STUDENT HAND BOOK

2023-24

(2-1)

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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 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 considerationfor 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, modeling, 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, andas 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 skill

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 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, and Digital Signal Processing & Microprocessors & Microcontrollers. The Department periodically organizes seminars, symposia, workshops and guest lecturers for the benefit of both the students and the faculty.

Academic Regulations, Course Structure andDetailed Syllabus under Autonomous Status

BACHELOR OF TECHNOLOGY (B.TECH.)

(CMREC – R-22 Regulations)

(Applicable for the batch admitted from 2022-2023)

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-22 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 (R22) FOR B.TECH REGULAR STUDENTS WITH EFFECT FROM THE ACADEMIC YEAR 2022-23

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

Jawaharlal Nehru Technological University Hyderabad (JNTUH) offers a 4-year (8 semesters) **Bachelor of Technology** (B.Tech.) degree programme, under Choice Based Credit System (CBCS) at its non-autonomous constituent and affiliated colleges with effect from the academic year **2022-23.**

Eligibility for Admission

Admission to the undergraduate (UG) programme shall be made either on the basis of the merit rank obtained by the qualified student in entrance test conducted by the Telangana State Government (EAMCET) or the University or on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the government from time to time.

The medium of instructions for the entire undergraduate programme in Engineering & Technology will be **English** only.

B.Tech. Programme Structure

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 ≥ 5) required for the completion of the undergraduate 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 undergraduate programme is of 4 academic years (8 semesters) with the academic year divided into two semesters of 22 weeks (□ 90 instructional days) each and in each

semester - „Continuous Internal Evaluation (CIE)" and „Semester End Examination (SEE)" under Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) indicated by UGC, and curriculum/course structure suggested by AICTE are followed.

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 anycredits.

Subject Course Classification

All subjects/ courses offered for the undergraduate programme in E&T (B.Tech. degree programmes) are broadly classified as follows. The University has followed almost all the guidelines issued by AICTE/UGC.

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		Industry Training/ Internship/ Industry Oriented Mini-	Industry Training/ Internship/ Industry Oriented Mini-Project/ Mini-Project/ Skill Development Courses
9		project/ Mini- Project/ Skill Development Courses	
		Seminar	Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering.
10	Minor Courses	-	1 or 2 Credit Courses (subset of HS)
11	Mandatory Courses (MC)	-	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 undergraduate 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 stamping". The online 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 the Head of the Department, Faculty Advisor/ Counselor and the student.

A student may be permitted to register for all the subjects/ courses in a semester as specified in the course structure with maximum additional subject(s)/course(s) limited to 6 Credits (any 2 elective subjects), based on **progress** and SGPA/ CGPA, and completion of the „**pre-requisites'** as indicated for various subjects/ courses, in the department course structure and syllabus contents.

Choice for „**additional subjects/courses**", not more than any 2 elective subjects in any Semester, must be clearly indicated, which needs the specific approval and signature of the Faculty Advisor/Mentor/HOD.

If the student submits ambiguous choices or multiple options or erroneous entries during **online** 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, 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 inevitable 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 **a 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 „within a period of 15 days" from the beginning of the current semester.

Open Electives: The students have to choose three Open Electives (OE-I, II & III) from the list of Open Electives given by other departments. However, the student can opt for an Open Elective subject offered by his own (parent) department, if the student has not registered and not studied that subject under any category (Professional Core,

Professional Electives, Mandatory Courses etc.) offered by parent department in any semester. Open Elective subjects already studied should not repeat/should not match with any category (Professional Core, Professional Electives, Mandatory Courses etc.) of subjects even in the forthcoming semesters.

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

Subjects/ courses to be offered

A subject/ course may be offered to the students, **only if** a minimum of 15 students opt for it.

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 come into picture, then the Head of the Department concerned shall decide, whether or not to offer such a subject/ course for **two (or multiple) 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 (including 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 also be Included in the attendance uploaded every fortnight in the University Website.**

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 student"s 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, including all academic credentials (internal marks etc.) of that semester. **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**.

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% (14 marks out of 40 marks) in the Continuous Internal Evaluation (CIE), not less than 35% (21 marks out of 60 marks) in the semester end examinations (SEE), 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 Real-time Research Project (or) Field Based Research Project (or) Industry Oriented Mini Project (or) Internship (or) 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 (i) does not submit a report on Industry Oriented Mini Project/Internship, or (ii) not make a presentation of the same before the evaluation committee as per schedule, or (iii) secures less than 40% marks in Real-time Research Project (or) Field Based Research Project (or) Industry Oriented Mini Project (or) Internship 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.

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 20 credits out of 40 credits i.e., 50% credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes thoseexaminations 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	**(i)** Regular course of study of second year second semester. **(ii)** Must have secured at least 48 credits out of 80 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes thoseexaminations 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 semesterto Fourth year first semester	**(i)** Regular course of study of third year second semester. **(ii)** Must have secured at least 72 credits out of 120 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes thoseexaminations 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) fulfills all the attendance and academic requirements for 160 credits, (iii) earn all 160 credits by securing SGPA □ 5.0 (in each semester), and CGPA ≥ 5 (at the end of 8 semesters), (iv) **passes all the mandatory courses,** to successfully complete the undergraduate programme. The performance of the student in these 160 credits shall be considered for the calculation of the final CGPA **(at the end of undergraduate programme),** and shall be indicated in the grade card / marks memo of IV-year II semester.

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 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 considered 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 / marks memo as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations Items 6 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 re-admitted shall be applicable. Further, 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 number of academic credits.** The academic regulations under which the student has been readmitted shall be applicable to him.

Evaluation - Distribution and Weightage of Marks

The performance of a student in every subject/course (including practical"s and Project Stage – I & II) will be evaluated for 100 marks each, with 40 marks allotted for CIE (Continuous Internal Evaluation) and 60 marks for SEE (Semester End-Examination).

In CIE, for theory subjects, during a semester, there shall be two mid-term examinations. Each Mid-Term examination consists of two parts i) **Part – A** for 10 marks, ii) **Part – B** for 20 marks with a total duration of 2 hours as follows:

1. Mid Term Examination for 30 marks:
   a. Part - A : Objective/quiz paper/Short Answers for 10 marks.(5*2=10Marks)
   b. Part - B: Descriptive paper for 20 marks.

The objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 10 marks. The descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks. The **average of the two Mid Term Examinations** shall be taken as the final marks for Mid Term Examination (for 30 marks).

The remaining 10 marks of Continuous Internal Evaluation are distributed as:

2. Assignment for 5 marks. (**Average of 2 Assignments** each for 5 marks)
3. Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks.

While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

Five (5) marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The average of the two assignments shall be taken as the final marks for assignment (for 5 marks).

Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the subject concerned for 5 marks before II Mid-Term Examination.

- The Student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and Overall 40% of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

There is NO Computer Based Test (CBT) for R22 regulations.

The details of the end semester question paper pattern are as follows:

The semester end examinations (SEE), for theory subjects, will be conducted for 60 marks consisting of two parts viz. i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from each 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.

- The duration of Semester End Examination is 3 hours.

For practical subjects there shall be a Continuous Internal Evaluation (CIE) during thesemester for 40 marks and 60 marks for semester end examination. Out of the 40 marksfor internal evaluation:

1. A write-up on day-to-day experiment in the laboratory (in terms of aim, components/procedure, expected outcome) which shall be evaluated for 10 marks
2. **10 marks for viva-voce (**or) tutorial (or) case study (or) application (or) poster presentation of the course concerned.
3. Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for 10 marks.
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the cluster / other colleges which will be decided by the examination branch of the University.

In the Semester End Examination held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

- The Student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and Overall 40% of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

There shall be an Industry training (or) Internship (or) Industry oriented Mini-project (or) Skill Development Courses (or) Paper presentation in reputed journal (or) IndustryOriented Mini Project in collaboration with an industry of their specialization. Studentsshall register for this immediately after II-Year II Semester Examinations and pursue itduring summer vacation/semester break & during III Year without effecting regular course work. Internship at reputed organization (or) Skill development courses (or) Paper presentation in reputed journal (or) Industry Oriented Mini Project shall be submitted in a report form and presented before the committee in III-year II semester before end semester examination. It shall be evaluated for 100 external marks. The committee consists of an External Examiner, Head of the Department, Supervisor of the Industry Oriented Mini Project (or) Internship etc, Internal Supervisor and a SeniorFaculty Member of the Department. There shall be **NO internal marks** for Industry Training (or) Internship (or) Mini-Project (or) Skill Development Courses (or) Paper Presentation in reputed journal (or) Industry Oriented Mini Project.

