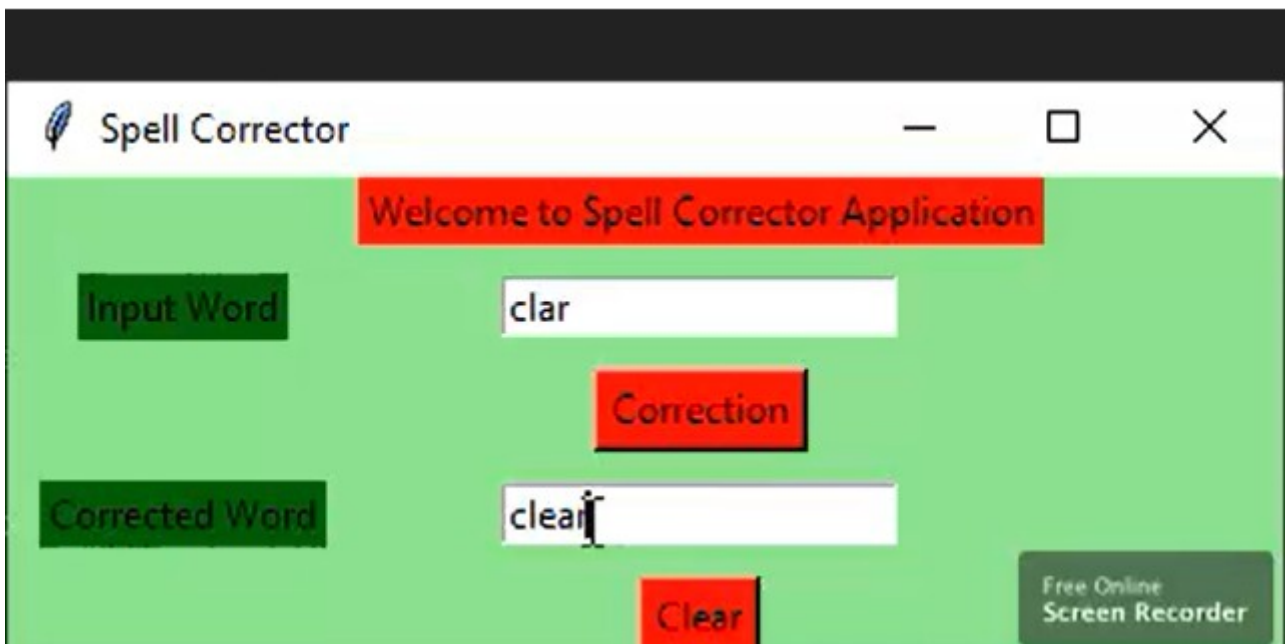
### **1. Python – Spell Corrector GUI using Tkinter**

Python offers multiple options for developing a GUI (Graphical User Interface). Out of all the GUI methods, Tkinter is the most commonly used method. Python with Tkinter outputs the fastest and easiest way to create GUI applications. In this article, we will learn how to create a GUI Spell

Corrector application using Tkinter, with a step-by-step guide.

To create a Tkinter :

- Importing the module – tkinter
- Create the main window (container)
- Add any number of widgets to the main window.
- Apply the event Trigger on the widgets.



## 2. Create digital clock using Python-Turtle:

**Turtle** is a special feature of Python. Using Turtle, we can easily draw on a drawing board. First, we import the turtle module. Then create a window, next we create a turtle object and using the turtle methods we can draw in the drawing board.

To create a **digital clock in Python using Turtle**, follow these instructions :

- **import** every module ( **time, datetime, turtle**).
- Then make **two turtles**, one to **draw a box** that is rectangular and the other to **display the time**.
- Create a window now, and use the window's **bgcolor() function** to set the background colour to **pink**.
- Position the turtle, draw a **rectangle**, and afterwards conceal it.
- Afterward, try to find the **current time** on our system (**hour, minute, second**). The **datetime** module will then be used for this.
- Use the other **turtle object** we have to display the time at this point.



#### 4. Python: Age Calculator using Tkinter:

Python offers multiple options for developing a GUI (Graphical User Interface). Out of all the GUI methods, Tkinter is the most commonly used method. It is a standard Python interface to the Tk GUI toolkit shipped with Python. Python with Tkinter outputs the fastest and easiest way to create GUI applications. Now, it's up to the imagination or necessity of a developer, what he/she wants to develop using this toolkit.

**To create a Tkinter :**

- Importing the module – Tkinter
- Create the main window (container)
- Add any number of widgets to the main window.

- Apply the event Trigger on the widgets.

## 12 .Assignment Question/Innovative Assignment Questions:

### I -ASSIGNMENT

1. a. **Explain** Python objects characteristics.(CO1)  
b. **Summarize** the primitive data types of the Python with example.(CO1)
2. a. **Compare** mutable and immutable data types.(CO3)  
b. **Contrast** String and List data structures in Python.(CO2)
3. a. **Define** the Dictionary data structure in Python.(CO3)  
b. **Write** Python File Modes in Python.(CO2)
4. a. **Explain** the usage of Command-Line Arguments in Python with an example.(CO2)  
b. **Write** about the errors and exceptions in Python. Give suitable examples.(CO4)
5. a. **Explain** the standard exceptions with examples.(CO4)  
b. **Write** about modules and import in Python with examples.(CO4)

### II ASSIGNMENT

1. **What** are regular expressions? (CO3)
2. **How** to find whether an email id entered by user is valid or not using Python 're' module. (CO3)
3. **Distinguish** between thread and threading classes.(CO4)
4. **List** web address components and explain them.(CO5)
5. **Explain** Persistent Storage.(CO2)

## **INNOVATIVE ASSIGNMENT QUESTIONS**

1. How can you generate random numbers in Python ?(CO3)
2. What are negative indexes and why are they used?(CO2)
3. What advantages do NumPy arrays offer over (nested) Python lists?(CO3)
4. Describes anonymous functions examples?(CO4)
5. Write a brief notes on PIP, Explain installing package via PIP.(CO5)

### **Important Question sets on each unit**

#### **UNIT-1**

1. List the standard type operators in Python with examples.
2. a) Give a note on each of the following constructs in Python language.  
(i) quotes (single, double and triple) (ii) multiline statements (iii) indentation  
b) How Python is different from C++.
3. a) Narrate the other built in data types of Python  
b) List the unsupported types in Python along with explanation.
4. a) Explain Python bitwise operators with example  
b) Compare and contrast the List and Tuple.
5. What is Python? Explain in detail.
6. Explain about the type of operators used in Python?
7. How to declare and call functions in python programs? Illustrate with an example script.
8. List and explain few most commonly used built-in types in python.
9. State any four applications where python is more popular.
10. List out the main differences between lists and tuples.

#### **UNIT-II**

1. What is the need of Exception in Python. Explain 'Now' exception.
2. Explain the importing module attribute with suitable examples.
3. What are the two ways of importing a module? Which one is more beneficial?  
Explain
4. a) Briefly discuss about Python packages.  
b) Explain about handling an exception.
5. a) How to handle an exception using try except block? Explain with the help of a program  
b) Why Exceptions (Now) is needed? Discuss with detailed examples.
6. Demonstrate usage of exceptions in Python?
7. Explain in detail about Packages in Python?
8. Give a short note on Python built in functions?

#### **UNIT-III**



1. What are regular expressions? How to find whether an email id entered by user is valid or not using Python 're' module.
2. Differentiate match () and search ().
3. a) What are the threads in Python?  
b) Differentiate thread and threading classes.
4. a) List special symbols and characters while forming regular expressions.  
b) Explain various String pattern matching functions in Python.
5. a) What is multithreading? Discuss about starting a new thread.  
b) Explain the methods of threading module.
6. Give a short note on Regular Expressions (Res)?
7. Explain threads with Global interpreter lock?
8. Define threading module of Python?

#### **UNIT-IV**

1. a) Explain about GUI programming in python  
b) Write a program to implement Turtle Graphics in Python
2. Write a Python program that creates a GUI with a textbox, Ok button and Quit button. On clicking Ok, the text entered in textbox is to be printed in Python shell; on clicking Quit, the program should terminate.
3. a) Explain about GUI programming in python  
b) Explain urllib Module along with the methods in urllib module.
4. a) Explain a procedure to create a static web page using Python.  
b) Explain a procedure to create Web Server in Python.
5. a) Explain a procedure to create a static web page using Python.  
b) Explain a procedure to create Web Server in Python.
6. What is the need of Tkinter module in python?

#### **UNIT-V**

1. a) Explain Persistent Storage.  
b) Database Connection Objects in Python.
2. a) Discuss database adapter with examples.  
b) Explain the object relational managers (ORMs)
3. a) Narrate the DB-API Module attributes with description.  
b) List Type Objects and Constructors along with the description.
4. a) Explain the Database connectivity procedure with an example.  
b) Explain the Cursor Object Attributes.

#### **13. List of topics for student's seminars**

1. Sequences
2. Regular expressions.
3. Files
4. Exceptions
5. Multi threading.
6. GUI programming.
7. Network application Programming.

#### **14. STEP/Course material in softcopy**



Step Material For python programming.rar

### **15. Expert Lectures with topics & Schedules (if any)**

1. Mrs. A. Sravanthi Assoc, Department of CSE in NREC.  
(E-mail-id: [sravaanthi.a@nrcmec.org](mailto:sravaanthi.a@nrcmec.org) , ph.no. 9628938890)

Real time applications of multi-threading and Database programming –Tentative period: in month of December last week.



**ACADEMIC PLANNER**

**FOR THE**

**ACADEMIC YEAR**

**2023-24**

**COURSE: IV YEAR B.TECH ECE-II-R20- SEM**

**SUBJECT: GLOBAL POSITIONING SYSTEM**

**CREDITS: 3**

## **ACADEMIC PLANNER**

### **SUBJECT: GLOBAL POSITIONING SYSTEM**

<b>S.NO</b>	<b>CONTENTS</b>
(1) -	<b>Preamble/Introduction</b>
(2) -	<b>Prerequisites</b>
(3) -	<b>Objectives and Outcomes</b>
(4) -	<b>Syllabus</b> <b>1. JNTU/R20-CMREC</b> <b>2. GATE</b> <b>3. IES</b>
(5) -	<b>List of Expert Details</b> (Local/National/International with Contact details/Profile link/Blogs/their research Contribution towards the subject)
(6) -	<b>Journals with min 5 ref paper for literature study</b>
(7) -	<b>Subject -Lesson plan</b>
(8) -	<b>Suggested Books</b> (prescribed and References)
(9) -	<b>Websites for self learning</b> <b>Resources like</b> (www.geeksforgeeks.org, www.schools.com, Coursera ,edX, Udemy, Khan Academy, NPTEL etc along Registration procedures)
(10) -	<b>Question Banks</b> <b>1.JNTUH/Model papers</b> <b>2. GATE</b>
(11) -	<b>Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications.</b> .
(12) -	<b>Assignment Question/Innovative Assignments sets.</b>
(13) -	<b>List of topics for students Seminars with Guidelines</b>
(14) -	<b>STEP/Course material in softcopy</b>
(15) -	<b>Expert Lectures with topics &amp; Schedules(if any)</b>

#### **(1). PREAMBLE/INTRODUCTION :**

The Global Positioning System was conceived in 1960 under the auspices of the U.S. Air Force, but in 1974 the other branches of the U.S. military joined the effort. The first satellites were launched into space in 1978. The System was declared fully operational in April 1995. The Global Positioning System consists of 24 satellites, that circle the globe once every 12 hours, to provide worldwide position, time and velocity information. GPS makes it possible to precisely identify locations on the earth by measuring distance from the satellites. GPS allows you to record or create locations from places on the earth and help you navigate to and from those places. Originally the System was designed only for military applications and it wasn't until the 1980's that it was made available for civilian use also.

**(2) PREREQUISITES:**

This course assumes that students have had an introduction to communication systems and the description of signals and circuits in terms of their frequency spectra and frequency response. A basic knowledge of analog and digital modulation is required, as is a working level familiarity with the basics of random variables and probability distributions

**(3) COURSE OBJECTIVE & OUTCOMES:**

- 1.To prepare students to excel in basic knowledge of satellite communication principles
- 2.To provide students with solid foundation in orbital mechanics and launches for the satellite communication
- 3.To train the students with a basic knowledge of link design of satellite with a design examples.
- 4.To provide better understanding of multiple access systems and earth station technology
- 5.To prepare students with knowledge in satellite navigation and GPS & and satellite packet communications.

**PROGRAM EDUCATION OUTCOMES**

1. Graduates will demonstrate knowledge of mathematics, science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
3. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
4. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
5. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
6. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.

7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.
11. Graduate who can participate and succeed in competitive examinations.

### **PROGRAM OUTCOMES (POs)**

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

**PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11:Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**PROGRAM SPECIFIC OUTCOMES(PSO'S)**

1. PSO1: Ability to apply concepts of Electronics & Communication Engineering to associated research areas of electronics, communication, signal processing, VLSI, embedded systems, IoT and allied technologies.
2. PSO2: Ability to design, analyze and simulate a variety of Electronics & Communication functional elements using hardware and software tools along with analytic skills.s

**COURSE NAME: GLOBAL POSITIONING SYSTEM**

<b>SUBJECT CODE</b>	<b>COURSE OUTCOMES</b>
EC863PE.1	Explain basic physical principles of remote sensing
EC863PE.2	Understand the basic difference between various kinds of satellites and sensors
EC863PE.3	Know the appropriate use of satellite data for different applications
EC863PE.4	Explain the principles of thermal and microwave satellites, sensors and their nature of the data
EC863PE.5	Apply remote sensing in different thematic studies.

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**CO-PO MATRIX:**

Course Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
EC863PE	2	2	2	2			2			2		
EC863PE	2	2		2	3					2		
EC863PE	2		2	2			2		2			2
EC863PE	2	2	2							2	2	
EC863PE			2	2	2				2			

**COURSE OUTCOME (CO)-PROGRAM SPECIFIC OUTCOME (PSO) MATRIX:**

Course Outcomes (CO's)	PSO 1	PSO 2
EC863PE.1	2	3
EC863PE.2		
EC863PE.3	2	3



EC863PE. 4	2	2
EC863PE. 5	3	2

#### **(4) SCOPE:**

The scope of this subject is to provide a thorough knowledge of the process how Global positioning systems operate remotely and how communication across the globe is exercised.

#### **(5) SYLLABUS:**

### **JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY**

#### **HYDERABAD**

#### **B.Tech. IV Year II Sem.**

#### **L T P C**

#### **Course Code: EC863PE**

#### **3 0 0 3**

UNIT - I Introduction: Basic concept, system architecture, GPS and GLONASS Overview, Satellite Navigation, Time and GPS, User position and velocity calculations, GPS, Satellite Constellation, Operation Segment, User receiving Equipment, Space Segment Phased development, GPS aided Geo augmented navigation (GAGAN) architecture.

UNIT - II **Signal Characteristics:** GPS signal components, purpose, properties and power level, signal acquisition and tracking, Navigation information extraction, pseudorange estimation, frequency estimation, GPS satellite position calculation, Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

UNIT - III **GPS Receivers & Data Errors:** Receiver Architecture, receiver design options, Antenna design, GPS error sources, SA errors, propagation errors, ionospheric error, tropospheric error, multipath, ionospheric error, estimation using dual frequency GPS receiver, multipath, ionospheric error, estimation using dual frequency GPS.

UNIT - IV **Differential GPS:** Introduction, LADGPS, WADGPS, Wide Area Augmentation systems, GEO Uplink subsystem, GEO downlink systems, Geo Orbit determination, Geometric analysis, covariance analysis, GPS /INS Integration Architectures

**UNIT - V GPS Applications:** GPS in surveying, Mapping and Geographical Information System, Precision approach Aircraft landing system, Military and Space application, intelligent transportation system. GPS orbital parameters, description of receiver independent exchange format (RINEX) , Observation data and navigation message data parameters, GPS position determination, least squares method

**TEXT BOOK:** 1. Mohinder S.Grewal, Lawrence R.Weill, Angus P.Andrews, “Global positioning systems, Inertial Navigation and Integration”, Wiley 2007.

**REFERENCE BOOK:** 1. E.D.Kaplan, Christopher J. Hegarty, “Understanding GPS Principles and Applications”, Artech House Boston 2005.

**GATE SYLLABUS:** not applicable

**IES SYLLABUS:** not applicable

**(6) SUJECT EXPERTS DETAILS:**

**INTERNATIONAL:**

1. Ms. Marie A Mak, Acting director, Acquisition Systems, Washington, DC 20548.
2. Tracy M. L. Brown ; Steven A. McCabe ; Charles Wellford , US

**NATIONAL:**

1. Dr. Sundeep Prabhakar hepuri, Dept of ECE, IISc Bangalore.
2. Dr. Dharmendra Kumar Singh, Professor, NIT Patna.

**REGIONAL:**

1. Dr. S. Anuradha, Dept of ECE, NITW, Warangal
2. Dr. T. Jaganatha swamy, Professor, Dept of ECE, GRIET

**(7) JOURNAL WITH MIN 5 REF PAPERS FOR LITERATURE SURVEY STUDY:**

**1. <https://ieeexplore.ieee.org/document/1614066/authors#authors>**

Title: Wearable Antenna Integrated into Military Berets for Indoor/Outdoor Positioning System

**2. <https://ieeexplore.ieee.org/document/482137>**

Title: Characteristics of the Trends in the Global Tropopause Estimated From COSMIC Radio Occultation Data

**3. <https://ieeexplore.ieee.org/document/109205>**

Title: Diversity systems comparison of satellite visibility improvement for designing mobile broadcasting satellite system

**4. <https://ieeexplore.ieee.org/document/1161901>**

Title: Example of a mixed-signal Global Positioning System (GPS) receiver using MCM-L packaging

**5. <https://ieeexplore.ieee.org/document/1162619>**

Title: GPS-Based System for the Measurement of Synchronized Harmonic Phasors

**(8) LESSON PLAN :**

Name of the topic	Sub topics	No. of classes	Text books	Remarks
<b>UNIT I</b>				
<b>Introduction</b>	Basic concept, system architecture	L1, L2,	T1,R1	
	GPS and GLONASS Overview	L3,L4	T1,R1	
	Satellite Navigation, Time and GPS, User position and velocity calculations, GPS	L5,L6,L7	T1,R1	
	Satellite Constellation, Operation Segment, User receiving Equipment	L8,L9	T1,R1	
	Space Segment Phased development, GPS aided	L10,L11, L12	T1,R1	

	Geoaugmented navigation (GAGAN) architecture.			
	No. of classes required: <b>12</b>			
<b>UNIT II</b>				
<b>Signal Characteristics</b>	GPS signal components, purpose, properties and power level, signal acquisition and tracking	L13,L14, L15	T1,R1,T2	
	Navigation information extraction, pseudorange estimation	L16,L17	T1,R1,T2	
	frequency estimation, GPS satellite position calculation, Signal structure,	L18, L19, L20,	T1,R1,T2	
	anti spoofing (AS), selective availability	L21,L22, L23,	T1,R1,T2	
	Difference between GPS and GALILEO satellite construction.	L24, L25	T1,R1,T2	
	No. of classes required:13			
<b>UNIT III</b>				
<b>GPS Receivers &amp; Data Errors</b>	GPS Receivers & Data Errors: Receiver Architecture	L26,L27	T1,R1	
	receiver design options, Antenna design, GPS error sources	L28,L29,L30	T1,R1	
	errors, propagation errors, ionospheric error, tropospheric error, multipath, ionospheric error	L31, L32, L33	T1,R1	
	multipath, ionospheric error, estimation using dual frequency GPS	L34,L35,L36	T1,R1	
	No. of classes required:11			

<b>UNIT IV</b>				
<b>Differential GPS</b>	Introduction, LADGPS, WADGPS	L37,L438, L39	T1,R1	
	Wide Area Augmentation systems	L40,L41,L42, L43,	T1,R1	
	Precision approach Aircraft landing system, Military and Space application,	L44,L45,L46, L47,	T1,R1	
	Geometric analysis, covariance analysis,	L48, L49	T1,R1	
	GPS /INS Integration Architectures	L50	T1,R1	
	No. of classes required:14			
<b>UNIT V</b>				
<b>GPS Applications</b>	GPS in surveying, Mapping and Geographical Information System	L51,L52	T1,R1	
	Precision approach Aircraft landing system, Military and Space application	L53,L54,	T1,R1	
	intelligent transportation system. GPS orbital parameters, description of receiver independent	L55, L56	T1,R1	
	exchange format (RINEX) , Observation data and navigation message data parameters	L57,L58	T1,R1	
	No. of classes required:08			
	<b>Total No. of Classes :58</b>			

**(9) SUGGESTED BOOKS:**

### **TEXT BOOK:**

1. Mohinder S.Grewal, Lawrence R.Weill, Angus P.Andrews, “Global positioning systems, Inertial Navigation and Integration”, Wiley 2007.

### **REFERENCE:**

1. E.D.Kaplan, Christopher J. Hegarty, “Understanding GPS Principles and Applications”, Artech House Boston 2005

### **WEBSITES FOR SELF LEARNING RESOURCES:**

- 1). <https://www.youtube.com/watch?v=08wH5k4uJ3s>
- 2) [https://www.youtube.com/watch?v=wCcARVbL\\_Dk](https://www.youtube.com/watch?v=wCcARVbL_Dk)
- 3). [https://www.youtube.com/watch?v=8eTII19\\_57g](https://www.youtube.com/watch?v=8eTII19_57g)
- 4).[https://www.youtube.com/watch?v=08wH5k4uJ3s&list=RDCMUCCDzHkpuIuD5\).  
1ZC0wsCXUuPQ&start\\_radio=1&t=43](https://www.youtube.com/watch?v=08wH5k4uJ3s&list=RDCMUCCDzHkpuIuD5).1ZC0wsCXUuPQ&start_radio=1&t=43)  
<https://www.youtube.com/watch?v=dhTnEcV4QVo>

### **(10) QUESTION BANK:**



QUESTIONBANK-JNTU-H-MODEL.rar

### **(11) CASE STUDY**

#### **Project 1:-**

## **TITLE:-RTOS based vehicle tracking system**

### **Abstract:**

The ability to track vehicles is useful in many applications including security of personal vehicles, public transportation systems, School buses and others. Therefore, the development of vehicle tracking system using the Global Positioning System (GPS) and Global System for Mobile Communications (GSM) modem is with the aim of enabling users to locate their vehicles with ease and in a useful manner. The system will provide users with the capability to track vehicle remotely through the mobile network. This project mainly deals with concept of Vehicle tracking, Monitoring and so gives a better supervision to the target vehicle. This system is based on ARM7, GSM and GPS. GSM technology is used to send information about the vehicle. This information contains exact location of the vehicle. ARM7 TDMI core LPC 2148 processor with collects the information and sends to the Monitoring system using GSM modem. The Monitoring system uses GUI (Graphical User Interface) to display the received information on Google Map.

### **Project 2:-**

## **TITLE :Guiding & control of fishermen boat using GPS**

### **Abstract:**

In this modern world, there are many technologies that are emerging day to day but no such technology is being efficiently and economically used to the fisherman in terms of their safety. The main drawback in the sea is that the fisherman are unaware of the border which makes them to cross the limit provided for their nation and ultimately they get caught into trouble. Our paper involves the Global Positioning Satellite System technology for tracking the position of the boat in the form of latitude and longitude. The received signal from the boat position is compared with the present value time to time. As a result of the comparison, the motor of the boat is operated in three different modes such as normal, slow and reverse. By employing this technique, the fisherman could get enough knowledge about their position which helps them to be in the safer zone.



## **(12) MODEL PAPERS**

### **SEPTEMBER 2020 MODEL PAPERS:**

1. Draw the functional block diagram of the Master Control Station. Also explain the functions of each block. [15]
- 2.a) Explain the trilateration method to estimate GPS receiver position in  
b) Compare GPS and GALILEO system with respect to satellite constellation and signal structure. [8+7]
- 3.a) Explain the characteristics of C/A code.  
b) Derive the equation for ionospheric delay for phase range measurement starting from the refractive index. [5+10]
4. Draw the schematic functional block diagram of the GPS receiver. List the signal processing functions of the GPS receiver. [15]
5. Explain the following errors in GPS receivers: a) Ionospheric errors b) Tropospheric errors c) SA errors. [15]
- 6.a) With the help of a neat diagram explain Wide Area DGPS. b) Compare GEO uplink and down link systems. [10+5]
- 7.a) How the GEO orbit can be determined by geometric analysis.  
b) Explain the RINEX format of observation and navigation data files. [8+7]
8. Describe the steps involved in receiver position estimation using Least Squares Approximation method. [15]

### **DECEMBER 2020 MODEL PAPER:**

1. How to determine the user position and velocity from received satellite ephemeris? Explain. [15]
2. Discuss briefly about User segment, Control segment and Space segment. [15]
3. Describe C/A code and P-code Generations with block diagrams. [15]
- 4.a) How Pseudo range is different from True range? b) Describe Selective Availability and how the Selective Availability is achieved. [6+9]

5. Draw the schematic functional block diagram of the generic GPS receiver and explain each block in detail. [15]
- 6.a) Describe how ionospheric delay is estimated using dual frequency GPS receiver measurements.  
b) Define the tropospheric delay. [12+3]
- 7.a) Discuss the salient features of WADGPS.  
b) What is Wide Area Augmentation System? [10+5]
8. Describe Receiver Independent Exchange format (RINEX) of GPS observation and navigation data. [15]

**(13) ASSIGNMENT QUESTIONS /INNOVATIVE ASSIGNMENT QUESTIONS:**

**PART-A**

- 1.Explain satellite constellation
- 2.Describe GPS satellite position calculations.
- 3.List out the application of GPS.
- 4.Explain Difference between GPS and GALILEO satellite construction.
- 5.Explain the GPS Receiver Architecture

**PART-B**

- 1.Explain the method multiple mitigation.
- 2.Explain EPHEMERIS data errors and clock errors.

3. Describe GPS/INS integration architecture.

4. Give a brief note of how GPS works in military and space application

5. Describe about RINEX in GPS.

### **(14) IMPORTANT QUESTION SETS ON EACH UNIT**

#### **UNIT 1**

1. Explain satellite constellation

2. Describe in detail about GAGAN Architecture.

3. Write about satellite navigation time and GPS.

4. What is space segment phase development system.

5. Give a brief overview of GPS and GLONASS system.

#### **UNIT 2**

1. Explain the terms pseudo range estimation and frequency estimation.

2. Explain Difference between GPS and GALILEO satellite construction.

3. Describe GPS satellite position calculations

4. Describe the signal acquisition, tracking and navigation of GPS

5. Write about anti spoofing

### **UNIT 3**

1. Explain the GPS Receiver Architecture
2. Explain the following errors
  - a. SA errors
  - b. Propagation errors
  - c. Ionospheric errors
  - d. Tropospheric errors
3. Explain about Antenna design in GPS Receivers.
4. Write about the methods of multiple mitigations
5. Describe about EPHEMERIS data errors and clock errors.

### **UNIT 4**

1. Describe about GEO orbit determination.
2. Explain wide area augmentation system.
3. Describe GEO uplink subsystem.
4. Describe GPS/INS integration architecture.
5. Explain about GEO Orbit determination

### **UNIT 5**

1. Give a brief note of how GPS works in military and space application
2. Describe about RINEX in GPS.
3. Give a brief note of how GPS works in Aircraft landing system
4. Give a brief note of how GPS works in Intelligent transportation system.

5.Explain about least squares method

### **STEP/COURSE MATERIAL:**

**1. What is the accuracy of a GPS receiver?**

A basic GPS system has accuracy of between one and two meters, depending on propagation specifics and performance of some receiver components. There are enhanced techniques such as differential GPS (where the GPS receiver is also linked to a nearby reference location), that can yield position accuracy on the order of a few centimeters.

**2. Who manages the GPS system?**

The U.S. Air Force is responsible for the satellites, the launches, maintaining the system, and correcting the signals as needed as the orbits change (and they do) or other perturbations occur.

**3. Can GPS determine the direction in which you are pointing, from a single reading?**

No. In contrast to a compass, a single GPS reading provides only location, not orientation. But if you move and take a second or series of GPS readings, then you will know its direction.

**4. How many satellites does GPS require?**

To ensure that users anywhere on Earth can have an unobstructed view of at least four satellites (the needed minimum), the GPS system provides an evenly spaced core constellation of 24 medium-Earth-orbit satellites in six different orbital planes, although only 12 are required for full Earth coverage; the others provide more “viewing” opportunities as well as redundancy.

**5. What critical development allowed the idea of GPS satellites to become a reality?**

Although there were many critical technical developments, one key advance was the availability of the lightweight, low-power atomic clock which each satellite needs for precise timing of its signals. This allows the satellite codes to be sent with extremely high timing accuracy, and is essential to the system performance. Other developments include sensitive, low-noise front-end amplifiers which operate at 1 GHz, and the processing power (via microprocessors or FPGAs) which can implement the complex, intensive algorithms in real time or nearly so.

**6. How is the GPS system organized?**

There are three functional segments: the control segment, the space segment, and the user segment:

7. The control segment includes the master control station which communicates with the satellites as needed, and manages overall system performance and parameters, many of which need adjustment due to inevitable drifts, aging, and orbit shifts;

8. The space segment consists of the satellites,

### **9. What about the control segment?**

The control segment must not only communicate with each satellite, but it must also determine what imperfections and changes the satellite orbits have undergone. To do this, there are multiple Earth-based stations at locations known with extreme accuracy and precision. Each base station uses radar and other techniques to ascertain the details of the orbit of each satellite.

### **10. What is the nature of the encoding for the transmitted signals?**

The satellites use pseudorandom sequences (PRSQ), which are resistant to noise and corruption, and easier to correlate. There are actually two such PRSQ sequences: the P-code pattern is long and provides more time-alignment, while the C/A code is shorter and less precise, but supports faster acquisition and analysis. Timing of these signals must be accurate and measurable to nanoseconds for GPS to be useful.

### **11. Who Uses Gps?**

GPS is used to support land, sea, and airborne navigation, surveying, Geophysical exploration, mapping and geodesy, vehicle location systems, and a wide variety of additional applications.

### **12. What Is Gps?**

GPS is a satellite-based radionavigation system developed and operated by the U.S. Department of Defense (DOD). GPS permits land, sea, and airborne users to determine their three-dimensional position, velocity, and time 24 hours a day, in all weather, anywhere in the world with a precision and accuracy far better than other radionavigation systems available today or in the foreseeable future.

<b>13. How</b>	<b>Is</b>	<b>Gps</b>	<b>Used?</b>
GPS receivers collect signals from satellites in view. They display the user's position, velocity, and time, as needed for their marine, terrestrial, or aeronautical applications. Some display additional data, such as distance and bearing to selected waypoints or digital charts.			

### **(15) LIST OF TOPICS FOR STUDENT SEMINARS**

1. GPS and GLONASS Overview,
2. Satellite Navigation,
3. GPS aided Geo augmented navigation (GAGAN) architecture.
4. GPS signal components, purpose, properties and power level,

- 5.Signal acquisition and tracking
- 6.GPS satellite position calculation,
7. Difference between GPS and GALILEO satellite construction.
8. GPS Receivers
9. Antenna design
- 10.GEO Uplink subsystem
- 11.GEO downlink systems
- 12.Geo Orbit determination
- 13.Mapping and Geographical Information System



## **DIGITAL CMOS IC DESIGN**

Subject Code: EC744PE

Class: IV-Year B.Tech ECE I-Semester

BY

VASEEM AHMED QURESHI  
ASSOCIATE PROFESSOR

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**CMR ENGINEERING COLLEGE**



<u>S.NO</u>	<u>CONTENT</u>
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(1) -	<b>Preamble/Introduction</b>
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(2) -	<b>Prerequisites</b>
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(3) -	<b>Objectives and Outcomes</b>
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(4) -	<b>Syllabus</b>
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	<b>1.JNTU/R20-CMREC</b>
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	<b>2.GATE</b>
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	<b>3.IES</b>
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(5) -	<b>List of Expert Details</b> (Local/National/International with Contact details/Profile link/Blogs/their research Contribution towards the subject)
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(6) -	<b>Journals with min 5 ref paper for literature study</b>
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(7) -	<b>Subject -Lesson plan</b>
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(8) -	<b>Suggested Books</b> (prescribed and References)
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(9) -	<b>Websites for self learning      Resources like</b>
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	<i>www.geeksforgeeks.org, www.schools.com, Coursera, edX,</i>
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	<i>Udemy, Khan Academy, NPTEL etc along Registration procedures)</i>
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(10) -	<b>Question Banks</b>
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	<b>1.JNTUH/Model papers</b>
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	<b>2.GATE</b>
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(11) -	<b>Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications.</b>
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(12)
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-	<b>Assignment Question/Innovative Assignments sets.</b>
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(13) -	<b>List of topics for students Seminars with Guidelines</b>
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(14) -	<b>STEP/Course material in softcopy</b>
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(15) -	<b>Expert Lectures with topics &amp; Schedules</b>
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## **1. Preamble/Introduction:**

Complementary metal oxide semiconductor (CMOS) digital integrated circuits are the enabling technology for the modern information age. Because of their intrinsic features in low-power consumption, large noise margins, and ease of design, CMOS integrated circuits have been widely used to develop random access memory (RAM) chips, microprocessor chips, digital signal processor (DSP) chips, and application-specific integrated circuit (ASIC) chips. The popular use of CMOS circuits will grow with the increasing demands for low-power, low-noise integrated electronic systems in the development of portable computers, personal digital assistants (PDAs), portable phones, and multimedia agents. Since the field of CMOS integrated circuits alone is very broad, it is conventionally divided into digital CMOS circuits and analog CMOS circuits. This course is focused on the CMOS digital integrated circuits.

## **2. Prerequisites:**

This course recommends basic knowledge and practice on CMOS Technology, Digital System Design and Digital IC's.

## **3. Objectives:**

1. Give exposure to different types of Inverter circuits.
2. Provide design concepts to build Combinational MOS circuits.
3. Understand basic concepts of Sequential MOS circuits.
4. Give exposure to Dynamic logic circuits.
5. Explain different categories of memories.

### **Outcomes:**

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

1. Design and analyze MOS Inverters with desired specifications.
2. Design combinational and sequential circuits with different logic circuits.
3. Design memories with efficient architecture to improve access times and power consumption.

## **4. CMREC R20**

### **UNIT –I:**

#### **MOS Design:**

Pseudo NMOS Logic – Inverter, Inverter Threshold voltage, Output high voltage, Output Low voltage, Gain at gate Threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

## **UNIT –II:**

### **Combinational MOS Logic Circuits:**

MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

## **UNIT –III:**

### **Sequential MOS Logic Circuits:**

Behavior of Bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip flop.

## **UNIT –IV:**

### **Dynamic Logic Circuits:**

Basic principle, Voltage Bootstrapping, Synchronous Dynamic Pass transistor circuits, Dynamic CMOS Transmission gate logic, High performance Dynamic CMOS circuits.

## **UNIT –V:**

### **Semiconductor Memories:**

Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.