The UG project shall be initiated at the end of the IV Year I Semester and the duration of the project work is one semester. The student must present Project Stage – I during IV Year I Semester before II Mid examinations, in consultation with his Supervisor, the title, objective and plan of action of his Project work to the departmental committee for approval before commencement of IV Year II Semester. Only after obtaining the approval of the departmental committee, the student can start his project work.

UG project work shall be carried out in two stages: Project Stage – I for approval of project before Mid-II examinations in IV Year I Semester and Project Stage – II during IV Year II Semester. Student has to submit project work report at the end of IV Year II Semester. The project shall be evaluated for 100 marks before 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 approve the project work to begin before II Mid-Term examination of IV Year I Semester. The student is deemed to be not eligible to register for the Project work, if he 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.

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 next subsequent semester, as and when it is scheduled.

For Project Stage – II, the external examiner shall evaluate the project work for 60 marks and the internal project committee shall evaluate it for 40 marks. Out of 40 internal marks, the departmental committee consisting of Head of the Department, Project Supervisor and a Senior Faculty Member shall evaluate the project work for 20 marks and Project Supervisor shall evaluate for 20 marks. The topics for Industry Oriented Mini Project/ Internship/SDC etc. and the main Project shall be different from the topic already taken. The student is deemed to have failed, if he (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the External

Examiner as per schedule, or (iii) secures less than 40% marks in the sum total of the CIE and SEE taken together.

For conducting viva-voce of project, University selects an external examiner from the list of experts in the relevant branch submitted by the Principal of the College.

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 has to reappear for the same in the next subsequent semester, as and when it is scheduled.

A student shall be given only one time chance to re-register for a maximum of two subjects in a semester:

- If the internal marks secured by a student in the Continuous Internal Evaluation marks for 40 (Sum of average of two mid-term examinations consisting of Objective & descriptive parts, Average of two Assignments & Subject Viva-voce/PPT/ Poster presentation/ Case Study on a topic in the concerned subject) are less than 35% and failed in those subjects.

A student must re-register for the failed subject(s) for 40 marks within four weeks of commencement of the class work in next academic year.

In the event of the student taking this chance, his Continuous Internal Evaluation marks for 40 and Semester End Examination marks for 60 obtained in the previous attempt stand cancelled.

Grading Procedure

Grades will be awarded to indicate the performance of students in each Theory Subject, Laboratory/Practicals/ Industry-Oriented Mini Project/Internship/SDC and Project Stage. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in item 8 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	**Ab**	**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, „**Ab'** grade will be allocated in that subject, and he 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 thesame 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 gradesecured in that subject/ course. The corresponding „Credit Points" (CP) are computed bymultiplying 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 (□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** decimalplaces. SGPA is thus computed as

$$\textbf{SGPA} = \{ \sum_{i=1}^{N} C_i G_i \} / \{ \sum_{i=1}^{N} C_i \} \text{ …. For each semester,}$$

where „i" is the subject indicator index (considering all subjects in a semester), „N" is the no. of subjects „**registered'** for the semester (as specifically required and listed under the course structure of the parent department), C_i is the no. of credits allotted to the i^{th} subject, and G_i represents the grade points (GP) corresponding to the letter gradeawarded 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 (of 160) 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

$$\textbf{CGPA} = \{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \} \text{ … for all S semesters registered}$$

$$\sum_{j=1}$$

(i.e., up to and inclusive of S semesters, S ≥ 2),

where „**M'** is the **total** no. 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), Cj is the no. of credits allotted to the j^{th} subject, and Gj represents the grade points (GP) corresponding to the letter grade awarded for that j^{th} 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 x 8 = 32
Course 2	4	O	10	4 x 10 = 40
Course 3	4	C	5	4 x 5 = 20
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	C	5	3 x 5 = 15
	21			152

SGPA = 152/21 = 7.24

Illustration of Calculation of CGPA up to 3rd Semester:

Semester	Course/ Subject Title	Credits Allotted	Letter Grade Secured	CorrespondingGrade 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 Credits	**69**		**Total Credit Points**	**518**

CGPA = 518/69 = 7.51

The calculation process of CGPA illustrated above will be followed for each subsequent semester until 8th semester. The CGPA obtained at the end of 8th semester will become the final CGPA secured for entire B.Tech. Programme.

For merit ranking or comparison purposes or any other listing, **only** the „**rounded off'** values of the CGPAs 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 passed his 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 secures a GP ≥ 5 (**'C'** grade or above) in every subject/course in that semester (i.e. when the student gets an SGPA 5.0 at the end of that particular semester); and he shall be declaredsuccessful or
„passed" in the entire undergraduate programme, only when gets a CGPA

 5.00 (**'C'** grade or above) 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, no. of credits, grade earned, etc.) and credits earned. **There is NO exemption of credits in any case.**

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.

% of Marks = (final CGPA – 0.5) x 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 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 inthe following classes.

A student with final CGPA (at the end of the undergraduate programme) > 8.00, and fulfilling the following conditions - shall be placed in „**First Class with**

Distinction'.
However, he

(i) Should have passed all the subjects/courses in „**First Appearance'** within the first 4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

(ii) Should not have been detained or prevented from writing the semester end examinations in any semester due to shortage of attendance or any other reason.

A student not fulfilling any of the above conditions with final CGPA > 8 shall be placed in **'First Class'.**

Students with final CGPA (at the end of the undergraduate programme) 7.0 but < 8.00 shall be placed in **'First Class'.**

Students with final CGPA (at the end of the undergraduate programme) 6.00 but < 7.00, shall be placed in „**Second Class'**.

All other students who qualify for the award of the degree (as per item 12.1), with final CGPA (at the end of the undergraduate programme) 5.00 but < 6, shall be placed in
„**pass class**".

A student with final CGPA (at the end of the undergraduate programme) < 5.00 willnot be eligible for the award of the degree.

Students fulfilling the conditions listed under item 12.3 alone will be eligible for awardof „**Gold Medal**".

Award of 2-Year B.Tech. Diploma Certificate

1. A student is awarded 2-Year UG Diploma Certificate in the concerned engineering branch on completion of all the academic requirements and earned all the 80 credits (within 4 years from the date of admission) upto B.Tech. II Year II Semester, if the student want to exit the 4-Year B.Tech. Program and *requests for the 2 -Year* B. Tech. (*UG) Diploma Certificate.*
2. The student **once opted and awarded 2-Year UG Diploma Certificate, the student will be permitted to join** in B. Tech. III Year I Semester and continue for completion of remaining years of study for 4-Year B. Tech. Degree ONLY in the next academic year along with next batch students. However, if any student wishes to continue the study after opting for exit, he/she should register for the subjects/courses in III Year I Semester before commencement of class work for thatsemester.
3. The students, who exit the 4-Year B. Tech. program after II Year of study and wish to re-join the B.Tech. program, must submit the 2 -Year B. Tech. (UG) Diploma Certificate awarded to him, subject to the eligibility for completion of Course/Degree.
4. A student may be permitted to take one year break after completion of II Year II Semester or B. Tech. III Year II Semester (with university permission through the principal of the college well in advance) and can re-enter the course in **next Academic Year in the same college** and complete the course on fulfilling all the academic credentials within a stipulated duration i.e. double the duration of the course (Ex. within 8 Years for 4-Year program).

Withholding of results

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

Transitory Regulations

A. For students detained due to shortage of attendance:

1. A Student who has been detained in I year of R20 Regulations due to lack of attendance, shall be permitted to join I year I Semester of R22 Regulations and he is required to complete the study of B.Tech. Programme within the stipulated period of eight academic years from the date of first admission in I Year.
2. A student who has been detained in any semester of II, III and IV years of R20 regulations for want of attendance, shall be permitted to join the corresponding semester of R22 Regulations and is required to complete the study of B.Tech. within the stipulated period of eight academic years from the date of first admission in I Year. The R22 Academic Regulations under which a student has been readmitted shall be applicable to that student from that semester. See rule (C) for further Transitory Regulations.

B. For students detained due to shortage of credits:

3. A student of R20 Regulations, who has been detained due to lack of credits, shallbe promoted to the next semester of R22 Regulations only after acquiring the required number of credits as per the corresponding regulations of his/her first admission. The total credits required are 160 including both R20 & R22 regulations. The student is required to complete the study of B.Tech. within the stipulated period of eight academic years from the year of first admission. The R22 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in R22 Regulations:

4. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including R22 Regulations. **There is NO exemption of credits in any case**.
6. If a student is readmitted to R22 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R22 Regulations will be substituted by another subject to be suggested by the University.