## **GATE**

**Not Applicable**

## **IES**

**Not Applicable**

## **5. List of Expert Details:**

### **International:**

- Dr. Hanho Lee, Professor School of Information and Communication Engineering,

Inha University, Korea.  
Email: [hhlee@inha.ac.kr](mailto:hhlee@inha.ac.kr)

**National:**

- Dr. Shaik Rafi Ahamed, Dept. of EEE, IIT Guwahati  
Phone: [+91-361-2582542](tel:+91-361-2582542), Email: [rafiahamed@iitg.ac.in](mailto:rafiahamed@iitg.ac.in)
- Prof. V. Janakiraman, Dept. of EE, IIT Madras  
Phone: [+91-44-22574485](tel:+91-44-22574485), Email: [janakiraman@ee.iitm.ac.in](mailto:janakiraman@ee.iitm.ac.in)

**Regional:**

- Dr. Cyril Prasanna Raj, Prof. & Dean, MS Engineering College, Bangalore  
Email: [cyril@msec.ac.in](mailto:cyril@msec.ac.in)

**6. Journals with min 5 reference papers for literature study:**

1. CMOS PLL Design in a Digital Chip Environment  
<https://link.springer.com/article/10.1023/A:1008250912571>
2. Digital Circuit Design Challenges and Opportunities in the Era of Nanoscale CMOS  
[https://www.d.umn.edu/~htang/ece4311\\_doc\\_F11/04403891.pdf](https://www.d.umn.edu/~htang/ece4311_doc_F11/04403891.pdf)
3. Performance Analysis of CMOS Technology  
[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3647984](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3647984)
4. A Review on Energy Efficient CMOS Digital Logic  
<https://etasr.com/index.php/ETASR/article/view/389>
5. Power Estimation Analysis For CMOS Cell Structures  
<https://www.mdpi.com/2079-9292/11/19/3118>

**7. Subject Lesson Plan:**

Topic Name	No. of classes	Text books
<b>UNIT I: MOS Design</b>		
Pseudo NMOS Logic	2	T1
Inverter	1	T1

Inverter Threshold voltage	1	T1
Output High voltage, Output Low voltage	1	T1
Gain at gate Threshold voltage	1	T1
Transient response	1	T1
Rise time, Fall time	1	T1
Pseudo NMOS logic gates	1	T1
Transistor equivalency	4	T1
CMOS Inverter logic	3	T1
<b>Total No. of Classes</b>	<b>16</b>	
<b>UNIT II: Combinational MOS Logic Circuits</b>		
MOS logic circuits with NMOS loads	2	T2
Primitive CMOS logic gates – NOR & NAND gate	2	T2
Complex Logic circuits design	2	T2
Realizing Boolean expressions using NMOS gates and CMOS gates	2	T2
Realizing Boolean expressions using AOI and OIA gates	1	T2, R1
CMOS Full Adder	1	T2, R1
CMOS transmission gates	1	T2, R1
Designing with Transmission gates	2	T2, R1
<b>Total No. of Classes</b>	<b>13</b>	
<b>UNIT III: Sequential MOS Logic Circuits</b>		
Behavior of Bistable elements	2	T2, R1
SR Latch	2	T2, R1
Clocked latch and flip flop circuits	2	T2, R1
CMOS D latch and edge triggered flip flop	2	T2, R1
<b>Total No. of Classes</b>	<b>08</b>	
<b>UNIT IV: Dynamic Logic Circuits</b>		

Basic principle	1	T2, R1
Voltage Bootstrapping	2	T2, R1
Synchronous Dynamic Pass transistor circuits	2	T2, R1
Dynamic CMOS Transmission gate logic	2	T2, R1
High performance Dynamic CMOS circuits	2	T2, R1
<b>Total No. of Classes</b>	<b>09</b>	
<b>UNIT V: Semiconductor Memories</b>		
Types, RAM array organization	1	T2, R1
DRAM – Types, Operation	2	T2, R1
Leakage currents in DRAM cell and refresh operation	2	T2, R1
SRAM operation Leakage currents in SRAM cells	2	T2, R1
Flash Memory- NOR flash and NAND flash	2	T2, R1
<b>Total No. of Classes</b>	<b>09</b>	
<b>Total No. of Classes</b>	<b>55</b>	

## 8. Suggested Books:

### TEXT BOOKS:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3<sup>rd</sup> Ed., 2011.

### REFERENCE BOOKS:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan,

## 9. Websites for self learning Resources:

1. <https://www.youtube.com/watch?v=oL8SKNxEdHs>
2. [https://www.youtube.com/watch?v=2kDp\\_ncbNuA](https://www.youtube.com/watch?v=2kDp_ncbNuA)

3. <https://www.youtube.com/watch?v=XycMoZIzyK0>
4. <https://www.electronics-tutorial.net/Digital-CMOS-Design/>
5. <https://www.tutorialspoint.com/digital-integrated-circuits>
6. <https://www.mphysicstutorial.com/2020/12/semiconductor-memory-types-ram-rom-dram.html>

## 10. Question Banks

### 1.JNTUH/Model papers

**M. Tech. I Semester Supplementary Examinations, Jan/Feb-2018**

#### **DIGITAL CMOS IC DESIGN**

**(Common to VLSI & ES, ES & VLSI, VLSID & ES, ES & VLSID, VLSI, VLSID, VLSID and VLSI&ME)**

**Time: 3 hours**

**Max. Marks: 60**

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*Answer any FIVE Questions All  
Questions Carry Equal Marks*

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1. a Define Threshold Voltage. Express threshold voltage and discuss dependency of  $V_T$  on various parameters.  
b Explain the DC noise margin of CMOS logic.
2. Design and implement CMOS full adder circuit.
3. Design and implement AOI and OIA using CMOS.
4. Realize NMOS complex logic gates using the Boolean function  $Z=A(D+C)+BE$ .
5. a Discuss the transient analysis of CMOS Transmission gate by replacing it with resistor equivalent circuit. Design an EX-OR gate using Transmission gate Logic.  
b Design an EX-OR gate using Transmission gate Logic.
6. a Draw the D latch by using CMOS logic and explain its operation in detail. b  
  
b. Write short notes SR latch in sequential MOS logic.
7. Mention different types of RAM cells. Draw and explain the operation of a single bit dynamic RAM cell.
8. a Compare the performance of SRAM and DRAM.  
  
b Write about dynamic pass transistor.

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**M.Tech. I Semester Supplementary Examinations,  
January-2017**

**DIGITAL CMOS IC DESIGN**

**(Common to VLSI & ES, ES & VLSI, VLSID & ES, ES & VLSID,  
VLSI, VLSID, VLSISD and VLSI&ME)**

**Time: 3 hours**

**Max. Marks: 60**

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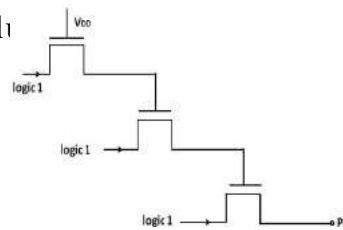
*Answer any FIVE Questions  
All Questions Carry Equal  
Marks*

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1. a Explain and derive the necessary DC region equations of a CMOS inverter.  
6M  
b Explain the DC noise margin of CMOS logic.  
6M
2. a Write short notes on transmission gates with the relevant circuits.  
6M  
b Bring out the differences between Pass Transistor logic and transmission gate logic.  
6M
3. a Design and explain the operation of 2 input NMOS NAND.  
6M  
b Explain the procedure to design an adder circuit using CMOS logic.  
6M
4. Explain voltage boots trapping with an example.  
12M
5. a Explain the concept of charge storage and charge leakage associated with pass  
6M transistor logic.



- b Find the value at the point P mentioned in the circuit shown in above figure for the 6M given value logic1=5V and explain it.



6. a Draw the D latch by using CMOS logic and explain its operation in detail.  
6M
- b Write short notes on SR latch in sequential MOS logic.  
6M
7. a Write notes on pseudo NMOS logic gate.  
6M
- b Write notes on Ferro electric Random Access Memory (FRAM).  
6M
8. a Write about the leakage currents in SRAM.  
6M
- b Explain NOR flash memory.  
6M

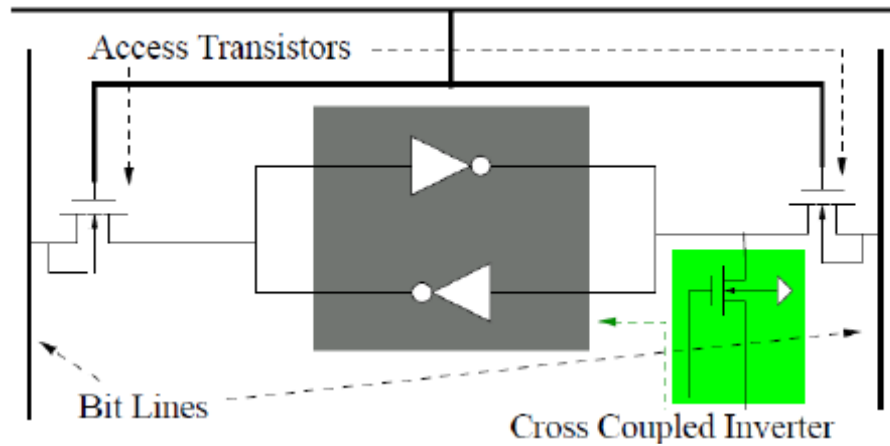
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## 11. Case study presentations:

### Project 1: Design and Analysis of Low Power SRAM using CMOS Technology

The power consumption in commercial processors and application specific integrated circuits increases with decreasing technology nodes. Power saving techniques has become a first class design point for current and future VLSI systems. These systems employ large on-chip SRAM memories. Reducing memory leakage power while maintaining data integrity is a key criterion for modern day systems. Unfortunately, state of the art techniques like power-gating can only be applied to logic as these would destroy the contents of the memory if applied to a SRAM system. Fortunately, previous works have noted large temporal and spatial locality for data patterns in commercial processors as well as application specific ICs that work on images, audio and video data. This paper presents a novel column based Energy Compression technique that saves SRAM power by selectively turning off cells based on a data pattern. This technique is applied to study the power savings in application

specific integrated circuit SRAM memories and can also be applied for commercial processors. The paper also evaluates the effects of processing images before storage and data cluster patterns for optimizing power savings.



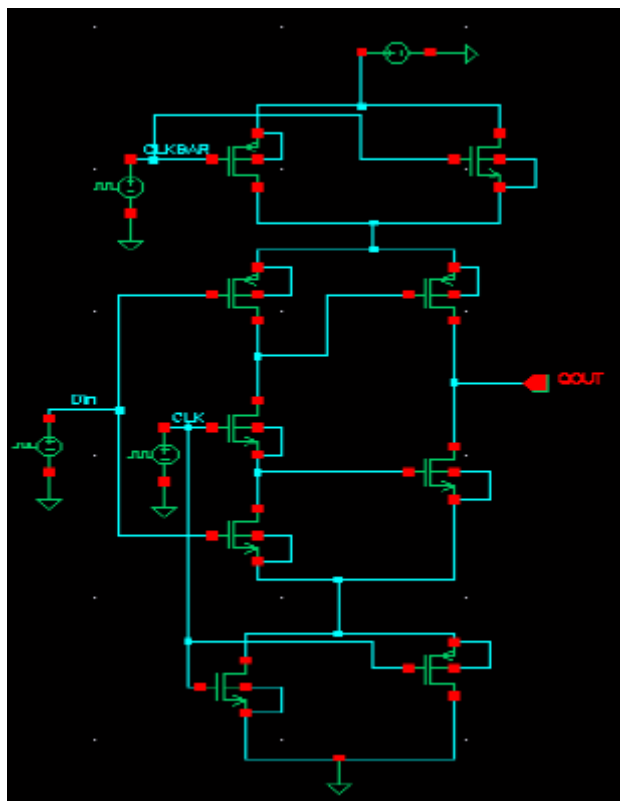
The En-Com System relies on energy compression using a frequently appearing data pattern. We choose a data pattern of 0000000 (eight zeros) to enable the compression. This number is selected based on figure 5 and table 1. A group of cells storing this pattern of eight zeros form the compress-group for the design. Each cell in the compress-group is a 7 transistor SRAM (7T SRAM). The design also requires a pivot cell to turn off the compress-group and store its value called the Zero-Switch Cell. Even though images contain more compress groups having only „1“s, the En-Com system stores inverted values of data for images. This is to make the design consistent even for commercial processors, that have higher number of „0“s over „1“s in the caches. Commercial processors can ignore the inversion of data. Other major design considerations are:

- The Zero-Switch Cell will require a small driver for operating on the compress-group and a power-gate transistor
- The power gate transistor sizing determines the turn on/off time of 8 cells
- The compress group must hold the data-value (0 for each cell) and requires a 7T SRAM structure.
- This ensures that reads to the compress group will work without any modifications to the read circuitry at the SRAM.
- At the system level, the implementation of write logic and the read logic for the SRAM Array requires a few changes. Reads require that the pulse generator is not activated by the system and writes require it to be active in case of writing data value „1“, the pulse generator must be active for an additional cycle to enable dual write.

The 16 rows in the 16x32 array are divided into 2 sections (vertically) of 8 rows each. Every column in a section has a Zero-Switch Cell. All Zero-Switch Cells are reset to a „0“ at the beginning. Every write of a 1 to the SRAM section is also written to its Zero-Switch Cell. Only when all 8 cells in the column have „0“s i.e the compress-group has the data pattern 00000000, the Zero-Switch Cell switches off the compress-group.

## Project 2:

This D Flip Flop circuit is analyzed by using the supply voltage level methods. These methods are used mainly to suppress the power consumption caused due to leakage currents. In addition, because of this implemented technique, the time taken for battery backup and the supply voltage given at standby mode gets minimized. The projected circuit uses a smaller number of transistors, such that power consumption and leakage currents are in prior limit. Mainly, the CMOS D Flip Flops are designed to use them in binary counters, shift registers, Analog and Digital circuit designs. And this circuit design is implemented in 45nm CMOS Technology Cadence Virtuoso Tool.



### SVL Method Enforced on CMOS D- FLIPFLOP:

SVL stands for Self-Voltage Level. This is utilized to minimize power dissipation for clocked structure as Flip-Flops at the time if it is working at standby mode. If the clock is given to the ground that is zero Volts then Flip-Flops works as standby mode. These also follows pull up and pull down structure that is like the CMOS technology. While pull up joints to inversion of Pulse and pulls down to get joints to clock. This method will optimize Power dissipation because of clock pulse is utilized as control signal for limitation of Power supply connected. To DFPFP so that it is named as self-voltage level. If clock pulse is given as one and clock bar is zero and P1 gets on and N1 gets off and clocked structure joints to Power supply. If clock is zero, the design automatically works in standby mode. If even the power supply voltage is minimized then also the circuit operates in a good mode, such that minimizes power dissipation, mainly the leakage supply which is passing through transistors makes the transistors are in off condition so that leakage power will be minimized. If clock is zero, then N2 gets off. Here the throwback is this PMOS transistor show zero which is a bad logic and gives threshold voltage as result for pull down. If P2 is PMOS transistor joints in pull down in place of

ground and gives some limited potential at virtual ground point. The virtual ground is internally converts to power supply to take down to the NMOS transistor of limiter design. While moderate positive potential is given to source terminal of NMOS transistor and this transistor will dissipated current is optimized because of it is in standby mode.

## **12. Assignment Questions:**

### **SET 1**

1. Illustrate Pseudo NMOS Logic.
2. Derive expression for Inverter threshold voltage.
3. Compare Output high voltage and output low voltage.
4. Explain MOS logic circuits with MOS loads.
5. Explain Complex Logic circuits design.
6. Realize Boolean expressions using NMOS gates and CMOS gates.
7. Explain CMOS D latch and edge triggered flip flop.
8. What is Voltage Bootstrapping? Explain.
9. How High performance Dynamic CMOS circuits are designed?
10. Explain types and RAM array organization.

### **SET 2**

1. Explain Gain threshold voltage.
2. Derive expression for rise time.
3. Write short notes on Pseudo NMOS logic gates.
4. Illustrate Primitive CMOS NOR logic gate.
5. Demonstrate CMOS Full Adder.
6. Explain designing logic gates with Transmission gates.
7. Explain behavior of Bistable elements.
8. Explain Synchronous Dynamic Pass transistor circuits.
9. What are the different types of DRAM's. Explain operation of any one DRAM.
10. What are the Leakage currents in DRAM cell?

### **SET 3**

1. Derive expression for fall time.
2. Demonstrate transistor equivalency.
3. Explain CMOS Inverter logic.
4. Illustrate Primitive CMOS NAND logic gate.
5. Explain CMOS transmission gate logic.

6. Realize Boolean expressions using AOI and OIA gates.
7. Illustrate Clocked latch and flip flop circuits.
8. Explain Dynamic CMOS Transmission gate logic.
9. What are the Leakage currents in SRAM cell?
10. Explain with diagram NOR & NAND Flash Memories.