Note: If a student readmitted to R22 Regulations and has not studied any subjects/topics in his/her earlier regulations of study which is prerequisite for further subjects in R22 Regulations, the College Principals concerned shall conduct remedial classes to cover

those subjects/topics for the benefit of the students.

Student Transfers

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

There shall be no transfers from one college/stream to another within the constituent colleges and units of Jawaharlal Nehru Technological University Hyderabad.

The students seeking transfer to colleges affiliated to JNTUH from various other Universities/institutions have to pass the failed subjects which are equivalent to the subjects of JNTUH, and also pass the subjects of JNTUH which the students have not studied at the earlier institution. Further, though the students have passed some of the subjects at the earlier institutions, if the same subjects are prescribed in different semesters of JNTUH, the students have to study those subjects in JNTUH in spite of the fact that those subjects are repeated.

The transferred students from other Universities/Institutions to JNTUH affiliated colleges who are on rolls are to be provided one chance to write the CBT (for internal marks) in the **equivalent subject(s)** as per the clearance letter issued by the University.

The autonomous affiliated colleges have to provide one chance to write the internal examinations in the **equivalent subject(s)** to the students transferred from other universities/institutions to JNTUH autonomous affiliated colleges who are on rolls, as per the clearance (equivalence) letter issued by the University.

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 Vice-Chancellor is final.

The University may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the dates notified by the University authorities.

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

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ACADEMIC REGULATIONS FOR B.TECH (LATERAL ENTRY SCHEME) FROM THE AY 2023-24

1. Eligibility for the 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.

2. The student shall register for 120 credits and secure 120 credits with CGPA ≥ 5 from II year to IV-year B.Tech. Programme (LES) for the award of B.Tech. Degree.

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

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

5. Promotion rule

S. No	Promotion	Conditions to be fulfilled
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	**(i)** Regular course of study of second year second semester. **(ii)** 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 to fourth year first semester	**(i)** Regular course of study of third year second semester. **(ii)** 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 yearfirst semester.

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

7. LES students are not eligible for 2-Year B. Tech. Diploma Certificate.

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Malpractices Rules

Disciplinary Action For / Improper Conduct in Examinations

	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) in which the student is appearing.	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/year. The hall ticket of the student is to be cancelled and sent to the University.
3.	Impersonates any other student in connection with the examination.	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/year. 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.
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.	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/year. 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.
5.	Uses objectionable, abusive or offensive language in the answer paper 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	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. 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.

	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.	
7.	Leaves the exam hall taking away answer script or intentionally tears off 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/year. 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.
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/year. 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/year. 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/year.
11.	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/year examinations.
12.	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.	

Malpractices identified by squad or special invigilators

1. Punishments to the students as per the above guidelines.
2. Punishment for Institutions: (if the squad reports that the college is also involved inencouraging malpractices)
   a. A show-cause notice shall be issued to the college.
   b. Impose a suitable fine on the college.
   c. Shifting the examination center from one college to another college for a specificperiod of not less than one year.

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 (REVISED)
B.Tech II-YEAR: ACADEMIC YEAR - 2023-2024

II B.Tech. I – SEMISTER

S. No.	EVENT	DATE		DURATION
		FROM	TO	
1	Commencement of Class Work	**18.09.2023**		---
2	First Spell of Instructions (Including Dusara Holidays)*	18.09.2023	18.11.2023	9 weeks
3	**First Mid Term Examinations (Theory & Practical)**	**20.11.2023**	**25.11.2023**	***1 Week***
4	Submission of First Mid Term Marks to Exam Branch	02.12.2023		---
5	Parents Teacher's Meeting	09.12.2023		---
6	Second Spell of Instructions (Including Pongal Holidays)	27.11.2023	20.01.2024	8 weeks
7	**Second Mid Term Examinations (Theory & Practical)**	**22.01.2024**	**27.01.2024**	***1 Week***
8	Submission of Second Mid Term Marks to Exam Branch	03.02.2024		---
9	Preparation Holidays and Practical Examinations	29.01.2024	03.02.2024	1 week
10	**End Semester & Supplementary Examinations**	**05.02.2024**	**17.02.2024**	***2 Weeks***

II B.Tech. II – Semester

S. No.	EVENT	DATE		DURATION
		FROM	TO	
1	Commencement of II-SEM Class work	**19.02.2024**		---
2	First Spell of Instructions	19.02.2024	13.04.2024	8 weeks
3	**First Mid Term Examinations**	**15.04.2024**	**20.04.2024**	1 week
4	Submission of First Mid Term Marks to Exam Branch	27.04.2024		---
5	Parents Teacher's Meeting	04.05.2024		
6	Second Spell of Instructions	22.04.2024	11.05.2024	3 weeks
7	**Summer Vacation**	***13.05.2024***	***25.05.2024***	***2 weeks***
8	Continuation of second spell of Instructions	27.05.2024	29.06.2024	5 weeks
9	**Second Mid Term Examinations**	**01.07.2024**	**06.07.2024**	**1 week**
10	Submission of Second Mid Term Marks to Exam Branch	13.07.2024		---
11	Preparation Holidays and Practical Examinations	08.07.2024	13.07.2024	1 week
12	**End Semester & Supplementary Examinations**	**15.07.2024**	**27.07.2024**	***2 weeks***
13	Commencement of Class Work for the next A.Y-2024-2025	*29.07.2024*		---

- *** Dusara Vacation** (Subjected to declaration by JNTUH / TS Govt.)

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

Controller of Examinations

Principal
CMR Engineering College
(Autonomous)

Department Event Planner A.Y 2023-2024

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
32	13/11/2023 - 16/11/2023	Lab External Exam for IV Year
33	14/12/2023	Workshop for II year
34	15/11/2024 - 16/11/2024	IV B.Tech Major Project Work Review II
35	25/12/2023 - 30/12/2023	II MID Exams for III Years
36	22/01/2024 - 27/01/2024	II MID Exams for II Years
37	22/01/2024 - 24/01/2024	II Lab Internal Exam for II Year
38	29/01/2024 - 31/01/2024	Lab External Exam for II &III Year
39	01/02/2024 - 03/02/2024	Preparation Holidays and Practical Examinations
40	03/02/2024	Submission of II mid marks to University
41	05/02/2024 - 17/02/2024	End Semester Exams

LIST OF SUBJECTS

1	Electronics Devices Circuits
2	Network Analysis and Synthesis
3	Digital Logic Design
4	signals and systems
5	Probability Theory and Stochastic Processes
6	Electronic Devices and Circuits Laboratory
7	Digital logic Design Laboratory
8	Basic Simulation Laboratory
9	environmental science

(UGC AUTONOMOUS)

ACADEMIC PLAN

FOR

ACADEMIC YEAR

2023-24

COURSE: B.TECH- II YEAR

ECE-I-SEM-R22

SUBJECT: ELECTRONIC DEVICES AND CIRCUITS

(EC301PC)

CREDITS: 3

ACADEMIC PLANNER

Subject:Analog and Digital Electronics

S.NO		CONTENT
(1)	**-**	**Preamble/Introduction**
(2)	**-**	**Prerequisites**
(3)	**-**	**Objectives and Outcomes**
(4)	**-**	**Syllabus** **1.JNTUH** **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.geeksforgeeks.org, www.schools.com, Coursera,edX, Udemy, Khan Academy*, NPTEL etc along Registration procedures*)*
(10)	**-**	**Question Banks** **1.JNTUH/Model papers** **2.GATE**
(11)	**-**	**Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications.**
(12)	**-**	**AssignmentQuestion/InnovativeAssignments 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. PREAMBLE/INTRODUCTION:

This subject provides an insight into analysis and design of components such as diodes, BJTs and FETs. To know the applications of components, switching characteristics of components and to give understanding of various types of Amplifier circuits.

2.PREREQUISITES

The prerequisites for understanding this course include knowledge of basic semiconductor physics.

3.OBJECTIVES AND OUTCOMES

COURSE OBJECTIVES:

1. To introduce components such as diodes, BJTs and FETs.
2. To know the applications of devices.
3. To know the switching characteristics of devices.

COURSE OUTCOMES: Upon completion of the Course, the students will be able to:

1. Acquire the knowledge of various electronic devices and their use on real life.
2. Know the applications of various devices.
3. Acquire the knowledge about the role of special purpose devices and their applications.

4. SYLLABUS

UNIT - I

Diode and Applications: Review of pn-Junction Diode, VI Characteristics of Diode, Diode Equation,Diode - Static and Dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances, Breakdown Mechanisms in Diodes, Diode Applications: Switch-Switching times.

Rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Rectifiers with Capacitive and Inductive Filters, Clippers-Clipping at two independent levels, Clamper-Clamping Circuit Theorem, Clamping Operation, Types of Clampers.

UNIT - II

Bipolar Junction Transistor (BJT): BJT Construction,Principle of Operation, Transistor Current Components, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch, switching times, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self Bias, Bias Stability, Thermal Runaway, Thermal Stability, Bias Compensation using Diodes.

UNIT - III

Junction Field Effect Transistor (FET): Construction, Principle of Operation, Pinch-Off Voltage, Volt- Ampere Characteristic, Comparison of BJT and FET, Biasing of FET, FET as Voltage Variable Resistor.

Special Purpose Devices: Zener Diode - Characteristics, Voltage Regulator. Principle of Operation - SCR, Tunnel diode, UJT, Varactor Diode, Photo Diode.

UNIT – IV

Analysis and Design of Small Signal Low Frequency BJT Amplifiers: Transistor Hybrid model, Determination of h-parameters from transistor characteristics, Typical values of h-parameters in CE, CB and CC configurations, Transistor amplifying action, Analysis of CE, CC, CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors on CE Amplifier.

UNIT – V

FET Amplifiers: Small Signal Model**,** Analysis of JFET Amplifiers, Analysis of CS, CD, CG JFET Amplifiers. MOSFET Characteristics in Enhancement and Depletion mode, Basic Concepts of MOS Amplifiers

(4.2) SYLLABUS - GATE

UNIT I

Diffusion current,Drift current, mobility and resistivity, PN Junction, Diode Current Equation.

UNIT II

BJT-Bipolar Junction Transistor

UNIT III

FET, LED, Photodiode,

UNIT IV

Analysis of CE, CC, CB Amplifiers.

UNIT V

CS, CD, CG JFET Amplifiers

(4.3)SYLLABUS - IES

UNIT I

Diode basics and characteristics, Diodes for different uses.

UNIT II

BJT-Bipolar Junction Transistor

UNIT III

JFETs

UNIT IV

Different typesof Transistor amplifiers ofBJT amplifiers

UNIT V

MOSFET

5.LIST OF EXPERT DETAILS:

LOCAL:

1. Dr. Mohammad Farukh Hashmi, Assistant Professor, ECE Department, NIT, Warangal
   E-Mail:mdfarukh@nitw.ac.in
   Phone No: 9666740604
2. Dr. T. Kishore Kumar, Professor , ECE Department, NIT, Warangal
   E-Mail: kishoret@nitw.ac.in,kishorefr@gmail.com
   Phone No: 8332969353, 9440973318

NATIONAL:

1 Mr.Avirup Dasgupta, Ph. D. Assistant Professor(Semiconductors)
ECE Department, IIT Roorkee, Uttarakhand, India. PIN: 247667
Phone: (+91-1332)28-4967)-Office
Email:avirup@ece.iitr.ac.in

2 Gourab Dutta,Ph.D.(IIT Madras),Assistant Professor(Compound semiconductor devices) in the Department of Electronics and Electrical Communication Engineering (E&ECE) at IIT Kharagpur
PHONE: (91-3222-283546)Office
Email:gdutta@ece.iitkgp.ac.in

INTERNATIONAL:

1. Dr.ROBERT FOX(Analog Integrated Circuit Design), associate professor AND ECE ASSOCIATE CHAIR at the University of Florida.

   Email: fox@tec.ufl.edu
   Phone: 352-392-2543
   Mailing Address: P.O. Box 116130, Gainesville, FL 32611-6130

2. Dr.Abeer Alwan , ECE Department Vice Chair of Undergraduate Affairswas a member of the faculty of the UCLA Samueli School of Engineering
Email: alwan@ee.ucla.edu
Phone: (310) 206-2231

6. JOURNALS FOR LITERATURE STUDY:

1. ieeexplore.ieee.org/abstract/document/1335548

TITLE: Superconducting digital electronics

2. https://ieeexplore.ieee.org/document/9784828

TITLE: Dielectrically Modulated III-V Compound Semiconductor Based Pocket Doped Tunnel FET for Label Free Biosensing Applications

3. https://ieeexplore.ieee.org/document/9719722

TITLE : High Speed and High Efficiency GaN Envelope Amplifier with Source-Floating Half-Bridge Switch

4.ieeexplore.ieee.org/document/9203217

TITLE :Circuit Models of Field Emission Silicon Diode and Transistor with a Nanoscale Vacuum Channel

5.ieeexplore.ieee.org/document/8567008

TITLE:Characteristics of Failure Schottky Barrier Diode and PN Junction Diode for Bypass Diode using Induced Lightning Serge Test

7.SUBJECT - LESSON PLAN

Subject Code	Name of the subject	Year/Branch	Name of the Faculty
EC301PC	Electronic Devices and Circuits	II-B.Tech,I-Sem ECE	Mrs.. P. Kavitha

Name of the Topic	Sub topics	No. Of classes	Text books	Methodology	Remarks
UNIT-I **Diode and Applications**	Review of PN-Junction Diode	L1	**T1, R1**	M1	
	VI Characteristics of Diode, Diode Equation,	L2,L3	T1, R1	M1	
	Diode - Static and Dynamic resistances	L4	T1, R1	M1	
	Equivalent circuit. Load line analysis	L5	T1, R1	M1	
	Transition and Diffusion Capacitances	L6	T1, R1	M1	

	Breakdown Mechanisms in Diodes	L7,L8	T1, R1	M1	
	Diode Applications Switch-switching times	L9,L10	T1, R1	M1	
	Half Wave Rectifier	L11	T1, R1	M1& M5	
	Full Wave Rectifier Bridge	L12	T1, R1	M1& M7	
	Bridge Rectifier	L13	T1, R1	M1& M7	
	Rectifier Rectifiers with Capacitive and inductive Filters	L14	T1, R1	M1& M5	
	Clippers-Clipping at two independent levels	L15	T1, R1	M1	
	Clamper-Clamping Circuit Theorem	L16	T1, R1	M1	
	Clamping Operation, Types of Clampers	L17	T1, R1	M1	
	TOTAL NO OF CLASSES 17				
UNIT-II **Bipolar Junction Transistor(BJT)**	BJT Construction Principle of Operation	L18	T1, R2	M1& M4	
	Transistor Current Components	L19	T1,		
	Common Base Configuration	L20	T1, R1	M1& M7	
	Common Emitter Configuration	L21	T1, R1	M1& M5	
	Common Collector Configuration	L22	T1, R1	M1& M5	

	Comparison of Filters	L23,L24	T1, R1	M1& M5	
	Transistor as a switch, switching times	L25	T1, R1	M1& M5	
	Transistor Biasing and Stabilization - Operating point, DC & AC load lines	L26,L27	T1, R2	M1& M4	
	Biasing - Fixed Bias, Self Bias, Bias Stability,	L28,L29	T1, R2	M1, M4	
	Thermal Runaway, Thermal Stability,	L30	T1, R2	M1	
	Bias Compensation using Diodes	L31	T1, R2	M1	
	TOTAL NO OF CLASSES 14				
UNIT III **Junction Field Effect Transistor(FET)** **&Special Purpose Devices**	Construction, Principle of Operation Pinch-Off Voltage Volt Ampere Characteristic	L32,L33	T1, R1	M1	
	Comparison of BJT and FET	L34	T2, R2	M1& M7	
	Biasing of FET, FET as Voltage Variable Resistor	L35	T1, R1	M1	
	Zener Diode - Characteristics, Voltage Regulator Principle of Operation	L36	T1, R1	M1	
	SCR, Tunnel diode UJT	L37,L38	T1, R1	M1	
	Varactor Diode, Photo Diode	L39	T1, R1	M1	
	TOTAL NO OF CLASSES 8				
UNIT-IV **Analysis and Design of Small Signal Low Frequency BJT Amplifiers**	Transistor Hybrid model, Determination of h-parameters from transistor characteristics	L40, L41	T1, R2	M1, M4	
	Typical values of h- parameters in CE,CB and CC configurations	L42, L43	T1, R2	M1, M4	
	Transistor amplifying action, Analysis of CE,CB and CC Amplifiers	L44, L45	T1, R2	M1, M4	
	CE Amplifier with emitter resistance	L46	T1, R2	M1, M4	

	low frequency response of BJT Amplifiers	L47	T1, R2	M1, M4	
	Effect of coupling and bypass capacitors on CE Amplifier.	L48	T1, R2	M1, M4	
	TOTAL NO OF CLASSES 9				
UNIT-V **FET Amplifiers**	Small Signal Model	L49	T2, R2	M1& M4	
	Analysis of JFET Amplifiers	L50	T2, R2	M1& M4	
	Analysis of CS, CD,CG JFET Amplifiers.	L51,L52	T2, R2	M1& M4	
	MOSFET Characteristics in Enhancement and Depletion rnode	L53,L54	T2, R2	M1& M4	
	Basic Concepts of MOS Amplifier	L55,L56	T2	M1& M4	
	TOTAL NO OF CLASSES 8				
TOTAL NO OF CLASSES56					