### **13. List of Topics for student seminars**

1. Domino CMOS Logic
2. Dynamic CMOS Logic
3. Challenges in CMOS IC Design
4. Clocked Flip Flops in ICs
5. Transmission Gates in ICs
6. CMOS Inverter Analysis
7. Differential CMOS Logic
8. Static RAM Design
9. Dynamic RAM Design
10. Challenges in Memory design

### **14.STEP/Course material in softcopy**



### **15.Expert Lectures with topics & Schedules**

<b>Expert Name</b>	<b>Topic</b>	<b>Schedule (Tentative)</b>
Dr. B. Rajendra Naik	CMOS IC Design	
Dr. N. Srikanth	Challenges in CMOS Memory Design	

## **ACADEMIC PLANNER**

**Subject: ELECTRONIC MEASUREMENTS&INSTRUMENTATION**

<b><u>S.NO</u></b>	<b><u>CONTENT</u></b>
(1) -	<b>Preamble/Introduction</b>
(2) -	<b>Prerequisites</b>
(3) -	<b>Objectives and Outcomes</b>
(4) -	<b>Syllabus</b> <b>1. CMREC-R20</b> <b>2. GATE</b> <b>3. IES</b>
(5) -	<b>List of Expert Details</b> (Local/National/International with Contact details/Profile link/Blogs/their research Contribution towards the subject)
(6) -	<b>Journals with min 5 ref paper for literature study</b>
(7) -	<b>Subject -Lesson plan</b>
(8) -	<b>Suggested Books</b> (prescribed and References)
(9) -	<b>Websites for self learning</b> <b>Resources like</b> <i>www.geeksforgeeks.org, www.schools.com, Coursera,edX,</i> <i>Udemy, Khan Academy, NPTEL etc along Registration procedures)</i>
(10) -	<b>Question Banks</b> <b>1.JNTUH/Model papers</b> <b>2.GATE</b>
(11) -	<b>Two case study presentations with Project /</b> <b>Product/ Model /prototypes/ Industrial applications.</b>
(12) -	<b>Assignment Question/Innovative Assignments sets.</b>
(13) -	<b>List of topics for students Seminars with Guidelines</b>
(14) -	<b>STEP/Course material in softcopy</b>
(15) -	<b>Expert Lectures with topics &amp; Schedules(if any)</b>

**(1) - Preamble/Introduction:**

Instrumentation is a technology of measurement which serves not only science but all branches of engineering, medicine, and almost every human endeavor. The knowledge of any parameter largely depends on the measurement. Measurement plays an important role in the context of the progressive metamorphosis of science and technology. The subject of measurement is crucial to advancements in the field of electronics.

**(2) - Prerequisites:**

This subject recommends the basic knowledge of electrical engineering and basic engineering mathematics.

**(3) - Objectives and Outcomes:**

**The objectives of the course are to:**

- It provides an understanding of various measuring system functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Understanding the concepts of various measuring bridges and their balancing conditions.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

**Course Outcomes:**

**Upon completing this course, the student will be able to:**

- **Discuss** the static and dynamic characteristics of measurement system
- **Analyze** the AC and DC voltmeters and current meters also analyze the signal analyzers
- **Discuss** the different types of signal generators and oscilloscopes
- **Classify** and analyze the different types of transducers.
- **Design** the different types of bridges.
- **Demonstrate** the Measurement of Physical Parameters.

**(4)-Syllabus - R20**

**UNIT – I**

**Block Schematics of Measuring Systems:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag.

**Measuring Instruments:** DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

## **UNIT - II**

**Signal Analyzers:** AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators.

**Signal Generators:** AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

## **UNIT – III**

**Oscilloscopes:** CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines. Applications: Measurement of Time, Period and Frequency Specifications.

**Special Purpose Oscilloscopes:** Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs

## **UNIT - IV**

**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hot wire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers, gyroscopes, accelerometers.

## **UNIT - V**

**Bridges:** Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

**Measurement of Physical Parameters:** Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

## ***SYLLABUS - GATE***

### **UNIT I**

Basic indicating Instruments, Error Analysis and Measurement, Digital Voltmeters.

### **UNIT II**

Sweep Frequency Generators

### **UNIT III**

Cathode Ray Oscilloscope



## **UNIT IV**

Transducers

## **UNIT V**

Measurement of Resistance and A.C Bridges

## **SYLLABUS - IES**

### **UNIT I**

Basic indicating Instruments, Error Analysis and Measurement, Digital Voltmeters

### **UNIT II**

Not Applicable

### **UNIT III**

Not Applicable

### **UNIT IV**

Transducers

### **UNIT V**

Measurement of Resistance and A.C Bridges

**(5) - List of Expert Details(Local/National/International with Contact details/Profile link/Blogs/their research contribution towards the subject)**

**The Expert Details which have been mentioned below are only a few of the eminent ones known Internationally, Nationally and Locally. There are a few others known as well.**

#### **INTERNATIONAL**

1. Kaushallya (Kay) Adhikari  
Assistant Professor  
Electrical, Computer and Biomedical Engineering  
University of Rhode Island  
United States of America  
[kadhikari@uri.edu](mailto:kadhikari@uri.edu)
2. R. Priyo Hartono Adji  
Junior Researcher at Indonesian Institute of Sciences  
Bandung, West Java, Indonesia  
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[rpri002@lipi.go.id](mailto:rpri002@lipi.go.id)

#### **NATIONAL**

1. Dr. Ravi Kumar Jatoth, Ph.D, Professor  
ECE Department, NIT Warangal

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Phone: 8702462444

2. Dr. Rahul Vivek Purohit, Professor, ECE Department, Pilani, Rajasthan  
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Phone No: 9716020727

3. Bansal R.K, Ph.D, ECE dept, IIT Kanpur  
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Email: [rkb@iitk.ac.in](mailto:rkb@iitk.ac.in)

## REGIONAL

1. Dr. N.D. Tiwari,  
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Phone No: 9165437352.
2. Mrs. A. Ajitha,  
Assistant Professor,  
ECE Department,  
IARE, Hyd.  
E-Mail: [g.ajitha@iare.ac.in](mailto:g.ajitha@iare.ac.in).  
Phone No: 7780656031.

## (6) - Journals with min 5 ref paper for literature study

1. EPJ Techniques and Instrumentation: Springer  
<https://epjtechniquesandinstrumentation.springeropen.com/>
2. Development and Validation of Testing System for Automated Millimeter-Wave Phased Array Multi-Beam Near-Field Measurement | IEEE Journals & Magazine | IEEE Xplore  
<https://ieeexplore.ieee.org/document/10123377>
3. A Digital Bridge Evaluation up to 100 kHz for Precision Impedance Measurements | IEEE Journals & Magazine | IEEE Xplore  
<https://ieeexplore.ieee.org/document/10122488>
4. A data-driven soft sensor for mass flow estimation | IEEE Journals & Magazine | IEEE Xplore  
<https://ieeexplore.ieee.org/document/10122147>
5. Electronic Measurement and Instrumentation- Research gate  
[https://www.researchgate.net/publication/342318778\\_Electronic\\_Measurement\\_and\\_Instrumentation](https://www.researchgate.net/publication/342318778_Electronic_Measurement_and_Instrumentation)

**(7)- Subject -Lesson plan**

S.N O	TOPIC TO BE COVERED	Sub-Topic	cumulative Lectures Required	Suggested Books	Remarks
<b>UNIT-I</b>					
1.	Introduction of measuring instruments	Need of instrumentation and measurement	L1	T2,R2,R4	
2.	Block Schematics Of Measuring Systems Performance Characteristics	Diagram	L2	T2,R1,R4	
3.	Static Characteristics	Accuracy, Precision, Resolution	L3	T2,R1,R4	
4.	Types of Errors	Gaussian Error	L4	T2,R1,R4	
5.	Dynamic Characteristics	Repeatability, Reproducibility, Fidelity, Lag	L5, L6	T2,R2,R4	
6.	Measuring Instruments: DC Voltmeters ,	Multirange Voltmeter	L7	T2,R1,R4	
7.	D'Arsonal Movement	Ammeter Loading Effect	L8		
8.	DC Current Meters, AC Voltmeters	Block Diagram	L9	T2,R1,R4	
9.	Ohmmeters	Series-Type ,Shunt Type, Multi Range	L10	T2,R1,R4	
10.	Multi meters: Meter Protection, Extension of Range	-	L11	T2,R2,R4	
11.	True RMS Responding Voltmeters,	Block Diagram	L12	T2,R1,R4	
12.	Specifications Of Instruments	-	L13	T2,R1,R4	
<b>UNIT-II</b>					
13.	Signal Analyzers, AF	Types	L14	T2,R1,R4	
14.	HF Wave Analyzers	-	L15	T2,R1,R4	
15.	Harmonic Distortion	-	L16	T2,R1,R4	
16.	Heterodyne wave Analyzers	Applications	L17	T2,R1,R4	
17.	Spectrum Analyzers,	Characteristics , Applications, Factors	L18	T2,R1,R4	
18.	Power Analyzers	Communicatio	L19, L20	T2,R1,R4	

		ns Signal Analyzer, Logic Analyzers, Network Monitoring System			
19.	Capacitance-Voltage Meters	-	L21		
20.	Oscillators	Consideration s in Choosing an Oscillator	L22	T2,R1,R4	
21.	Signal Generators: AF-,RF ,Signal Generator Sweep Frequency Generators,	-	L23	T2,R2,R4	
22.	Pulse and Square Wave Generators,	-	L24	T2,R1,R4	
23.	Function Generators, Arbitrary Waveform Generator, Video Signal Generators	Applications, Specifications.	L25	T2,R1,R4	

### UNIT-III

24.	Oscilloscopes: Cathode ray tube, Block Schematic Of CRO	-	L26	T2,R1,R4	
25.	Time Base Circuits,	neon time base circuit	L27 L28	T1,T2,R2, R4	
26.	Lissajous Figures	-	L29		
27.	CRO Probes	Types of CRO Probes	L30	T2,R1,R4	
28.	High Frequency CRO Considerations	Limitations	L31	T2,R1,R4	
29.	Delay lines, Applications, Specifications.	Types	L32	T2,R1,R4	
30.	Special purpose oscilloscopes: Dual Trace CROs	Types of phosphors used for CRO screens	L33	T2,R1,R4	
31.	Dual Beam CROs	-	L34		
32.	Sampling oscilloscopes,	Vertical and Time Base	L35	T2,R2,R4	
33.	Storage oscilloscopes	Types	L36	T2,R1,R4	
34.	Digital Storage CROs	CRO Probes	L37	T2,R1,R4	

### UNIT-IV

35.	Transducers: Classification, Strain gauges, , unbounded;	Factors That Affect the	L38	T2,R1,R4	
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		Performance of a Transducer, Applications			
36.	Bonded-Type Strain Gauges	Filament Construction, Temperature Effect	L39	T2,R1,R4	
37.	Special Resistance-Thermometers	-	L40	T1,T2,R1, R4	
38.	Digital Temperature sensing systems	-	L41	T1,T2,R1, R4	
39.	Piezoelectric Transducers, Variable Capacitance-Transducers	Advantages	L42	T2,R1,R4	
40.	Magnetostrictive Transducers	Types	L43		
41.	Force and Displacement Transducer,-	Potentiometer, Potentiometric Transducer, Loading Effect on a Potentiometer	L44	T2,R1,R4	
42.	Resistance Thermometers	Self-Heating, Advantages	L45	T2,R1,R4	
43.	Hotwire Anemometer	Types	L46	T2,R1,R4	
44.	LVDT	Applications, Load Cells	L47	T2,R1,R4	
45.	Thermocouple	Junction, Installation	L48	T2,R1,R4	
46.	Synchros	Microsyn	L49	T2,R1,R4	
<b>UNIT-V</b>					
47.	Measurement of Physical parameters: Flow Measurement, ,	-	L50	T1,T2,R1, R4	
48.	Displacement Meters		L51	T2,R3,R4	
49.	Wheat Stone Bridge,	Operation, Measurement Errors, Thevenin's Equivalent Circuit	L52	T2,R1,R4	
50.	Kelvin Bridge	Kelvin Double Bridge, Applications	L53	T2,R3,R4	
51.	AC Bridges	General Form of Bridge Circuit	L54	T2,R1,R4	
52.	Maxwell, Hay	Phasor Diagram	L55	T2,R1,R4	

53.	Liquid level –Measurement	Direct and Indirect Methods	L56	T2,R3,R4	
54.	Measurement of Humidity and Moisture	-	L57	T2,R1,R4	
55.	Velocity, Force, Temperature Measurements	Types	L58	T2,R1,R4	
56.	Pressure-High Pressure,-Vacuum level,	Manometers	L59	T2,R1,R4	
57.	Data Acquisition Systems.	-	L60	T2,R3,R4	

#### **(8) - Suggested Books (prescribed and References)**

##### **TEXT BOOKS:**

1. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbins, W. D. Cooper: PHI 5<sup>th</sup> Edition 2003.
2. Electronic Instrumentation: H. S. Kalsi – TMH, 2nd Edition 2004.

##### **REFERENCE BOOKS:**

1. Electrical and Electronic Measurement and Measuring Instruments – A K Sawhney, Dhanpat Rai & Sons, 2013.
2. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
3. Industrial Instrumentation: T.R. Padmanabham Springer 2009.
4. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.

#### **(9) – Websites for self learning Resources like**

[www.geeksforgeeks.org](http://www.geeksforgeeks.org), [www.schools.com](http://www.schools.com), Coursera,edx,Udemy, Khan Academy, NPTEL etc along Registration Procedures

1. <https://www.electricalvolt.com/2023/01/definition-of-accuracy-precision-resolution-range/>
2. <https://instrumentationtools.com/darsonval-movement/#>
3. <https://www.quora.com/p/4645/explain-heterodyne-type-wave-analyzer-and-its-appl/>
4. [https://onlinecourses.nptel.ac.in/noc23\\_ee105/preview](https://onlinecourses.nptel.ac.in/noc23_ee105/preview)
5. <https://www.coursera.org/learn/sensors-circuit-interface>
6. <https://www.elprocus.com/cro-cathode-ray-oscilloscope-working-and-application/>
7. <https://www.youtube.com/watch?v=r7XMje25BFM&list=PLwAOmydmnlw2xKoemZSGsupZFXAvtM0Iw>
8. <https://www.youtube.com/watch?v=8Zhufd64rGg>

**(10) – Question Bank**

**1. JNTUH/Model papers**

**R09**

Code No: 55023

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2018

ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

(Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 75

Answer any five questions  
All questions carry equal marks  
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- 1.a) Explain in detail the various static performance characteristics
- b) Explain the working of D'Arsonval movementmeter with circuit diagram. [8+7]
- 2.a) With an example explain the working of successive approximation DVM.
- b) Write explanatory notes on square wave generators. [8+7]
3. Explain with a neat diagram the construction and working of HF wave analyser. [15]
- 4.a) Explain the construction of an AC bridge and derive the expression for unknown capacitance.
- b) Write short notes on bridged T networks. [8+7]
- 5.a) Draw the block diagram of CRO and explain each block of CRO.
- b) How much voltage is required across two deflection plates separated by 1 cm to deflect an electron beam by one degree, if the effective length of the deflecting plates is 2 cms and the accelerating potential is 1000 V. [9+6]
- 6.a) What do you mean by multi-trace with respect to oscilloscopes.
- b) With a neat block diagram explain each block of a dual trace oscilloscope. [5+10]
- 7.a) What is transducer? Classify all the transducers in detail.
- b) Explain the working of Piezo electric transducers with a neat sketch. [7+8]
- 8.a) Explain any one method of measuring moisture.
- b) Explain the working of a typical transducers to measure flow of a liquid. [7+8]

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**R16/R15/R13**

Code No: 135CD/125AM/115AM

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, March - 2021**

**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**

(R16-Common to ECE, CSE; R15-Electronics and Communication Engineering;

R13-Electronics and Communication Engineering)

**Time: 3 hours**

**Max. Marks: 75**

**Answer any five questions  
All questions carry equal marks**

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- 1.a) What are the Dynamic characteristics of measuring systems? Define them.  
b) Explain the working of Average responding Voltmeters. [9+6]
- 2.a) Describe the different types of errors.  
b) How could you extend the range of Voltmeter? Explain with an example. [7+8]
- 3.a) What is the need of spectrum analyzers?  
b) Discuss about pulse and square wave generator. [6+9]
- 4.a) Describe the working of AF Signal generator.  
b) Draw the block diagram Heterodyne wave analyzer and explain its working. [6+9]
- 5.a) How do you measure Period and Frequency using CRO? Explain.  
b) Compare Dual Beam and Dual trace CROs. [6+9]
- 6.a) What are the elements CRT and describe the function of each element of it.  
b) Draw the Block diagram of Digital storage CRO and explain function of each block. [7+8]
- 7.a) Explain the working principle of Synchros and mention its applications.  
b) Describe the principles of operation of capacitive transducers and mention their applications. [7+8]
- 8.a) How do you measure humidity? Explain.  
b) Draw the block diagram of Data Acquisition System and explain the function of each block. [7+8]

Code No: 135CD

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD****B. Tech III Year I Semester Examinations, September - 2021****ELECTRONIC MEASUREMENTS AND INSTRUMENTATION****(Electronics and Communication Engineering)****Time: 3 hours****Max. Marks: 75****Answer any five questions  
All questions carry equal marks**

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- 1.a) List out the different DC Current Meters used in measuring instruments and explain any one in detail.  
b) Explain the following terms in detail: [6+9]  
(i) Repeatability (ii) Reproducibility
- 2.a) List out the different DC Voltmeters used in measuring instruments and explain any one in detail.  
b) Two ammeters are joined in series in a circuit carrying 100 A. one ammeter has a resistance of 10000 ohm shunted by 0.10 ohm while the other ammeter has a resistance of 150 ohm shunted by 0.02ohm. If the shunts are interchanged what would be the readings of the instruments. [7+8]
- 3.a) What is AF oscillators and explain its operation along with circuit diagram.  
b) Draw the circuit diagram of Digital Fourier Analyzers and explain its operation. [7+8]
- 4.a) Draw the circuit diagram of Sweep generator and explain its operation in detail.  
b) Draw the circuit diagram of Frequency selective wave analyzer and explain its operation. [7+8]
- 5.a) Draw the circuit diagram of Sampling oscilloscope and explain its operation in detail.  
b) Explain the concept of Storage oscilloscope along with circuit diagram. [7+8]
- 6.a) Draw the cross section view of CRT and explain the operation of CRT in detail.  
b) Draw and explain the measurement procedure of Lissajous patterns with one example. [7+8]
- 7.a) List out different types of Strain Gauges used transducer and explain any one in detail.  
b) Explain the Resistive position Transducer along with circuit diagram. [8+7]
- 8.a) Explain the principle and working of Ultrasonic Flow meters. Compare this with other types of flow measurements.  
b) Describe briefly data acquisition system. [7+8]

---ooOoo---

Code No: 135CD

**R16**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, October - 2020**

**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**

**(Common to EEE, ECE, CSE)**

**Time: 2 hours**

**Max. Marks: 75**

**Answer any five questions  
All questions carry equal marks**

- 1.a) Draw the circuit for D.C current meter and explain its working.  
b) What are the different types of errors found in a measurement? Explain all. [7+8]
2. Draw the circuit of an electronic multimeter and explain how DC and AC currents, Voltages and resistance are measured. [15]
3. Draw the block diagram of an RF spectrum analyzer and explain its working and also write its applications. [15]
- 4.a) Determine the dynamic range of a spectrum analyzer with a third-order intercept point of +40 dBm and noise level of -100 dBm.  
b) How is broad band sweep frequencies generated using a sweep generator. [8+7]
- 5.a) Compare and contrast between analog and digital storage CROs.  
b) Discuss the screen of a CRT and factors affecting the brightness of the display. [7+8]
- 6.a) Briefly discuss the procedure for making amplitude and time measurements on an oscilloscope.  
b) Explain with neat sketches the time base generator in the CRO. [8+7]
- 7.a) How are passive transducers classified? Explain the principle of those transducers briefly.  
b) With the help of a neat sketch explain working principle and applications of LVDTs. [8+7]
- 8.a) What are the significance of bridge circuit measurements over direct meter measurements?  
b) Write a short note on the principle of Wheat stone Bridge. Give its limitations. [8+7]

—ooOoo—

**R16**

Code No: 135CD

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2018

ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

(Common to EEE, ECE)

Time: 3 hours

Max. Marks: 75

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A**

(25 Marks)

- 1.a) Explain the concept of Gaussian Error in detail. [2]
- b) List out the different types of Errors presented in measuring instruments. [3]
- c) What is Signal Generator? [2]
- d) List out the few applications of AF oscillator. [3]
- e) List out the different applications of CRO. [2]
- f) Explain the procedure how to Measurement of Time period of any wave in CRO. [3]
- g) What is Piezo electric effect? [2]
- h) Explain the importance of Thermocouples with one example. [3]
- i) List out the different Limitations of Wheatstone's Bridge in detail. [2]
- j) List out different flow measurement method. [3]

**PART - B**

(50 Marks)

- 2.a) Draw the Ramp type Digital voltmeter and explain its operation in detail.
- b) A Voltmeter having a sensitivity of  $60k/V$  reads  $40V$  on a  $100V$  scale when connected across an unknown resistor. The current through the resistor is  $4mA$ . Calculate the % of error due to loading effect. [5+5]

**OR**

- 3.a) Draw the Sketch and explain the principle and operation of True RMS measuring Thermocouple type Voltmeter.
- b) Define Fidelity? Explain the importance of Fidelity in measuring instruments in detail. [5+5]

- 4.a) Draw the circuit diagram of Spectrum Analyzers and explain its operation in detail.
- b) Draw the circuit diagram of Function Generator and explain its operation. [5+5]

**OR**

- 5.a) List out the different modes of operation of Harmonic Distortion Analyzers and explain any one mode in detail.
- b) What is Heterodyne and explain the operation of Heterodyne wave analyzer along with its circuit diagram. [5+5]

## **UNIT-I**

1. What are the basic performance characteristics of a system?
2. What are the different types of static errors in a system?
3. What is the method used to calculate the errors in an instrument?
4. Describe the function of the DC-Voltmeter and multi range voltmeter and explain their operation?
5. Explain the working of solid state voltmeter?
6. Draw the block diagram of the measuring system and explain the function of each stage of this system?
7. Explain the types of test signals used in determining dynamic characteristics of measurements applied to a system.
8. What is ayrton shunt? Describe it with a neat sketch .specify its application?
9. Explain with a neat block diagram of a dual slope digital voltmeter?
10. Explain the constructional details and differentiate between Ohmmeter series type and shunt type. ?

## **UNIT-II**

1. Describe the functioning of standard signal generator?
2. How can a sine and square wave be generated using signal generator?
3. Explain how a Function Generator works?
4. Explain the functioning of Random Noise Generator and explain the parameters of noise?
5. Explain Square and Pulse Generator?
6. What is the basic difference between a signal generator and an oscillator?
7. Discuss fixed and variable AF oscillator?
8. What are the precautionary measures to be taken in a signal generator application?
9. Draw the Block Schematic of AF Wave analyzer and explain its principle and Working?
10. What are the applications of wave Analyzer?
11. Explain the working of the harmonic distortion analyzer?
12. Draw the block Schematic of a Basic Spectrum Analyzer and explain its working?
13. With a neat sketch explain the working of a digital Fourier analyzer?
14. Differentiate between wave analyzer and harmonic distortion analyzer?
15. Explain the two types of spectrum analyzers?
16. Explain the terms
  - a. Distortion in a waveform
  - b. Distortion in a communication sign
17. Explain how distortion occurs during transmission of a waveform

## **UNIT-III**

1. Explain about storage oscilloscope with block diagram?
2. Draw the block Diagram of a Dual Trace CRO and explain it?
3. Explain with Neat Block Diagram of Digital Storage oscilloscope?
4. Draw the simplified block diagram of the oscilloscope and explain in detail?
5. What are the difference between digital storage oscilloscope and conventional storage oscilloscope?
6. Explain the method of finding phase, frequency relation ship of two waveforms using Lissajous figures?
7. Explain the logic of a time base of a frequency counter?
8. Explain in detail about various types of attenuators?

9. Explain briefly the Basic Features of a CRT?
10. Explain about Triggered Sweep CRO?
11. Explain briefly about delay line in triggered sweep circuit?
12. Explain briefly about the Vertical amplifier and Horizontal deflecting system?
13. Explain the measurement of frequency using CRO?

#### **UNIT-IV**

1. What is transducer? Write the classifications of transducers?
2. What parameters should be considered in selecting a transducer?
3. What is the difference between photo emissive, photoconductive and photovoltaic transducers?
4. Explain working of semiconductor strain gauge and what are its specific advantages?
5. What is temperature coefficient of resistor? Explain in detail?
6. Explain Piezo-electric effect?
7. Compare RTD with thermister.
8. Explain briefly about poisons ratio?
9. Write short notes on resistive transducer?
10. Draw the different forms of metal foil strain gauges and explain their principles of operation?

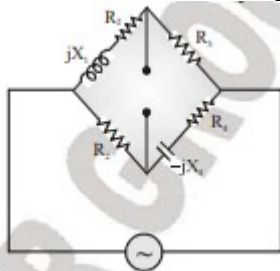
#### **UNIT-V**

1. Illustrate the principle of force summing devices using suitable examples and sketches?
2. Explain general Data Acquisition System (DAS) with a neat block diagram?
3. Show and explain the capacitive transducer arrangement to measure angular velocity and what are its limitations?
4. What are the main elements of velocity transducer?
5. Explain about Linear Variable Differential Transformer.
6. Explain spiral type bourdon tube?
7. Explain how pressure is measured using Piezoelectric transducer?
8. Briefly explain the working principles and measurement of force by any two nonelectric techniques?
9. Explain the working principle of potentiometric type accelerometer?
10. Explain the stroboscopic method of measuring the angular speed?
11. Draw the Maxwell's Bridge Circuit and derives the expression for the unknown element at balance?
12. Draw the Wien's Bridge Circuit and derives the expression for the unknown element at Balance?
13. Draw the Hay's Bridge Circuit and derives the expression for the unknown element at balance?
14. Draw the Wheat stone's Bridge Circuit and derives the expression for the unknown element at balance?
- 15.

#### **(10.2) QUESTION BANK – GATE**

1. A variable  $w$  is related to three other variables  $x, y, z$  as  $w = xy/z$ , The variables are measured with meters of accuracy  $\pm 0.5\%$  reading,  $\pm 1\%$  of full scale value and  $\pm 1.5\%$  reading. The actual readings of the three meters are 80, 20 and 50 with 100 being the full scale value for all three. The maximum uncertainty in the measurement of  $w$  will be  
(a)  $\pm 0.5\%$  rdg (b)  $\pm 5.5\%$  rdg (c)  $\pm 6.7\%$  rdg (d)  $\pm 7.0\%$  rdg
2. A moving coil of a meter has 100 turns, and a length and depth of 10 mm and 20 mm respectively. It is positioned in a uniform radial flux density of 200 mT. The coil carries a current of 50 mA, The torque on the coil is  
a) 200 Nm (b) 100 Nm (c) 2 Nm (d) 1 Nm

3. A dc Ammeter is rated for 15 A, 250 V. The meter constant is 1.4,4 A-sec/rev, The meter constant at rated voltage may be expressed as  
(a) 3750 rev/kWh (b) 3600 rev/kWh (c) 1000 rev/kWh (d) 960 rev/kWh
4. A moving iron ammeter produces a full scale torque of 240 Nm with a deflection of  $120^\circ$  at a current of 10 A. The rate of change of self induction ( H/radian) of the instrument at full scale is  
(a) 2.0 H/radian (b) 4,8 H/radian (c) 12.0 H/radian (d) 114.6 H/radian
5. An analog voltmeter uses external multiplier settings. With a multiplier setting of 20 k, it reads 440V and with a multiplier setting of 80 k , it reads 352V, For a multiplier setting of 40 k , the voltmeter reads  
(a) 371V (b) 383V (c) 394 V (d) 406V
6. An ammeter has a current range of 0.5 A, and its internal resistance is 0.2 . In order to change the range to 0-25 A, we need to add a resistance of  
(a) 0.8 in series with the meter (b) 1.0 in series with the meter  
(c) 0.04 in parallel with the meter (d) 0.05 in parallel with the meter
7. The bridge method commonly used for finding mutual inductance is  
(a) Heaviside Campbell bridge (b) Schering bridge (c) De Sauty bridge (d) Wien bridge
8. A bridge circuit is shown in the figure below. Which one of the sequence given below is most suitable for balancing the bridge ?



- (a) First adjust (b) First adjust (c) First adjust (d) First adjust

## (11) - Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications:

### 1. Performance Monitoring of Bridges through Instrumentation

Bridge engineers did not pay adequate attention to certain very vital aspects adversely affecting the serviceability condition and sometimes even jeopardize the safety of bridges. Some examples of these aspects which might be appropriately termed “Performance factors” are: the true stress conditions in the bridge components, serviceability factors such as deflection and cracking, actual stress and deformation conditions in the foundations, corrosion of reinforcing and pre-stressing steel, etc.

In recent years, the steadily increasing number of bridges, severely distressed owing to one or more of these factors acting over a period of time, has sharply brought home to engineers throughout the world to consider these factors in the design and construction of all major bridges. In India too, afflictions caused by some of these „performance factors“ have severely affected the health of several major bridges on our national and state highways.

### 2. A method to improve cathode ray oscilloscope accuracy

Distortion in cathode ray oscilloscopes limits the achieved accuracy in spite of piecewise linear correction. Polynomial functions for static and timebase nonlinearity corrections can achieve 4 to 5

times improvement inaccuracy compared to only about 2 times improvement for linear correction. For fast transient waveform recording this improvement is important in increasing dynamic range and decreasing waveform noise

## (12) - Assignment Question sets:

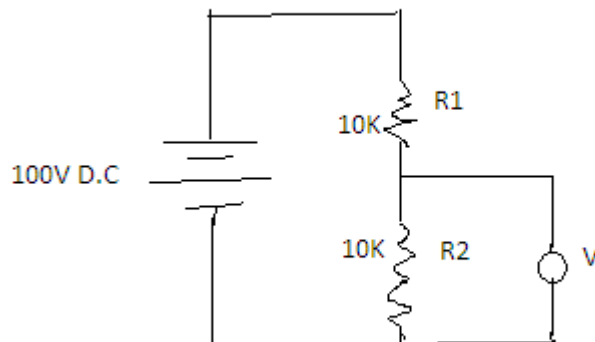
### MID I

#### SET-1

1. A voltmeter having sensitivity of  $15\text{K}\Omega/\text{V}$  reads  $80\text{V}$  in its  $100\text{V}$  scale when connected across an unknown resistance  $R_x$ . The current through the resistor is  $1.8\text{mA}$ . Determine the % error due to loading effect. (CO1)
2. Design a basic DC-Voltmeter and multi range voltmeter and explain their operation? (CO2)
3. Draw the block Schematic of a Basic Spectrum Analyzer and explain its working? (CO3)
4. Design a sine and square wave generator. (CO3)
5. Design a triangular wave generator. (CO3)

#### SET-II

1. In the circuit shown in the figure two resistors  $R_1$  and  $R_2$  are connected to a  $100\text{V D.C}$  source. If the voltage across  $R_2$  is to be measured by voltmeter having. (CO1)



- (i) A sensitivity of  $1000\Omega/\text{V}$  and
  - (ii) A sensitivity of  $20,000\Omega/\text{V}$ , then find which voltmeter will read the accurate value of voltage across  $R_2$ . Both the meters are used on the  $50\text{V}$  range
2. Design a universal ayrton shunt to provide an ammeter with a current range of  $2\text{A}, 5\text{A}, 10\text{A}$ . Using a D'Arsonval movement with an internal resistance  $R_m = 50\text{ ohm}$  and full scale deflection current of  $50\text{ mA}$ . (CO1)
  3. Draw the Block Schematic of AF Wave analyzer and explain its principle and Working? What are the applications of wave Analyzer? (CO3)
  4. Explain the method of finding phase, frequency relationship of two waveforms using Lissajous figures. (CO3)



5. Design a Wein bridge oscillator. (CO3)

## **MID II**

### **SET-I**

1. Explain about LVDT.(CO4)
2. Differentiate the digital storage oscilloscope and conventional oscilloscope. (CO3)
3. What is the principle of ultrasonic flow meters? Explain the operation of ultrasonic flow meter with neat Sketch (CO6)
4. A Maxwell bridge is used to measure an inductive impedance at a frequency of 3 KHZ .The Bridge constants at balance are 1:a capacitor of value  $0.02\mu\text{F}$  in shunt with  $390\text{ K}\Omega$  ;arm 3 opposite to the arm 1 is having the unknown component; the other arms have each  $18\text{ K}\Omega$  resistor .Find the equivalent series circuit of the unknown impedance., What is the value of the quality factor ?(CO5)
5. Draw the block diagram of dual trace oscilloscope and explain the function of each block? (CO3)

### **SET-II**

1. Write about the storage oscilloscope in detail.(CO3)
2. Write a small note on following one by drawing block diagrams a) Dual trace CRO b) Dual beam CRO  
c) Sampling CRO d) Digital storage CRO.(CO3)
3. write a small note on 1) Magneto strictive transducer 2) Piezo electric effect 3) Thermometers. (CO4)
4. Write about variable capacitive transducer in detail.(CO4)
5. Explain about double Kelvin's bridge method in detail.(CO5)

### **SET-III**

1. (a) Explain LVDT. (CO4)  
(b) Explain the classification of transducers with the help of examples. (CO4)
2. What are the applications of a piezo electric transducers, and Hot wire ammeter in Engineering measurements. (CO4)
3. Draw the neat sketch of the CRT and explain the main components of it. (CO3)
4. Explain with Neat Block Diagram of Digital Storage oscilloscope? (CO3)
5. Draw the block Diagram of a Dual Trace CRO and explain it? (CO3)

## **(13) - List of topics for students Seminars**

1. Challenges in multiphase flow measurement.
2. Custody Transfer Metering.
3. Wireless Instruments - Challenges.
4. Vibration Measurement And Monitoring System
5. Application of instrument in navigations
6. Virtual Instrumentation
7. Mass flow Measurement

8. Infrared Temperature Measurement
9. Smart instruments

**(14) - STEP/Course material in softcopy**



1. Name the types of instruments used for making voltmeter and ammeter.

The types of instruments used for making voltmeter and ammeter are

- i. PMMC type
- ii. Moving iron type
- iii. Dynamometer type
- iv. Hot wire type
- v. Electrostatic type
- vi. Induction type.

2. State the advantages of moving iron type instruments.

The advantages of moving iron type instruments are:

- i. Less expensive
- ii. Can be used for both DC and AC
- iii. Reasonably accurate.

3. What are the basic performance characteristics of a system?

Ans:

**STATIC CHARACTERISTICS**

The static characteristics of an instrument are, in general, considered for instruments which are used to measure an unvarying process condition. All the static performance characteristics are obtained by one form or another of a process called calibration. There are a number of related definitions (or characteristics), which are described below, such as accuracy, precision, repeatability, resolution, errors, sensitivity, etc.

1. Instrument: A device or mechanism used to determine the present value of the quantity under measurement.
2. Measurement: The process of determining the amount, degree, or capacity by comparison (direct or indirect) with the accepted standards of the system units being used.

3. Accuracy: The degree of exactness (closeness) of a measurement compared to the expected (desired) value.
4. Resolution: The smallest change in a measured variable to which an instrument will respond.
5. Precision: A measure of the consistency or repeatability of measurements, i.e. successive readings does not differ. (Precision is the consistency of the instrument output for a given value of input).
6. Expected value: The design value, i.e. the most probable value that calculations indicate one should expect to measure.
- 7 Error: The deviation of the true value from the desired value.
8. Sensitivity: The ratio of the change in output (response) of the instrument to a change of input or measured variable.