8.SUGGESTED BOOKS (PRESCRIBED AND REFERENCES):

TEXT BOOKS:

1. Electronic Devices and Circuits- Jacob Millman, McGraw Hill Education
2. Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson

REFERENCE BOOKS:

1. The Art of Electronics, Horowitz, 3rd Edition Cambridge University Press
2. Electronic Devices and Circuits, David A. Bell – 5th Edition, Oxford.
3. Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. Prakash Rao, 2Ed., 2008, Mc Graw Hill

9. WEBSITES FOR SELF LEARNING:

1. http://www.engineersgarage.com/electronic-circuits
2. http://www.gobookee.net/electronic-devices-and-circuits/
3. http://engineeringppt.blogspot.in/electronic-devices-and-circuits.html

4. https://www.physics-and-radio-electronics.com/electronic-devices-and-circuits.html
5. https://archive.nptel.ac.in/courses/108/108/108108122/
6. https://www.coursera.org/specializations/semiconductor-devices

10. QUESTION BANKS: (ATTACHED SEPARATELY)

1. JNTUH Model Papers

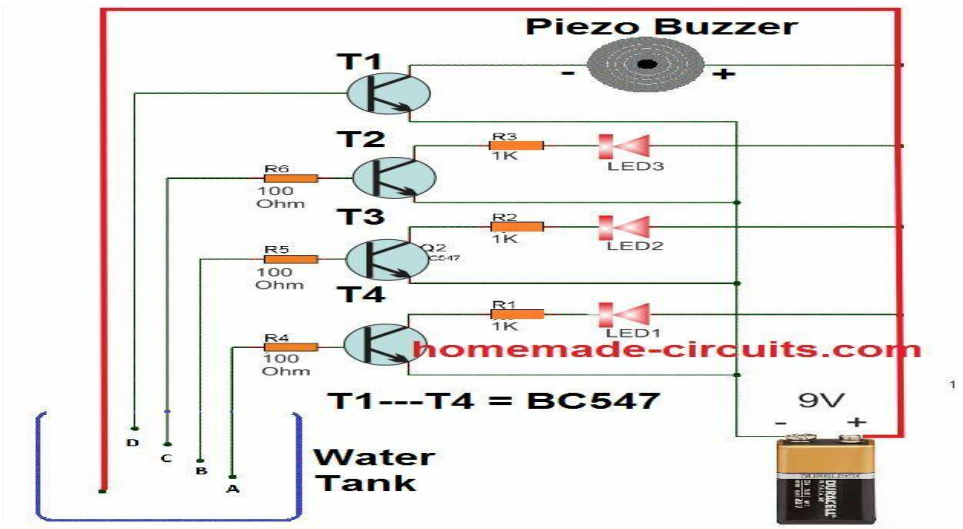
EDC QP.rar

edc gate paper.rar

11. CASE STUDY

1. Design and development of sensor-based mini projectsof Electronic Components – a Case Study

ABSTRACT: This is the circuit diagram of a simple **corrosion free water level indicator** for home and industries. In fact, the level of any conductive non-corrosive liquids can be measured using this circuit. The circuit is based on 4 transistor switches. Each transistor is switched on to drive the corresponding LED when its base is supplied with current through the water through the electrode probes.



One electrode probe is (F) with 9V DC is placed at the bottom of the tank. Other probes are placed step by step above the bottom probe. When water is rising the base of each transistor gets electrical connection to 9V DC through water and the corresponding probe. This, in turn, makes the transistors conduct to glow LED and indicate the level of water. The ends of probes of the water tank level indicator are connected to corresponding points in the circuit as shown in circuit diagramInsulated Aluminum wires with end insulation removed will do for the probe. Arrange the probes in order on a PVC pipe according to the depth and immerse it in the tank. AC voltage is used to

prevent electrolysis at the probes. So this setup will last really long. It guarantee at least a 2 years of maintenance-free operation.

2.Automatic Emergency LED Light

This is the simple and cost effective automatic LED Emergency Light Circuit with light sensing. This system charges from main supply and gets activated when main supply is turned OFF. This emergency lamp will work for more than 8 hours (depending the battery capacity and the power consumed by the LEDs).When power supply is turned OFF, the circuit senses the day light and according to the light it turns on the LED's. If the light is present even though power fails the circuit turns OFF the LEDs. Here LDR (Light Dependent Resistor) is used to sense the light.

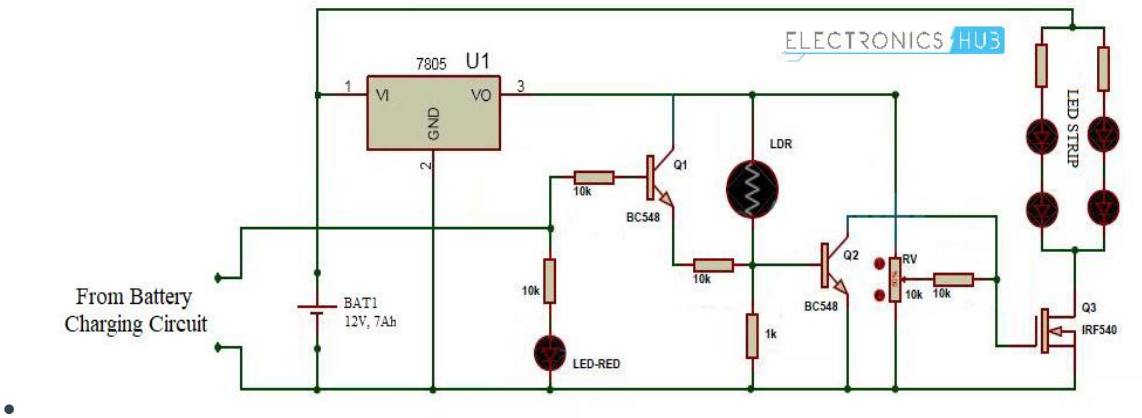
Automatic Emergency Light Circuit Principle

When power supply is available, battery charges through the battery charging circuit. When the power fails, the white LED's which are connected MOSFET will glow based on the light condition till the battery shuts down.When LDR (Light Dependent Resistor) is in light, the resistance of LDR is very low. As a result base of the transistor Q2 becomes high. As a result white LED's which are connected to MOSFET turns OFF.

When the circuit is in dark, the resistance of LDR is in order of mega ohms. Now the base of the transistor becomes low, as a result transistor Q2 switches the white LED's to ON state.

Components for Automatic LED Emergency Light Circuit

- 7805 voltage regulator
- Light Dependent Resistor – 2MΩ
- IRF540 MOSFET
- BC548 NPN Transistor
- Pot – 10KΩ
- High bright LEDs – 3V@15mA
- Red LED – 1
- 10KΩ Resistors – 3
- 1KΩ Resistor – 1



Instead of immediately turning ON the LEDs, it first reads the ambient lighting through the LDR and then if the lighting is low, the LEDs are turned ON..

12. ASSIGNMENT QUESTIONS:

UNIT – I

SET 1

1. Define static and dynamic resistance of P-N diode.
2. Compare the characteristics of P-N junction diode and Zener diode.
3. Explain the operation of full wave rectifier with inductive filter.

SET 2:

1. Derive an expression for transition capacitance of a diode?
2. Compare FWR and Bridge rectifiers?
3. Compare the characteristics of a p-n junction diode?
4. Draw the equivalent circuit of a diode circuit when a DC voltage to forward biasthe diode along with an ac signal is applied?
5. Differentiate between normal PN junction diode and a Zener diode?

SET 3:

1. Derive expressions for ripple factor, regulation and rectification efficiency of ahalf wave rectifier.
2. Design an LC filter for a Full wave rectifier to give 9V output as DC voltage at100 mA current. Assume ripple factor to be 2%
3. With neat diagram,explain the operation of P-N junction diode, considering different biasing condition.
4. Describe the action of a full wave bridge rectifier with the aid of input-output wave forms.

5. What are the advantages of bridge rectifier over centre tapped Transformer?

Unit – II

SET 1:

1. Explain the operation of CC configuration of BJT and its input and output characteristics briefly?
2. What is Biasing? Explain the need of it. List out different types of biasing methods?
3. Compare CE, CB, CC configurations?
4. How FET acts as voltage variable resistor
5. Design a CE BJT circuit with self bias and then explain its operation?

SET 2:

1. Draw the circuit diagram of SCR and explain its operation along with its characteristics?
2. How FET acts as voltage variable resistor
3. An n channel JFET has I dss=10mA and VP=-2 v. Determine the drain source resistance for 1)Vgs=0v Vgs=-0.5v
4. Draw and explain BJT small signal model?
5. Compare the performance of BJT and FET?

SET 3:

1) Based on the currents flowing through a BJT illustrate the amplification process?
2) Compare CB, CC, and CE configurations?
3) What is need for biasing? List the deficiencies overcome in voltage divider bias method?
4) Define stability factors for a BJT with any biasing method?
5) Suggest a method to effects on operating point of a BJT circuit?

Unit – III

SET 1:

1. Explain the working of tunnel diode?
2. Define pinch off voltage?
3. Explain the operation of n channel JFET?
4. Discuss effect of VGS on drain current of a JFET based on its structure?
5. Define: Pinch-off voltage, mutual conductance (gm), dynamic drain resistance (rd)?

SET 2:

1. Which type of diode capacitance is utilized in varactor diode operation? Explainits principle of operation?
2. Name the device exhibiting negative resistance region in its V-I characteristic. With suitable diagram explain the operation of this device?
3. Discuss the constructional details of SCR and Schotky barrier diode?
4. Give symbol of UJT and mark required polarities for operation?
5. Give the equivalent circuit of UJT?

SET 3:

1. Explain how UJT can be used as a negative resistance device, with the help of static characteristics?
2. Discuss effect of VGS on drain current of a JFET based on its structure?
3. Give the equivalent circuit of UJT?
4. Explain how UJT can be used as a negative resistance device, with the help of static characteristics?
5. Explain about SCR?

Unit – IV

SET 1:

1. Given Ie=2.5 mA, hfe=140,hoe=20us and hob=0.5 us. Determine the common emitter hybrid equivalent circuit?
2. Explain about the effect of coupling and bypass capacitor on CE amplifier?
3. Compare CB, CE, CC configurations with respect to current gain, voltage gain, input resistance and output resistance?
4. Explain the typical values of h parameters?
5. Explain about Transistor Amplifying action?

SET 2:

1. Derive the expression of voltage gain and input resistance for common emitter amplifier?
2. Explain about CE amplifier with Emitter Resistance/
3. Explain about Low frequency response of BJT Amplifiers?
4. Determine h parameters from hybrid Characteristics?
5. Draw the h parameter model for CC?

SET 3

1. Derive upper and lower cut off frequencies of CE amplifier?

2. Why 3db frequency for the current gain is not same as voltage gain?
3. Explain about the frequency response?
4. Derive the expression current gain, voltage gain, input resistance and output resistance for CE configurations?
5. Explain about phase Reversal in CE amplifier?

Unit – V

SET 1

1. Explain the working of MOSFET amplifier?
2. Calculate the game and frequency response characteristics of MOSFET amplifier?
3. Derive the expression of voltage gain and input resistance for common gate FET amplifier?
4. Compare depletion and enhancement mode MOSFET?
5. Explain the operation of n channel JFET?

SET 2:

1) Discuss effect of VGS on drain current of a JFET based on its structure?
2) Define: Pinch-off voltage, mutual conductance (gm), dynamic drain resistance (rd)?
3) Explain about CS Amplifier?
4) Compare Depletion and Enhance type MOSFET?
5) Explain about Characteristics of MOSFET?

SET 3:

1) Write principle of operation of FET amplifiers?
2) Compare Drain and Enhancement Characteristics of MOSFET?
3) Explain the operation of a MOSFET in enhancement and depletion modes?
4) Explain operation of MOSFET?
5) Explain about basic concept of MOS Amplifiers?

13. LIST OF STUDENT SEMINARS:

1 Diode rectification

2 Transistor- transistor logic for designing logic gates

3 Integrated CMOS Tri-Gate Transistors

4 Organic Light Emitting Diode

5 Diode applications in real life

14. COURSE FILE

(Attached Separately)

15. EXPERT LECTURE:

S.NO	SUBJECT	TOPIC	YEAR	RESOURCE PERSON	DATE
1	EDC – 01	DIODES AND ITS APPLICATIONS	II-I	Others	18/11/2023
2	EDC - 02	Amplifiers	II-I	Others	23/12/2023

ACADEMIC PLAN

FOR

ACADEMIC YEAR

2023-24

COURSE: II-YEAR-I-SEM, B.TECH, ECE

SUBJECT: NETWORK ANALYSIS AND SYNTESIS

CREDITS: 3

Subject: NETWORK ANALYSIS AND TRANSMISSION LINES

S.NO		CONTENT
(1)	-	Objectives and Outcomes as per NBA
(2)	-	Scope
(3)	-	Prerequisites
(4)	-	Syllabus
		1. AUTONOMOUS
		2. GATE &IES
(5)	-	Subject Plan
(6)	-	Suggested Books (Text/Ref)
(7)	-	Question Bank with answers (JNTU/GATE)
(8)	-	E-Resources (CMREC Repositories)
(9)	-	Expert Details (Guest Lecture/Seminars)
(10)	-	Two case study presentations with Project / Product/ Model /prototypes/ Industrial applications
(11)	-	Assignment/Innovative Assignment Questions
(12)	-	Important question sets on each unit
(13)	-	List of topics for student's seminars
(14)	-	Journals
(15)	-	STEP/Course material

1) OBJECTIVE & OUTCOMES AS PER NBA

OBJECTIVE: This course introduced the Knowledge

1. To understand the basic concepts on RLC circuits.
2. To know the behavior of the steady state and transient states in RLC circuits.
3. To understand the two port network parameters.
4. Learn the design concepts of various filters and attenuators

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

1. Gain the knowledge on basic RLC circuit's behavior.
2. Analyze the Steady state and transient analysis of RLC Circuits.
3. Characterization of two port network parameters.
4. Analyze the Design aspect of various filters and attenuators

(2) SCOPE

The purpose of this is to overview the activities in the network analysis and design process. A detailed explanation of network analysis tools and techniques is beyond the scope of this course and network synthesis covering topics such as foster andcauser methods.

(3) PREREQISITES

1. This subject recommends prior knowledge of engineering mathematics.
2. Various functions like trigonometric and exponential etc.
3. Basic notations of charge, current, and potential.
4. Knowledge on KCL, KVL, Mesh & Nodal Analysis.

5. Knowledge of Vectors and Calculus, Coordinate system

(4) SYLLABUS-AUTONOMOUS

UNIT I:

Network Topology, Terminology, Basic cutest and tie set matrices for planar networks, Illustrative Problems, Magnetic Circuits, Self and Mutual inductances, dot convention, impedance, reactance concept, Impedance transformation and coupled circuits, co-efficient of coupling, equivalent T for Magnetically coupled circuits, Ideal Transformer.

UNIT – II

Steady state and transient analysis of RC, RL and RLC Circuits, Circuits with switches, step response, 2' order series and cases parallel RLC Circuits, Root locus, damping factor, over damped, under damped, critically damped, quality factor and bandwidth for series and parallel resonance, resonance curves

UNIT – III

Two port network parameters, Z, Y, ABCD, h and g parameters, Characteristic impedance, Image transfer constant, image and iterative impedance, network function, driving point and transfer functions — using transformed (S) variables, Poles and Zeros.

UNIT – IV

Filters: Classification of Filters, Filter Networks, Constant-K Filters-Low pass, high pass, Band pass, band-stop filters, M-derived Filters- T and π filters- Low pass, high pass

Attenuators: Types – T, π , L, Bridge T and lattice ,Asymmetrical Attenuators T, π , L Equalizers-Types- Series, Shunt, Constant resistance, bridge T attenuation, bridge T phase, Lattice attenuation, lattice Phase equalizers

UNIT – V

Network Synthesis: Driving point impedance and admittance, transfer impedance and admittance, network functions of Ladder and non ladder networks, Poles, Zeros analysis of network functions**,** Hurwitz polynomials, Positive Real Functions, synthesis of LC, RC and RL Functions by foster and causer methods.

(4.1) SYLLABUS – GATE and IES

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin's and Norton's, maximum power transfer; Star-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks.