**(15) - Expert Lectures with topics & Schedules (if any)**

S.NO	SUBJECT	TOPIC	YEAR	RESOURCE PERSON	DATE
1	EMI – EL01	Bridges - Wheat stone, Kelvin & Maxwell	IV-I	Others	July,2023
2	EMI - EL02	Development of Cathode Ray Oscilloscope Tubes	IV-I	Others	Sep.,2023



## **Microwave Engineering**

Subject Code: EC702PC

Class: IV Year B.Tech ECE I Semester

BY

POONGODI S  
Professor

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**CMR ENGINEERING COLLEGE**

**SUBJECT: Microwave Engineering****S.NO****CONTENT**

- |        |   |                       |
|--------|---|-----------------------|
| (1) -  | <b>Preamble/Introduction</b>                                  |                       |
| (2) -  | <b>Prerequisites</b>  |                       |
| (3) -  | <b>Objectives and Outcomes</b>                                |                       |
| (4) -  | <b>Syllabus</b>   |                       |
|        | <b>1.JNTUH</b>  |                       |
|        | <b>2.GATE</b>   |                       |
|        | <b>3.IES</b>  |                       |
| (5) -  | <b>List of Expert Details (Local/National/International</b>   |                       |
|        | <b>with Contact details/Profile link/Blogs/their research</b> |                       |
|        | <b>Contribution towards the subject)</b>                      |                       |
| (6) -  | <b>Journals with min 5 ref paper for literature study</b>     |                       |
| (7) -  | <b>Subject -Lesson plan</b>                                   |                       |
| (8) -  | <b>Suggested Books (prescribed and References)</b>            |                       |
| (9) -  | <b>Websites for self learning</b>                             | <b>Resources like</b> |
| (10) - | <b>Question Banks</b>   |                       |
|        | <b>1.JNTUH/Model papers</b>                                   |                       |
|        | <b>2.GATE</b>   |                       |
| (11) - | <b>Two case study presentations with Project /</b>            |                       |
|        | <b>Product/ Model /prototypes/ Industrial applications.</b>   | <b>(12) -</b>         |
|        | <b>Assignment Question/Innovative Assignments sets.</b>       |                       |
| (13) - | <b>List of topics for students Seminars with Guidelines</b>   |                       |
| (14) - | <b>STEP/Course material in softcopy</b>                       |                       |
| (15) - | <b>Expert Lectures with topics &amp;Schedules(if any)</b>     |                       |

Problems.

Ferrites— Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator, Circulator.

### UNIT - III

**Microwave Tubes:** Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M Type Classifications, O-type Tubes : 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics, Illustrative Problems.

**Helix TWTs:** Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

### UNIT - IV

#### M-Type Tubes:

Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics, Illustrative Problems

**Microwave Solid State Devices:** Introduction, Classification, Applications. TEDs – Introduction, Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Introduction to Avalanche Transit Time Devices.

### UNIT - V

Scattering Matrix– Significance, Formulation and Properties, S Matrix Calculations for – 2 port Junctions, E plane and H plane Tees, Magic Tee, Circulator and Isolator, Illustrative Problems.

**Microwave Measurements:** Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Microwave Power Measurement, Bolometers. Measurement of Attenuation, Frequency. Standing Wave Measurements – Measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

#### TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Microwave Principles – Herbert J. Reich, J.G. Skolnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.

#### REFERENCES:

1. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
2. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
3. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI, 1999.
4. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3rd ed., 2011 Reprint.

Head  
Electronics and Communication Engineering  
Jyoti College of Engineering (Autonomous)  
Osmania University  
Hyderabad-500 007.

Approved



Subject: **Microwave Engineering**

Year: **IV– B.Tech, I SEM**

Branch: **ECE**

### **1. PREAMBLE/INTRODUCTION**

Microwaves are a form of electromagnetic radiation with wavelengths ranging from about one meter to one millimeter, with frequencies between 300 MHz (1 m) and 300 GHz (1 mm). A more common definition in radio engineering is the range between 1 and 100 GHz (wavelengths between 0.3 m and 3 mm), frequencies in the microwave range are often referred to by their IEEE radar band designations: S, C, X, K<sub>u</sub>, K, or K<sub>a</sub> band. Different types of microwave tubes, their structures and principles of microwave power generation and microwave measurements

### **2. PRE REQUISITES**

- ✓ Knowledge of basics of electromagnetic wave theory
- ✓ Antennas and Propagation
- ✓ Prior knowledge of basic concepts of communication and also distortion and losses in communication  
and transmission media

### **3. OBJECTIVES AND RELEVANCE:**

- ❖ To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
- ❖ To develop the theory related to microwave transmission lines, and to determine the characteristics of rectangular waveguide, micro strip lines, and different types of waveguide and ferrite devices
- ❖ To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
- ❖ To know the functions and working principles of microwave M type tubes, and to characterize their performance features and applications with solid state devices.
- ❖ To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S Matrix for various types of microwave junctions and to understand the concept of microwave measurement

#### **✓ COURSE OUTCOMES:**

<b>CO 1</b>	To analyze completely the rectangular waveguides, their mode characteristics, and design waveguides for solving practical microwave
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	transmission line problems.
<b>CO 2</b>	To distinguish between the different types of waveguide and ferrite components, explain their functioning and select proper components of engineering problems
<b>CO 3</b>	To distinguish between the methods of power generation at microwave frequencies, derive the performance characteristics of 2 cavity and reflex klystron, Magnetron, TWTs and estimate their efficiency levels, and solve related numerical problems
<b>CO 4</b>	To realize the need of solid state microwave sources, Understand the concepts of TEDs, RWH theory and explain salient features of Gunn diodes and ATT devices.
<b>CO 5</b>	To establish the properties of scattering matrix, formulate the S matrix for various microwave junctions and understand the measurement of S parameters using microwave components.

## SYLLABUS

### UNIT - I

**Microwave Transmission Lines - I:** Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides – Solution of Wave Equations in Rectangular Coordinates, TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Filter Characteristics, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations, Power Transmission, Impossibility of TEM Mode. Illustrative Problems, Micro strip Lines– Introduction,  $Z_0$  Relations, Effective Dielectric Constant.

### UNIT - II

**Cavity Resonators**– Introduction, Rectangular Cavities, Dominant Modes and Resonant Frequencies, Q Factor and Coupling Coefficients, Illustrative Problems

**Waveguide Components and Applications:** Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions – E plane and H plane Tees, Magic Tee. Directional Couplers – 2 Hole, Bethe Hole types, Illustrative

Head of Electronics and Communication Engineering (Autonomous)  
College of Engineering (Autonomous)

S. Potthalaiah

Approved



#### 4. GATE & IES

##### SYLLABUS – GATE&IES

###### UNIT I

Gate: Waveguides: modes in rectangular waveguides and circular waveguides boundary conditions, Cut off frequencies, description relations. Basic propagation in dielectric waveguide.

IES: Waveguides-basics, rectangular types, modes, cut-off frequency, dispersion, dielectric types

###### UNIT II

Not applicable

###### UNIT III

Not applicable

###### UNIT IV

Not applicable

###### UNIT V

S-parameters

#### 5. Expert Details

##### INTERNATIONAL

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##### NATIONAL

3. K.J. Vinoy, Professor & Chair, Electrical Communication Engineering, Indian Institute of Science Bangalore 560 012 India. Phone: (+91) 80-2293 2853. E-mail: [kjvinoy@iisc.ac.in](mailto:kjvinoy@iisc.ac.in); [kjvinoy@ieee.org](mailto:kjvinoy@ieee.org).
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##### REGIONAL

1. Dr. MalajiSushama, B.Tech, M.Tech(EPS), Ph.D,Professor,ISTE, SSI, IETE,Electrical& Electronics Engineering, JNTUH College of Engineering Hyderabad, Official Email: m73sushama@jntuh.ac.in  
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2. Dr. Arun Kumar Gande, Assistant Professor, Department of Electronics & communication Engineering, National Institute of Technology, Warangal - 506004, Telangana, INDIA. Email: g.arun@nitw.ac.in, Mob:08702462429

## 6. JOURNALS.

1. <https://ieeexplore.ieee.org/document/8963087>

**Title :** A Leaky Waveguide with High Radiation Efficiency for Millimeter-Wave Compact-Range Communications. (2019)

2 <https://ieeexplore.ieee.org/document/9783606>

QAM-4 Dielectric Waveguide Communication Link for mid-range Distances at W-Band Frequencies. (2022)

3 <https://ieeexplore.ieee.org/document/8988584>.

**Title :** Coplanar Waveguide Antenna with Defected Ground Structure for 5G Millimeter Wave Communications. (2020)

4. <https://www.sciencedirect.com/science/article/abs/pii/S2213343722015974>

Title : Microwave-induced fabrication of fiber-reinforced adsorbent from waste cardboard and chitosan for effective dye removal (2022)

5. [https://tentzeris.ece.gatech.edu/ieeejm22\\_wagih.pdf](https://tentzeris.ece.gatech.edu/ieeejm22_wagih.pdf)

**Title :** Microwave-Enabled Wearables: Underpinning Technologies, Integration Platforms, and Next-Generation Roadmap (2022)

6. [https://www.researchgate.net/publication/366238788\\_Microwave-Enabled\\_Wearables\\_Underpinning\\_Technologies\\_Integration\\_Platforms\\_and\\_Next-Generation\\_Roadmap](https://www.researchgate.net/publication/366238788_Microwave-Enabled_Wearables_Underpinning_Technologies_Integration_Platforms_and_Next-Generation_Roadmap)

**Title :** Microwave-Enabled Wearables: Underpinning Technologies, Integration Platforms, and Next-Generation Roadmap (2022)

## 7. Teaching Schedule/Lesson plan

S.N O	TOPIC TO BE COVERED	Suggested Books (Eg. T1, T2,R5)	NO. OF LECTURES REQUIRED	Remarks
UNIT-I				

1	Introduction, Microwave Spectrum and Bands	T1,T2,R1	2	
2	Applications of Microwaves	T1,T2,R1	2	
3	Rectangular Waveguides – TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies.  Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities,	T1,T2,R1	3	
4	Wavelengths and Impedance Relations; Power Transmission and Power Losses in Rectangular Guide. Related Problem	T1,T2,R1	2	
5	Nature of Fields, Characteristic Equation, Dominant and Degenerate Modes.	T2,R3,R4	2	14
6	Impossibility of TEM mode. Microstrip Lines– Introduction, Zo Relations, Effective Dielectric Constant, Losses, Q factor.	T2,R4	3	
UNIT-II				
7	Resonators Rectangular Cavities	T1,T2,R3	2	19
8	Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients. Related Problems.	T1,T2,R2	2	
9	Coupling Mechanisms – Probe, Loop, Aperture types.	T1,T2,R3,R4	2	
10	Waveguide Discontinuities – Waveguide irises, 2 Tuning Screws and Posts, Matched Loads.	T1,T2,R3,R4	2	
13	Waveguide Attenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types.	T1,T2,R3,R4	2	
11	Waveguide Multiport Junctions – E plane and H plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2 Hole, Bethe Hole types.	T1,T2,R2,R3	3	
12	Ferrites– Composition and Characteristics,	T1,T2,R2,R3,R4	2	

	Faraday Rotation; Ferrite Components – Gyrator, Isolator, Circulator.			
13	Scattering Matrix– Significance, Formulation and Properties.	T1,T2,R2,R3,R4	1	
14	Matrix Calculations for – 2 port Junction, E plane and H plane Tees, Magic Tee	T1,T2,R1,R2,R3	2	
15	Directional Coupler, Circulator and Isolator. Related Problems.	T1,T2,R1,R2,R3	1	
	<b>UNIT-III</b>			
16	Limitations and Losses of conventional tubes at microwave frequencies	T1, T2,R3,R4	1	12
17	Microwave tubes – O type and M type classifications. O-type 2tubes : 2 Cavity Klystrons – Structure, Reentrant Cavities	T1, T2,R3,R4	2	
18	Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for o/p Power and Efficiency.	T1, T2,R2,R3	2	
19	Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Mathematical Theory of Bunching, Power Output, Efficiency, Electronic Admittance	T1, T2,R3,R4	2	
20	Oscillating Modes and o/p Characteristics, Electronic and Mechanical Tuning. Related Problems.	T1, T2,R3,R4	2	
21	Significance, Types and Characteristics of Slow Wave Structures	T1,T2,R3,R4	1	
22	Structure of TWT and Amplification Process	T1,T2,R3,R4	2	
<b>UNIT-IV</b>				
23	Suppression of Oscillations, Nature of the four Propagation Constants, Gain Considerations.	T1,T2,R3,R4	2	
24	Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron	T1,T2,R3,R4	2	
25	Introduction Classification, Applications	T1,T2,R2,R3,R4	1	
26	TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics	T1,T2,R2,R3,R4	2	
27	Basic Modes of Operation, Oscillation Modes	T1,T2,R2,R3,R4	2	

28	Avalanche Transit Time Devices – Introduction, IMPATT and TRAPATT Diodes – Principle of Operation and Characteristics.	T1,T2,R2,R3,R4	2	11
<b>UNIT-V</b>				
29	Description of Microwave Bench	T1,T2,R1,R3,R4	1	5
30	Different Blocks and their Features, Precautions	T1,T2,R1,R2,R3	2	
31	Microwave Power Measurement – Bolometer Method	T1,T2,R1,R2,R3	1	
32	Measurement of Attenuation, Frequency, VSWR, Cavity Q. Impedance Measurements.	T1,T2,R2,R3,R4	1	
<b>Total Classes</b>				<b>61</b>

### 7.DETAILED LECTURE PLAN:

S.No	Topics to be covered	COs	Date
1.	<b>Unit I</b>	<b>CO1</b>	
	Introduction – Microwave bands and applications		
2.	Rectangular waveguide – Solution of wave equation		
3.	TE mode analysis		
4.	TM mode analysis		
5.	TM mode analysis & Characteristic equations		
6.	Cut off frequency, Filter characteristics, Dominant and Degenerate mode		
7.	Sketches of TE & Tm fields, Cross section mode characteristics and phase velocity		
8.	Group velocity & Wavelength		
9.	Impedance Relations & Power transmission		
10.	Impossibility of TEM mode		
11.	Problems		
12.	Problems & Revision		

13	Microstrip lines - Introduction & $Z_0$ relations	CO2	
14	Effective dielectric constant & Problems		
15	<b>Unit –II</b> Cavity Resonators – Rectangular cavity		
16	Dominant mode & Resonant frequencies		
17	Q factor		
18	Coupling coefficient & Problems		
19	Coupling mechanism – Probe & loop		
20	Aperture types, WG windows		
21	Tuning screws, post, matched load		
22	WG attenuator & its types		
23	E plane Tee, H plane Tee		
24	Magic Tee		
25	Directional coupler- 2 hole and Bethe hole coupler		
26	Ferrite- Composition, characteristics and Faraday rotation		
27	Gyrator & Isolator		
28	Circulator & Problems		
29	<b>Unit –III</b> Limitation, losses & O tube types	CO3	
30	M tube type, Classification 2 cavity klystron structure		
31	Re entrant cavity, velocity modulation, Applegate diagram		
32	Bunching Process, output power & Efficiency		
33	Reflex klystron - structure		
34	Velocity modulation & Applegate diagram		
35	Mathematical theory of bunching process		

36.	Output power & Efficiency		
37.	Oscillating modes, Output characteristics & Problems		
38.	Helix TWT – Significance, types & characteristics		
39.	TWT amplification Process, Suppression of oscillations, Gain considerations		
<b>40. Unit-IV</b>	Introduction, Cross field effects, Magnetron – Different types	CO4	
41.	Cylindrical TWT – Hull cut off condition		
42.	Hatree condition		
43.	Modes of resonance & PI mode operation		
44.	Separation of PI mode and output characteristics		
45.	Problems		
46.	Introduction and classifications of TED, Gun diode-Principle and RWH theory		
47.	Characteristics and mode of operation – Gunn oscillation mode		
48.	Introduction to Avalanche transit time device		
<b>49. Unit - V</b>	Scattering matrix significance	CO5	
50.	Formulation & Properties		
51.	S matrix calculation of 2 port junction – E plane Tee		
52.	H Plane Tee		
53.	Magic Tee		
54.	Circulator & Isolator		
55.	Description of microwave bench, different block and features		
56.	Errors & precautions, Microwave power measurements		
57.	Bolometer, Measurement of attenuator		

58.	Measurement of frequency, SWR – Low VSWR		
59.	High VSWR, Cavity Q		
60.	Impedance Measurement		

## 8. SUGGESTED BOOKS

### TEXT BOOKS

- T1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003
- T2. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krass, CBS Publishers and Distributors, New Delhi, 2004.

### REFERENCE BOOKS

- R1. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
- R2. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
- R3. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI, 1999.
- R4. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 Reprint.

## 9. WEBSITES

1. <https://nptel.ac.in/courses/108/103/108103141/>
2. [https://www.youtube.com/watch?v=JdXogpO\\_wgU&list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW](https://www.youtube.com/watch?v=JdXogpO_wgU&list=PLgwJf8NK-2e6A4Mtxud6xPHE1UecxWsHW)
3. <https://lecturenotes.in/subject/83/microwave-engineering-me>
4. <https://www.coursera.org/learn/microwave-antenna>
5. [https://www.tutorialspoint.com/microwave\\_engineering/index.htm](https://www.tutorialspoint.com/microwave_engineering/index.htm)
6. <https://www.udemy.com/course/rf-microwave-basics-for-engineers-and-techs/>

## 10. Question Bank:

### Unit wise IMP Questions - MWE

### UNIT - 1



1. Derive the field equations for Rectangular Waveguide in TE mode starting from Maxwell's equations.
2. Determine the equations of Fields of Rectangular waveguide in TM mode starting from Maxwell's equations.
3. Write a brief notes about the microstrip lines. Mention the expressions for characteristic impedance, Q factor and dielectric losses existing in microstrip line.
4. Why TEM wave is not possible in Rectangular waveguide?