(5) SUBJECT (LESSON) PLAN

UNIT-I

S.NO	TOPIC TO BE COVERED	SUGGESTED BOOKS	NO OF LECTURERS REQUIRED	TEACHING METHODS
1	Network Topology, Terminology	T1,R1, R3	2	M1:Board
2	Basic cutest and tie set matrices for planar networks, Illustrative Problems,	T1,R2, R3	3	M2:PPT(NPTEL)
3	Magnetic Circuits, Self and Mutual inductances, dot convention, impedance, reactance concept	T1,T2, R3	3	M1:Board

4	Impedance transformation and coupled circuits, co-efficient of coupling, equivalent T for Magnetically coupled circuits, Ideal Transformer	T1,T2, R1	3	M2:PPT(NPTEL)
TOTAL CLASSES :11				

UNIT-II

S.NO	TOPIC TO BE COVERED	SUGGESTED BOOKS	NO OF LECTURERS REQUIRED	TEACHING METHODS
1	Steady state and transient analysis of RC, RL and RLC Circuits	T1,R1 , R3	3	M6
2	Circuits with switches, step response	T1, R1,R3	2	M5
3	2' order series and parallel RLC Circuits	T1, R1,R3	3	M1:Board
4	Root locus, Damping factor, over damped, under damped, critically damped cases,	T2,R1,R2	3	M2:PPT(NPTEL)
5	Quality factor and bandwidth for series and parallel resonance, resonance curves	T1,R1,R3	3	M6
TOTAL CLASSES :14				

UNIT-III

S.NO	TOPIC TO BE COVERED	SUGGESTED BOOKS	NO OF LECTURERS REQUIRED	TEACHING METHODS
1	Two port network parameters, Z, Y, ABCD, h and g parameters,	T1,T2,R2	6	M1

2	Characteristic impedance, Image transfer constant, image and iterative impedance	T2,R1,R3	3	M2
3	Network function, driving point and transfer functions — using transformed (S) variables, Poles and Zeros.	T2,R1,R2	4	M4
TOTAL CLASSES :13				

UNIT-IV

S. NO	TOPIC TO BE COVERED	SUGGESTED BOOKS	NO OF LECTURERS REQUIRED	TEACHING METHODS
1	Filters: Classification of Filters, Filter Networks, Constant-K Filters-Low pass	T2,R3,R4	3	M1
2	high pass, Band pass, band-stop filters,	T2,R3,R4	3	M2
3	M-derived Filters- T and π filters- Low pass, high pass	T2,R3	3	M4
4	Attenuators: Types – T, π , L, Bridge T and lattice ,Asymmetrical Attenuators T, π , L	T2,R3,R4	3	M1
	Equalizers- Types- Series, Shunt, Constant resistance, bridge T attenuation, bridge T phase, Lattice attenuation, lattice Phase equalizers		2	
TOTAL CLASSES :14				

UNIT-V

S.NO	TOPIC TO BE COVERED	SUGGESTED BOOKS	NO OF LECTURERS REQUIRED	TEACHING METHODS
1	Driving point impedance and admittance, transfer impedance and admittance, network functions of Ladder and non ladder networks,	T2,R3,R4	3	M2
2	Poles, Zeros analysis of network functions, Hurwitz polynomials, Positive Real Functions	T2,R3,R4	4	M1
3	Synthesis of LC, RC and RL Functions by foster andcauser methods.	T2,R3	4	M3
4	Synthesis of LC, RC and RL Functions by foster andcauser methods.	T2,R4	4	M6
TOTAL CLASSES :15				
TOTAL NO. OF CLASSES :67				

METHODS OF TEACHING

M1 : Green board
M2 : ICT Methods (PPT/E-resources/NPTEL
M3 : Think-Pair-Share
M4 : Group Learning
M5 : Mind Mapping
M6 : Mnemonics

(6) SUGGESTED BOOKS

TEXT BOOKS:

1. Van Valkenburg - Network Analysis, 3rd Ed., Pearson, 216.
2. JD Ryder - Networks, Lines and Fields, 2nd Ed., PHI, 1999.

REFERENCE BOOKS:

1. J. Edminister and M. Nahvi - Electric Circuits, Schaum's Outlines, Mc Graw Hills Education, 1999.
2. A. Sudhakar and Shyammohan S Palli - Networks & Circuits, 4th Ed., Tata McGraw- Hill Publications
3. William Hayt and Jack E. Kimmerley - Engineering Circuit Analysis, 6th Ed., William Hayt andJack E. Kimmerley, McGraw Hill Company

(7) Question Bank:

UNIT IV

1. Draw circuit diagram of π attenuator.
2. A π pad attenuator is required to reduce the level of an audio signal by 12dB while
3. matching the impedance of the 500 ohm network calculate the values of the three resistors required
4. Draw the low pass filter and draw its frequency response
5. Design a constant k high pass π filter with cut off frequency of 2KHz
6. Describe the band stop filter with suitable example.
7. What is a Hurwitz polynomial and write its properties?
8. What is a low-pass filter? Draw its characteristics and diagram.
9. What do you mean by "ACTIVE" and "PASSIVE" filters? What are the advantages and disadvantages of active filters over passive filters? Discuss the different types of active and passive filters.
10. Design constant K low pass T and πsectionfilters to be terminated in 600 Ω having cut-offfrequency 3 kHz.

UNIT V

1. State Foster Reactance Theorem
2. Find the 1st form of Foster for the following impedance function

$$Z(s) = \frac{s(s^2+2)}{(s^2+1)(s^2+3)}$$

3. Obtain both Cauer I and II realizations of the driving point function given by:

$$Z(s) = \frac{10s^4 + 12s^2 + 1}{2s^3 + 2s}$$

4. Define Driving point function.

5. Write down the properties of Hurwitz polynomial.
6. What are the limitations of Foster forms?
7. Differentiate between Foster and Cauer forms and also write down the steps to obtain Foster-I and Foster-II forms.
8. What do you mean by network synthesis? How is it different from network analysis?
9. Draw the ideal characteristics of low pass, high pass, band pass and band elimination filters.

(8) E-RESOURCES

Do not confine yourself to the list of websites mentioned here alone. Be cognizant and keep yourself abreast of the others too. The given list is not exhaustive.

1. www.mit.edu
2. www.soe.stanford.edu
3. www.grad.gatech.edu
4. www.gsas.harward.edu
5. www.eng.ufl.edu
6. www.iitk.ac.in
7. www.iitd.ernet.in
8. www.iitb.ac.in
9. www.iitm.ac.in
10. www.iitr.ac.in
11. www.iitg.ernet.in
12. www.bits-pilani.ac.in
13. www.bitmesra.ac.in
14. www.psgtech.edu
15. www.iisc.ernet.in
16. www.circuit-magic.com
17. www.ieee.org

(9) EXPERT DETAILS

International

1.Dr. Steven W. Blume Professor Of Electrical Engineering, Dept. Of Electrical Engg. University Of California, New Jersey.Usa.

2. Dr Ray Kwok Professor In Dept. Of Physics And Astronomy, San Jose State University,Usa.

National

1. Prof G S Punekar, Dept Of Eee, Nitk.
2. Dr.D.Ganesh Rao Professor And Head Of The Dept Of Telecommunication Engineering,Ms Ramaiah Institute Of Technology.

Regional

1. Prof. Shyam Mohan S Palli, Hod Of Dept, Eee, Sir Crr College Of Engineering.
2. Dr.G.S.N.Raju Professor Of Electronics And Communication Engineering,College Of Engineering Andhra University.