## UNIT – 2

1. Explain coupling loops and coupling probes.
2. Why matched loads are needed in microwave circuits? Explain its working with neat diagrams.
3. What are the different types of Attenuators? Explain them with neat diagram.
4. What are the different types of Phase shifters? Explain them with neat diagrams
5. Draw the structure diagram of the following and explain its characteristics  
(i) H -plane Tee                      (ii) E -plane Tee                      (iii) Magic Tee
6. What are the characteristics of two hole direction coupler and derive the S -matrix of it
7. Explain the principle of Faraday rotation and types of different ferrite component with its function. List and explain the characteristic of Ferrites.

## UNIT – 3

1. Classify the various microwave tubes with respect to the orientation of electric and magnetic fields.
2. Explain how velocity modulation is converted into current modulation with Applegate diagram and also derive the equation for output power efficiency
3. Draw the mode curve of reflex klystron and derive the relation between mode number and repeller in reflex klystron.
4. Explain with neat sketch, the principle of operation of a TWT amplifier and write the equations for the maximum voltage gain and efficiency.
5. Explain how TWT is increased gain by increasing the bunching of electrons and derive the equation of gain.
6. Compare the performance of TWT and Klystron amplifier.

## UNIT – 4

1. Explain how 8 -cavity cylindrical Magnetron is used to produce oscillations (or) Explain the electron bunching process in Cylindrical Magnetron with neat diagrams and derive the Hartee condition.
2. What are the applications of Magnetron oscillator?
3. Derive equation for Hull cut-off voltage in a magnetron.
4. Explain how Gunn diode is used in waveguide oscillator
5. Discuss in detail the principle of operation of Gunn diode considering the two valley model theory and sketch its volt-ampere characteristics.
6. What are the different avalanche transit time devices?
7. Explain RWH theory.
- 8.

## UNIT – 5

1. Explain the S-matrix representation of a multiport microwave network and its significance.
2. Find the S matrix for
  - (i) E-plane tee
  - (ii) H-plane tee
  - (iii) Magic tee
  - (iv) Circulator
  - (v) Isolator
3. Explain how a slot line section is used to measure the frequency of a given microwave signal. (Frequency Measurement)
4. Explain the blocks of microwave bench and their features.
5. Describe in detail about the power measurement. (very low power, low power, medium power and high power)
6. Explain the procedure for measuring the attenuation with neat diagram.
7. Describe the Standing Wave ratio Measurement in detail with neat sketch. (VSWR measurement)
8. Describe methods of impedance measurement.
9. Give the measurement procedure for measuring Q factor of resonant cavity.

## 11. CASE STUDY

**(1) Title: Neural Network Enhanced Optimization of the Microwave Waveguide Amplifiers (<https://ieeexplore.ieee.org/document/9790445>)(2021)**

**Abstract :** High-Q waveguide resonators have become more commonplace since the losses of planar circuit are significant at higher frequencies. In amplifiers design, three-dimensional (3D) waveguide

cavities are often employed as the matching networks of the planar circuits including the transistor. Thus, the interconnection of the waveguide-to-microstrip transition and the feedback of the transistor itself make the calculation and optimization of the physical model more difficult. The neural network technique can be used in the electromagnetic (EM) optimization of the waveguide amplifiers, leading to improved design efficiency.

**(2). Title : Waveguide Array Applicator for Microwave Medical Imaging (<https://ieeexplore.ieee.org/document/9924394>) (2022)**

**Abstract :** In this paper, we propose a novel idea of a diagnostic applicator composed of an array of 8 waveguides filled with distilled water, which can be used for non-invasive temperature measurement based on microwave tomography during cancer treatment using microwave hyperthermia. The waveguide design procedure and simulation results from SEMCAD X are presented. To verify the impedance matching of the applicator, scattering matrix measurements were performed with a muscle tissue agar phantom. Measurements with dielectric inhomogeneity in the agar phantom region are presented to demonstrate the feasibility of using our design for further developments in this area.

**12.Question Bank: POWER POINT PRESENTATIONS (PPTS):**



MICROWAVE ENGINEERING - IV YEAR ECE - B & C SEC - PPT.rar

**ASSIGNMENT QUESTIONS :**

**Microwave Engineering  
Final year ECE – 4-1 semester  
Assignment Questions mid 1**

**SET – I**

- 1 What are the advantages of dominant of propagation in rectangular waveguide?
- 2 Discuss how the microwave spectrum is categorized into different bands.
- 3 Explain the following (i) Waveguide windows (ii) Screws.
- 4 Give the performance specification of 2 cavity klystron.
- 5 Explain the principle of Ferrite phase shifter.

**SET – II**

- 1 Explain waveguide excitation in rectangular waveguide
- 2 Derive the expressions for the field components due to TM waves in rectangular wave guide
- 3 Explain the following (a) Precision variable attenuator (b) Rotary vane attenuator
- 4 What is meant by normalized voltage and normalized current with respect to the microwave circuit concept. Draw a neat sketch of a Magic Tee and obtain its S matrix
- 5 Define and explain current modulation with neat diagrams and required expressions.

### SET - III

1. Explain the coupling mechanism of waveguide.
2. Explain following terms (a) Gyrator (b) Isolator
3. Derive the S-matrix for directional coupler
4. Derive the S-matrix for E-plane junction.
5. Describe with a neat sketch the constructional details and principle of operation of a reflex klystron tube and Write any two limitations of conventional tubes at Microwave frequencies.

### Microwave Engineering

Final year ECE – 4-1 semester

### Assignment Questions mid 2

#### SET - I

1. What are the Limitations of conventional tubes at microwave frequency?
2. Explain the operation of a two cavity klystron with Applegate diagram .
3. Discuss in detail Construction and Operation of Reflex klystron.
4. Explain in detail about Construction and Operation of TWT
5. What is magnetron? Explain principle of operation of it with a neat sketch.

#### SET - II

1. Explain Gunn effect using two valley theory and explain VI characteristics of Gunn diode
2. Explain RWH theory with relevant diagrams
3. Explain the various power measurement techniques in accordance with its range.
4. What are various impedance measurement techniques using microwave bench setup.
5. What are the various techniques for measuring low and high VSWR

#### SET - III

1. Discuss in detail about attenuation measurement techniques.
2. Explain the microwave bench setup with neat diagram.
3. Explain the S-matrix representation of a multiport microwave network and its significance.
4. Find the S matrix for  
(i) E-plane tee (ii) H-plane tee (iii) Magic tee (iv) Circulator (v) Isolator
5. Give the measurement procedure for measuring Q factor of resonant cavity.

### Microwave Engineering

Final year ECE – 4-1 semester

### Tutorial

### Questions

1. For a cavity of dimensions 3 cm x 2 cm filled with air and made of copper, find the resonant frequency.
2. If the broader dimension of a rectangular waveguide is 2.2 cms, what is the cutoff frequency and wavelength for dominant mode?

3. A rectangular wave guide with dimension of  $3 \times 2$  cm operates in the TM<sub>11</sub> mode at 10 GHz. Determine the characteristic wave impedance.
4. Calculate the group and phase velocities for an angle of incidence of  $33^\circ$ .
5. A rectangular waveguide with a width of 4 cm and a height of 2 cm is used to propagate an electromagnetic wave in the TE<sub>10</sub> mode. Determine the wave impedance, phase velocity, and group velocity of the waveguide for the wavelength of 6 cm.
6. A wave of frequency 6GHz is propagated in a parallel plane waveguide separated by 3cm. Calculate i) the cut-off wavelength for the dominant mode. ii) Wavelength in the waveguide. iii) The group and phase velocities. iv) Characteristic wave impedance.
7. A rectangular wave guide with dimension of  $3 \times 2$  cm operates in the TM<sub>11</sub> mode at 10 GHz. Determine the characteristic wave impedance.
8. A rectangular wave guide with dimension of  $8 \times 4$  cm operates in the TE<sub>11</sub> mode at 10GHz. Determine the characteristic wave impedance. Calculate the cut-off frequency of the following modes in a square waveguide  $4 \text{ cm} \times 4 \text{ cm}$  TE<sub>10</sub>, TM<sub>11</sub> and TE<sub>22</sub>.
9. Calculate resonant frequency of rectangular cavity filled with dielectric with  $\epsilon_r=4$  and having dimensions  $a=5\text{cm}$   $b=4\text{cm}$  and  $d=15\text{cm}$ .
10. A wave guide operating in TE<sub>10</sub> mode has dimensions  $a = 2.26 \text{ cm}$  and  $b = 1 \text{ cm}$ . The measured guide wave length is 4 cm. Find i. Cut off frequency of the propagating mode ii. The frequency of operation iii. Maximum frequency of propagation in this mode



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### INNOVATIVE ASSIGNMENT - I

- 1 Microwave amplifier design using high mobility electron transistor (**Paper based**)  
([https://www.researchgate.net/publication/341493717\\_Microwave\\_amplifier\\_design\\_using\\_high\\_mobility\\_electron\\_transistor](https://www.researchgate.net/publication/341493717_Microwave_amplifier_design_using_high_mobility_electron_transistor))
- 2 Microwave power amplifier analysis and design (**Project based**)  
([https://www.researchgate.net/publication/253918178\\_Microwave\\_power\\_amplifier\\_analysis\\_and\\_design](https://www.researchgate.net/publication/253918178_Microwave_power_amplifier_analysis_and_design))
- 3 Low-Cost Microwave Components' Fabrication in Hybrid Technology of Laminates and Additive Manufacturing on an Example of Miniaturized Suspended Directional Coupler (**Product based**)  
([https://www.researchgate.net/publication/342912024\\_Low-Cost\\_Microwave\\_Components'\\_Fabrication\\_in\\_Hybrid\\_Technology\\_of\\_Laminates\\_and\\_Additive\\_Manufacturing\\_on\\_an\\_Example\\_of\\_Miniaturized\\_Suspended\\_Directional\\_Coupler](https://www.researchgate.net/publication/342912024_Low-Cost_Microwave_Components'_Fabrication_in_Hybrid_Technology_of_Laminates_and_Additive_Manufacturing_on_an_Example_of_Miniaturized_Suspended_Directional_Coupler))
- 4 For a wave guide having cross section  $3\text{cm} \times 2\text{cm}$ , compute the cut-off frequency in the TE<sub>01</sub> mode. Also, calculate the phase velocity and guide wavelength at a frequency equal to 50% above the cut-off frequency. (**Problem Based**)

### INNOVATIVE ASSIGNMENT - II

- 1 Ultrawideband Compact Lightweight Biconical Antenna With Capability of Various Polarizations Reception for Modern UAV Applications (<https://ieeexplore.ieee.org/document/10054542>) (Paper based)
- 2 5G NR FR2 Femtocell Coverage Map Using an Omni directional Twisted SWAA(<https://ieeexplore.ieee.org/document/9292979>) (Paper based)
- 3 Millimeter-Wave End-Fire Magneto-Electric Dipole Antenna and Arrays With Asymmetrical Substrate Integrated Coaxial Line Feed(<https://ieeexplore.ieee.org/document/9293000>) (Project based)
- 4 Ka-band Substrate Integrated Waveguide Isolator with Novel Matched Load(<https://ieeexplore.ieee.org/document/9755549>) **(Problem Based)**

Code No: 157CM

**R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech IV Year I Semester Examinations, February/March - 2022

**MICROWAVE AND OPTICAL COMMUNICATIONS**

(Electronics and Communication Engineering)

Time: 3 Hours

Max. Marks: 75

Answer any Five Questions  
All Questions Carry Equal Marks

- 1.a) Explain in detail the operation of Reflex Klystron and derive equation for its efficiency.  
b) What is Velocity modulation? How is it different from normal modulation? Explain how velocity modulation is utilized in Klystron amplifier. [8+7]
- 2.a) Explain the operation of TWT and derive its gain. Give its characteristics and applications.  
b) What is a Gunn Diode? Explain how it works as a Oscillator and also discuss about the characteristic curve. [8+7]
- 3.a) Explain the operation of magnetron and derive its Hull Cutoff Voltage equation.  
b) Explain the operation of IMPATT Diode and explain its characteristics curve. [7+8]
- 4.a) Discuss the design of Waveguide terminations.  
b) With a neat diagram explain in detail about H-plane tee and determine its S-matrix. [8+7]
- 5.a) What are ferrites? How they are useful in microwaves? Explain faradays rotation.  
b) Explain the design and working principle of a Gyrator. [8+7]
- 6.a) Explain the operation of Magic Tee. Describe how it can be used in constructing a Circulator and a Duplexer.  
b) Discuss in detail the operation of a 2-hole directional coupler, Calculate the coupling factor if the power in the primary waveguide is 65mw and the power delivered to the directional coupler is 7mw. [8+7]
- 7.a) With a neat block diagram of typical microwave bench, explain the functionality of each block.  
b) Define an optical fiber. Explain in detail different types of optical fibers with neat sketches. [8+7]
- 8.a) Explain P-I-N photo detector with neat sketch.  
b) Briefly explain the types of losses occur in optical fiber. [7+8]

—ooOoo—

**(13) TOPICS FOR STUDENT'S SEMINARS**

1. Applications of microwave antennas in 5G
2. Importance of Rectangular Wave guide and Circular Wave guide in Communications
3. Basics of Satellite Communication
4. Uses of Waveguide components in Communication
5. Roles and applications of MIMO technology

**14. STEP/COURSE MATERIAL IN SOFTCOPY**



MWE notes.rar

**15. EXPERT LECTURES WITH TOPICS & SCHEDULE (IF ANY)**

S.No.	Name of the Title	Expert details
1	Role of microwave communication in 5G technology	Dr.S.Karthikeyan, Professor, Department of ECE, KSR College of Engineering, Tiruchengode, Namakkal, Tamil Nadu
2	Recent Microwave Applications	Vallurupalli Nageswara Rao VignanaJyothi Institute of Engineering & Technology, VignanaJyothiNagar, Pragathi Nagar, Nizampet(S.O, Hyderabad, Telangana 500090





**CMR ENGINEERING COLLEGE**

**UGC AUTONOMOUS**

(Approved by AICTE - New Delhi. Affiliated to JNTUH and Accredited by NAAC & NBA)

Kandlakoya (V), Medchal (M), Medchal - Malkajgiri (D)-501401



## **WIRELESS COMMUNICATION AND NETWORKS**

### **DEPARTMENT OF ECE**

### **ACADEMIC PLANNER**

**By**

**DR.SRAVAN KOTHAPALLI**  
**(Associate professor)**



**Subject: WCN**

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### **1. Vision of the Department:**

To promote excellence in technical education and scientific research in electronics and communication engineering for the benefit of society.

### **Mission of the Department:**

- To impart excellent technical education with state of art facilities inculcating values and lifelong learning attitude.
- To develop core competence in our students imbibing professional ethics and team spirit.
- To encourage research benefiting society through higher learning

### **2. PEOs:**

1. Excel in professional career & higher education in Electronics & Communication Engineering and allied fields through rigorous quality education.
2. Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.
3. Solve real life problems relating to Electronics & Communications Engineering for the benefits of society.

### **PSO:**

- 1. Ability to apply concepts of Electronics & Communication Engineering to associated research areas of electronics, communication, signal processing, VLSI, Embedded systems**

2. Ability to design, analyze and simulate a variety of Electronics & Communication functional elements using hardware and software tools along with analytic skills

## POs

1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### 3. Mapping of course objectives, course out comes with PEOS and Pos & JUSTIFICATION

#### *COURSE OUTCOMES*

Course Code.CO No	Course Outcomes (CO's)
At the end of the course student will be able to	
EC731PE.1	<b>Explain</b> the Principles of wireless communication and fundamentals of wireless networking.
EC731PE.2	<b>Analyze</b> various multiple access schemes used in wireless Communication.
EC731PE.3	<b>Describe</b> cellular system design concepts and different channel assessment technologies.
EC731PE.4	<b>Distinguish</b> Wireless wide area networks and local area networks and their performance analysis.

#### **Justification of correlation levels:**

**CO1 ,CO2, CO3 and CO5 with PO1:** CO1 ,CO2, CO3,CO5 and CO6 moderately correlates with PO1 as they deals with knowledge of engineering fundamentals.

**CO1 ,CO2, CO3 and CO4 with PO2:** CO1 ,CO2, CO3,CO4 and CO5 **are** moderately correlates with PO2 as it applies knowledge of engineering fundamentals and it includes the analysis of engineering problems.

**CO2,CO3 and CO4 with PO3:** CO2,Co3,CO4 and Co5 are moderately correlates with PO3 as it addresses the design principles of engineering principles

**CO2with PO4:** CO2, substantially correlates with PO4 as they addresses usage of research knowledge of engineering

**CO1, CO4 and CO5 with PO12:** CO1&Co4 moderately correlates with PO12 as it deals with the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

#### **(4) *SYLLABUS – R20 AUTONOMOUS***

##### **UNIT -I:**

**The Cellular Concept-System Design Fundamentals:** Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

##### **UNIT –II: Mobile Radio Propagation: Large-Scale Path Loss:**

Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- LongleyRyce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

##### **UNIT –III: Mobile Radio Propagation: Small –Scale Fading and Multipath:**

Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

#### **UNIT -IV: Equalization and Diversity:**

Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration, Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

#### **UNIT -V: Wireless Networks:**

Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

#### **TEXT BOOKS:**

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

#### REFERENCE BOOKS:

1. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.
2. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
3. Wireless Communication and Networking – William Stallings, 2003, PHI.
4. Wireless Communication – Upen Dalal, Oxford Univ. Press.
5. Wireless Communications and Networking – Vijay K. Gary, Elsevier.

#### 6. Individual time table

NAME: DR.SRAVAN KOTHAPALLI					SUBJECT: WCN			
DAY& TIME	I 9.10- 10.10	II 10.10- 11.00	III 11.00- 11.50	IV 11:50-12:40		V 12.40- 1.20	VI 1.20- 2.20	VII 2.20- 3.10 3.10- 4.00
MON					L U N C H			
TUE								
WED								
THU								
FRI								
SAT								



**(7) SUBJECT (LESSON) PLAN**

S.NO	Topic (JNTU syllabus)	Sub-Topic	No. of Lectures Required	Suggested Books	Remarks
		<b>UNIT - I</b>	<b>08</b>		
1	<b>The Cellular Concept-System Design Fundamentals:</b>	Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies-Prioritizing Handoffs,	L1, L2	<b>T1, R1</b>	
2		Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity,	L3, L4	<b>T1, R2</b>	
3		Channel planning for Wireless Systems, Adjacent Channel interference ,	L5	<b>T1, R3</b>	
4		Power Control for Reducing interference, Trunking and Grade of Service,	L6, L7	<b>T1, R2</b>	
5		Improving Coverage & Capacity in Cellular Systems-Cell Splitting, Sectoring .	L8, L9	<b>T1, R1</b>	
		<b>UNIT – II</b>			
1	<b>Mobile Radio Propagation: Large-Scale Path</b>	Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms,	L13	<b>T1, R1</b>	
2		Reflection-Reflection from Dielectrics, Brewster Angle,	L14, L15	<b>T1, R1</b>	

	<b>Loss:</b>	Reflection from perfect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry,			
3		Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models-	L16.L17	<b>T1, R2</b>	
4		LongleyRyce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model,	L18, L19	<b>T1, R3</b>	
5		Indoor Propagation Models- Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model,	L20, L21		
6		Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.	L22	<b>T1, R2</b>	Unit II complete s on L22
		<b>UNIT-III</b>			
1	<b>Mobile Radio Propagation: Small –Scale</b>	Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power,	L23, L24	<b>T1, R2</b>	
2		Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum	L25	<b>T1, R1</b>	

	<b>Fading and Multipath:</b>	Sliding Correlator Channel Sounding,			
3		Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time,	L26, L27	<b>T1, R1</b>	
4		Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading,	L28	<b>T1, R3</b>	
5		slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model,	L29	<b>T1, R1</b>	
6		Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.	L30	<b>T1, R2</b>	Unit III complete s on L30
		<b>UNIT – IV</b>			
1	<b>Equalization and Diversity:</b>	Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver,	L31, L32	<b>T1, R2,</b>	
2		Linear Equalizers, Non linear Equalization Decision Feedback Equalization (DFE), Maximum Likelihood	L33, L34	<b>T1, R2,</b>	

		Sequence Estimation (MLSE) Equalizer			
3		Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm	L35	<b>T1, R2,R6</b>	
4		Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement,	L36	<b>T1, R2</b>	
5		Practical Space Diversity Consideration Selection Diversity, Feedback or Scanning Diversity	L37	<b>T1, R2</b>	
6		, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity	L38, L39	<b>T3, R2</b>	
7		Frequency Diversity, Time Diversity, RAKE Receiver.	L40, L41	<b>T3, R2,</b>	Unit IV complete s on L41
		<b>UNIT – V</b>			
1		Introduction to wireless Networks,	L42, L43	<b>T3, R2,</b>	
2		Advantages and disadvantages of Wireless Local Area Networks,	L44	<b>T3, R2</b>	
3	<b>Wireless Networks:</b>	WLAN Topologies, WLAN Standard IEEE 802.11,IEEE 802.11 Medium Access Control,	L45, L46	<b>T3, R2</b>	
4		Comparision of IEEE 802.11 a,b,g and n standards	L47		
5		IEEE 802.16 and its enhancements,	L48, L49, L50	<b>T3, R2,</b>	

6		Wireless PANs,	L51	<b>T3, R2</b>	
7		Hiper LAN	L52	<b>T3, R1</b>	
8		WLL.	L53	<b>T3, R1</b>	Unit IV complete s on L53

## 8.SSESSION EXECUTION LOG

S.No	Unit	Starting Date	Completed Date
1	I	05-06-2023	
2	II		
3	III		
4	IV		
5	V		

## (9) ASSIGNMENT QUESTION SETS

### UNIT-1

#### SET-1

1. Explain Frequency reuse concept in cellular system.
2. Explain different Channel assignment strategies
3. Explain the trunking and grade off service
4. Explain cell splitting

#### SET-2

1. What are performance criteria of basic cellular system?
2. Compare analog & digital cellular system.
3. What is spectrum allocation?
4. Explain the operation of cellular mobile system from a customer's perception without touching on design parameters

#### SET-3

5. Draw & explain process of selecting & allocating channel groups for all Cellular BS within the system.
6. Explain basic cellular system?
7. What is frequency reuse concept?
8. What are different handoff strategies?

#### SET-4

1. What is co- channel interference?
2. Write short note on interference & system capacity?
3. Explain methods of improving capacity of a cell.
4. How system capacity is increased to get better performance

## **UNIT-2**

### **SET-1**

1. Explain the importance of multiple access control protocols
2. What are the multiple access control protocols? Discuss.
3. Mention the various multiple access techniques that are used in various wireless communication systems.
4. Explain about packet radio.

### **SET-2**

1. How can we measure capacity of a cellular system?
2. Explain TDMA system.
3. What is space division multiple access?
4. Discuss various methods through which overall system capacity can be improved?

### **SET-3**

1. Write short note on CDMA technology.
2. Discuss various strategies of spread spectrum (FH-SS & DS-SS).
3. Explain CSMA/CD.
4. Compare FDMA/TDMA/SDMA.

### **SET-4**

1. List & explain in brief the field included in TDMA time slots.
2. What is CDMA network? Give its structure.
3. Compare CDMA with other technologies.
4. What are key elements in designing CDMA system?

## **UNIT-3**

### **SET-1**

1. Compare Wireless and fixed telephone networks.
2. What are the challenges of traffic routing in wireless networks.
3. What are the challenges of traffic routing in wireless networks? Explain.
4. What is common channel signaling? Discuss.

### **SET-2**

1. Compare wireless & fixed telephone network.
2. How routing of traffic takes place in wireless networks?
3. Discuss purpose & concept of common channel signaling.
4. Explain concept of traffic routing in wireless network

### **SET-3**

1. Draw & explain practical set up of ISDN.
2. Explain different channels in ISDN.
3. Explain fixed network transmission hierarchy.
4. What are the milestones in development of wireless networks?

### **SET-4**

1. Draw & explain practical set up of ISDN.
2. What is common channel signaling? Discuss.
3. What are the milestones in development of wireless networks?

4. What are various wireless data services?

#### **UNIT-4**

##### **SET-1**

1. What are the different types of WLANS and explain.
2. IS-95 CDMA forward channel, IS-95 CDMA reverse channel
3. How is GPRS technology different from GSM technology? Briefly describe the functions of those network elements in GPRS architecture which are different from GSM architecture.
4. Describe the important functions of forward and reverse channels in W-CDMA and CDMA 2000.

##### **SET-2**

1. Draw the system architecture for GPRS and explain that?
2. Packet and frame formats in IS-95, IMT-2000.
3. Explain about Short messaging services in GPRS mobile application protocols.
4. How is GPRS technology different from GSM technology? Briefly describe the functions of those network elements in GPRS architecture which are different from GSM architecture.

##### **SET-3**

1. Explain how GPRS is different from GSM
2. Describe the important functions of forward and reverse channels in W-CDMA and CDMA 2000.
3. Draw the system architecture for GPRS and explain that?
4. Explain Forward channel in W-CDMA and CDMA 2000

##### **SET-4**

1. Draw the system architecture for GPRS and explain that?
2. Explain about Short messaging services in GPRS mobile application protocols.
3. What are the different types of WLANS and explain
4. What is Distributed coordination function (DCF) Explain?

#### **UNIT-5**

##### **SET-1**

1. Explain the concept and salient features of IEEE 802.11 MAC layer.
2. Compare WLAN and Hyper LAN
3. Compare the various enhancements of IEEE 802.11
4. What are various layers of ATM? Explain each of them.

##### **SET-2**

1. Explain Wireless home networking
2. Explain Historical overviews of the LAN industry
3. Compare WLAN and HYPERLAN
4. Explain HYPER LAN-1, HYPER LAN-2

##### **SET-3**

1. Explain the Evolution of the WLAN industry
2. Explain wireless ATM
3. Explain wireless home networking
4. Explain the architecture of IEEE 802.11

#### **SET-4**

1. Explain the concept and salient features of IEEE 802.11 MAC layer
2. Compare the various enhancements of IEEE 802.11
3. What are various layers of ATM? Explain each of them
4. Explain HYPER LAN-1, HYPER LAN-2

#### **10. Sample assignment script**

#### **11. UNIT-WISE COURSE MATERIAL**



UNIT WISE NOTES.rar

#### **15. References (Text books/websites/Journals)**

##### **TEXT BOOKS:**

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

##### **REFERENCE BOOKS:**

1. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.
2. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
3. Wireless Communication and Networking – William Stallings, 2003, PHI.
4. Wireless Communication – Upen Dalal, Oxford Univ. Press.
5. Wireless Communications and Networking – Vijay K. Gary, Elsevier.



## ***WEBSITES***

1. [jwcn.eurasipjournals.springeropen.com/](http://jwcn.eurasipjournals.springeropen.com/)
2. [www.wirelesscommunication.nl/contents.htm](http://www.wirelesscommunication.nl/contents.htm)
3. [williamstallings.com/Wireless1e.html](http://williamstallings.com/Wireless1e.html)
4. [www.comsoc.org/wirelessmag](http://www.comsoc.org/wirelessmag)
5. [https://en.wikipedia.org/wiki/Wireless\\_network](https://en.wikipedia.org/wiki/Wireless_network)

## ***JOURNALS***

### **INTERNATIONAL**

1. [International Journal of Wireless and Mobile Computing](#)
2. [International Journal of Mobile Communications \(IJMC\)](#)
3. [International Journal of Wireless & Mobile Networks \(IJWMN\)](#)
4. [International Journal on Wireless & Optical Communications](#)
5. [EURASIP Journal on Wireless Communications and Networking](#)
6. [International Journal - of Science and Research \(IJSR\)](#)
7. [IEEE Transactions on Wireless Communications](#)
8. [Mobile and Wireless Networking Symposium - IEEE ICC 2015](#)

### **NATIONAL**

1. Journal of the Institute of Engineers
2. Journal of the Indian Institute of Science
3. IETE Journal of Education
4. IETE Journal of Research
5. IETE Technical Review

## ***QUESTION BANK - JNTU***

### **UNIT 1**

1. (a) Explain all spread spectrum multiple access techniques with features.  
(b) What is packet radio? Discuss CSMA protocols?
2. (a) Write about the basic cellular system with block diagram?  
(b) Explain traffic routing in wireless networking.
3. (a) What is cellular digital packet data? Explain with link layer characteristics.  
(b) Explain common channel signaling using network architecture.

4. (a) What is SS7? Explain with the help of protocol architecture.  
(b) What is ISDN? Explain with the help of block diagram.
5. (a) What is the tunneling in Mobile IP? Explain with the frame formats?  
(b) Explain WAP using protocol stack.
6. (a) What are the basic requirements of Wireless LAN? Discuss.  
(b) Explain Narrowband Microwave LANs with a practical example.
7. (a) Explain IEEE802.11 MAC control logic and frame format.  
(b) Explain Radio specification of the Bluetooth.
8. (a) Explain Quality of service parameters in L2CAP?  
(b) Explain about the following in brief.
  - i. Ad hoc Networking
  - ii. Mobile Application Protocol
  - iii. HIPERLAN
  - iv. SMS

## UNIT II

1. (a) What is the use of Space Division Multiple Access technique (SDMA)? Explain the practical usage of SDMA over TDMA, FDMA & CDMA.  
(b) Determine the maximum throughput that can be achieved using ALOHA and slotted ALOHA protocols?
2. (a) Discuss various generations of the wireless networks? Explain development of each generation clearly.  
(b) Explain hierarchy of X.25 in OSI reference model?
3. (a) Explain SS7 network service part with functional diagram of message transfer part.  
(b) Write about the following:
  - i. Cellular digital packet data.
  - ii. Advanced radio data information system.
  - iii. RAM Mobile Data.
  - iv. Reservation Protocol.
4. (a) Explain the concept and operation of Mobile IP with scenario?  
(b) Explain Mobile IP discovery and registration process with the help of message formats.
5. (a) Discuss Wireless local area network applications over wired area networks.  
(b) What are the differences between Single-cell and Multiple-cell wireless LANs? Explain.
6. (a) Explain Baseband specifications of Bluetooth.

- (b) List and explain L2CAP logic channels.
- 7. (a) Explain Data oriented CDPD network with uses?
- (b) Write about SMS in GSM and Mobile application protocol with limitations.
- 8. Explain the following with suitable example.
  - (a) Wireless ATM.
  - (b) HIPERLAN.
  - (c) SMS.
  - (d) WPAN.
  - (e) GPRS.
- 9. (a) Explain CSMA protocols? Discuss practical application of CSMA.
- (b) If a normal GSM time slot consists of six trailing bits, 8.25 guard bits, 26 training bits, and two traffic bursts of 58 bits of data, find the frame efficiency.
- 10. (a) Write about PSTN and what are the limitations of the wireless networking?
- (b) Explain fixed network transmission hierarchy with digital transmission hierarchy table?
- 11. (a) Discuss development of wireless data services with suitable descriptions?
- (b) What is ISDN? Explain with the help of block diagram?

### UNIT III

- 1. (a) How to measure efficiency of TDMA? Explain.
- 2. Explain the following:
  - (a) Circuit switching.
  - (b) Packet switching.
  - (c) X.25 protocol.
- 3. (a) What is SS7? Explain with the help of protocol architecture.
- (b) Differentiate broadband ISDN and ATM?
- 4. (a) Explain wireless session protocol with the help of primitives & parameters.
- (b) Explain wireless transaction protocol data unit with fixed header formats.
- 5. (a) Explain IEEE802.11 physical layer with block diagram?
- (b) What are the IEEE802.11 standards? Write about each standard briefly.
- 6. (a) Differentiate LLC and L2CAP?
- (b) Explain WLL Technology with suitable block diagrams?
- 7. Write about the following:

- (a) Short Message Services in GSM.
- (b) Mobile Application Protocol.
- 8. (a) What is the importance of Wireless ATM? Explain.
- (b) Why do we need Adhoc networking and WPAN? Discuss.

#### UNIT IV

- 1. (a) What is packet radio? Explain slotted ALOHA and pure ALOHA with neat sketches.
- (b) Write the silent features of TDMA with diagram.
- 2. (a) Write the difference between wireless and fixed telephone networks.
- (b) Discuss the development of 1st generation wireless networks.
- 3. (a) Compare the ISDN, BISDN and ATM.
- (b) Explain signaling traffic in SS7.
- 4. (a) Explain about co-located address and registration.
- (b) Discuss silent features of "WML" scripts.
- 5. (a) Draw the protocol architecture of LAN and compare it with OSI model.
- (b) Explain the transmission techniques that are used in infrared LAN.
- 6. (a) Draw the "BLUTOOTH" architecture and explain the working of each layer.
- (b) Write short notes on "BLUE TOOTH" usage model.
- 7. (a) Explain about data oriented CDPD network.
- (b) Explain how the mobility support is achieved in GPRS with neat schematic.
- 8. (a) Draw the basic architecture of WATM network and explain each block.
- (b) Explain about the adhoc networking.
- 9. (a) Explain the silent features of FDMA with a neat diagram.
- (b) Explain about CSMA protocols.
- 10. (a) Write down the difference between wireless and fixed telephone networks.
- (b) Discuss the development of 3rd generation wireless networks.
- 11. (a) Explain the function of ARDIS networks with block diagram.
- (b) Explain the protocol architecture of SS7.
- 12. Explain the following terms with example.
  - (a) Co-located address.
  - (b) Registration.
  - (c) Tunneling.
- 13. (a) Draw the architecture of IEEE 802 protocol and explain each block.

- (b) Write short notes about spread spectrum LANS.
- 14. (a) Explain the logic link control in BLUE TOOTH.
- (b) Discuss "WLL" Technologies.
- 15. (a) Write short notes on \mobile application protocol"?
- (b) Explain what are the higher data rates.
- 16. Explain the following:
  - (a) Wireless ATM.
  - (b) Adhoc Networking.

## UNIT V

- 1. Explain the following terms with examples.
  - (a) FDMA.
  - (b) TDMA.
- 2. (a) Discuss the development of 2<sup>nd</sup> generation wireless networks.
- (b) Explain packet switching with necessary data formats.
- 3. (a) Write short notes on RAM mobile data (RAD).
- (b) Distinguish between ISDN and BISDN with necessary figures.
- 4. (a) What is wireless data gram protocol and explain?
- (b) Discuss the tunneling in mobile IP.
- 5. (a) Write the difference between infrared LANS and spread spectrum LANS.
- (b) Explain the physical layer of 802.11.
- 6. (a) Discuss the three error correction schemes that are used in BLUETOOTH.
- (b) Explain adaptation protocol.
- 7. (a) What is GPRS? Explain higher data rates for GPRS.
- (b) Explain the short message services in GSM.
- 8. (a) Discuss the protocol entries in wireless ATM.
- (b) Write short notes on HIPERLAN.
- 9. Explain the following terms.
  - (a) Spread spectrum.
  - (b) Multiple access.
  - (c) SDMA.
- 10. (a) Discuss the limitations in wireless networking.
- (b) Explain about traffic routing in wireless networks.

III *THE END* III



