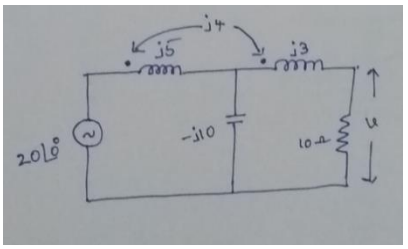
(10) ASSIGNMENT/INNOVATIVE ASSIGNMENT QUESTIONS:

SET 1

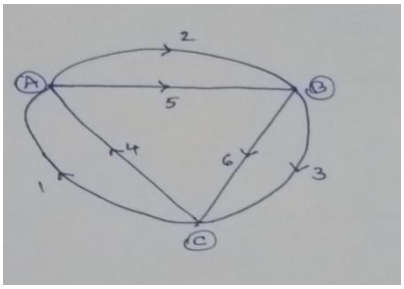
1. For the topological graph, Obtain Tie set and cutest matrices by taking 5 and 6 as tree branches.(CO1)

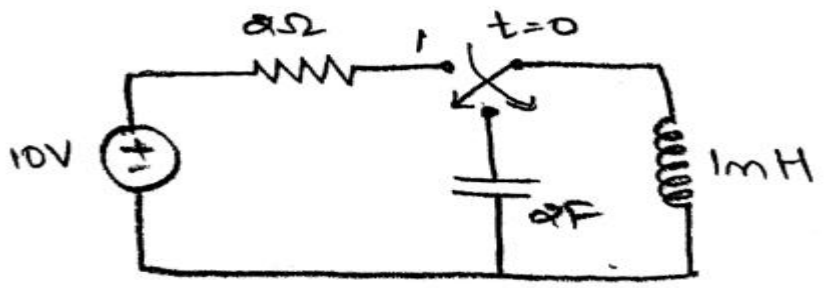
2. a)Write short notes on Dot convention.(CO1)

   b)Find the voltage across 10 ohm resistor in the given network.(CO1)



3. Determine the current in the inductor when switch position is changed from 1 to 2 at t=0



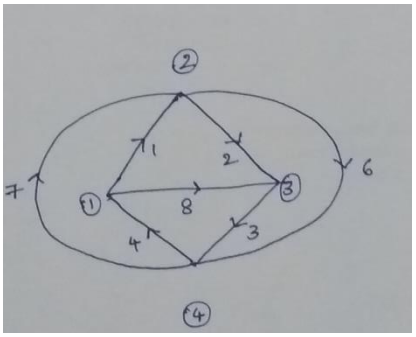


4. Derive the equation for bandwidth and quality factor in series resonance circuit. (CO2)
5. In a series RLC circuit of L=10mH and C=0.0lμF.and R=50O. Calculate the resonant

Frequency and also the impedance at the resonant frequency

SET 2

1. Write the incidence matrix and calculate the no of trees for the graph given below.(CO1)



2. Define Ideal transformer. Derive the relation between input impedance and load impedance in ideal transformer. **(CO1)**

3. A series RC circuit is applied with 30V at t=0, if R =10 ohms, c=0.1 F calculate the current and voltages across R and C. **(CO2)**

4. For the series Resonance circuit, if R=10 ohms, L=0.5 H, C=20 μF. Calculate the impedance (CO1)

(a) at resonance frequency

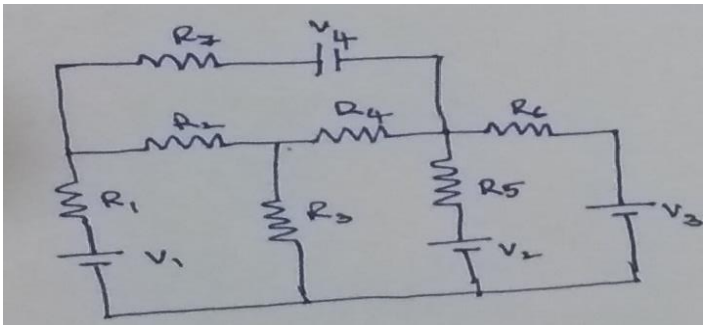
(b) 10 Hz above resonant frequency

(c) 10 Hz below resonant frequency

5. Derive the expression of resonant frequency of tank circuit(CO2)

SET 3

1. Draw the oriented graph for the given network and write the cutest matrix with Procedure(CO1)



2. Determine the response of the RL series circuit and calculate voltages across R and L, if 50V is applied at t=0. Given if R=20 ohms, L=10H. (CO2)

3. Coil 1 of a pair of coupled coils has a continuous current of 5A, and the corresponding fluxes φ11 and φ12 are 0.2 and 0.4 mWb respectively. If the turns are N1 = 500 and N2 = 1500, find L1, L2, M and k. (CO1)

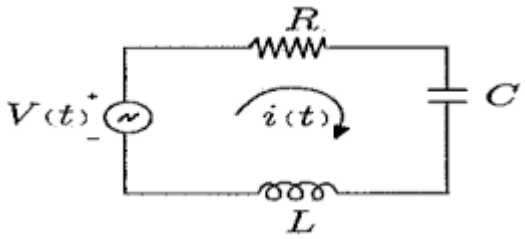
4. An impedance Z1 = 10 + j10 Ω is connected in parallel with another impedance of resistance 8.5 Ω and a variable capacitance connected in series. Find C such that the circuit is in resonance at 5 KHz. **(CO2)**

5. Given series RLC Circuit with R=10 ohms, L= 1 mH, C=1 μF is connected to a sinusoidal source of 20 volts with variable frequency. Find (a) Resonant frequency (b) Q-factor (c)Half power frequency. **(CO2)**

ASSIGNMENT 2:

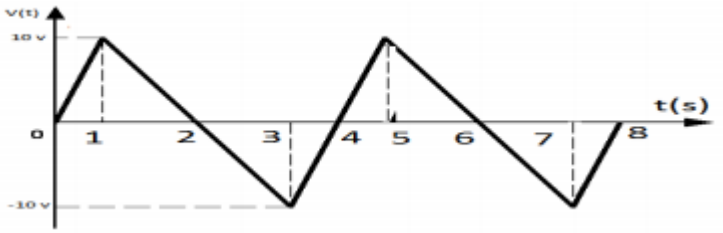
1. Explain the response of series RL and RLC circuit for the following inputs (CO3) i)Unit step signal ii) Ramp signal iii) Impulse iv)exponential [CO3]
2. Derive the equation for driving point input and output impedences for Y parameters?(CO4)
3. Derive the characteristic impedence for T network. (CO5)

5. Derive the equations for characteristic impedances and propagation constant of symmetrical network.(CO5)
6. Derive the expression for the current i(t) in the circuit using laplace transform. Given R=10Ω, L=3H, C=5F and V(t) is exponential signal (CO3)



7. A) Define reciprocity and symmetry and give its conditions for two port parameters(CO4)
B) Express ABCD parameters in terms of Y and h parameters.
8. Design symmetrical T attenuator? (CO5
9. Explain the response of series RL and RLC circuit for the following inputs (CO3)
i)Unit step signal ii) Ramp signal iii) Impulse iv)exponential
10. Express Z parameters in terms of Y , ABCD and h parameters. (CO4)
11. Derive the equations for characteristic impedance in π network (CO5)

12. Determine the average and RMS values of voltage waveform shown below (CO3)



INNOVATIVE ASSIGNMENT

Technical Essay:

1. How Network analysis is useful in our day to day life?
2. Transformers: Basics and Types
3. Wireless Power Transfer through Coils
4. Smart Grid – Future Electric Grid
5. Applications of Fuel Cells

Problem analysis

1. The table below defines the activities within a small project.

Activity	Start node	End node	Completion time (weeks)
1	1	2	2

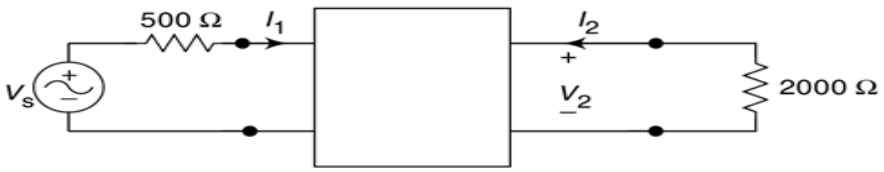
2	1	3	3
3	1	4	2
4	2	5	3
5	3	6	7
6	4	6	5
7	5	7	4
8	6	7	9
9	7	8	3

In addition to the above information we have that activity 7 cannot start until activity 5 has been completed.

- Draw the network diagram.
- Calculate the minimum overall project completion time.
- Calculate the float time for each activity and hence identify the activities which are critical.

3. The impedance parameters of a two-port network are $z_{11} = 25\ \Omega$, $z_{12} = 50\ \Omega$, $z_{21} = 75\ \Omega$, and $z_{22} = 75\ \Omega$. Find the port currents I_1 and I_2 when a 15-V voltage source is connected at port 1 and port 2 is short circuited.

The *h*-parameters of a two-port network shown in figure are $h_{11} = 1000\Omega$, $h_{12} = 0.003$, $h_{21} = 100$, and $h_{22} = 50 \times 10^{-6}$ mho. Find V_2 and *z*-parameters of the network if $V_s = 10^{-2} \angle 0^\circ\ (V)$.



Project Based:

1. Design a transformer with loss reduction.
2. Design a tank circuit to stabilize oscillations
3. Design a model of wind mill
4. Design an ideal high pass filter

Program Based:

1. Analyze the response of RLC series circuit using Multisim.
2. Evaluate and plot the total input impedance of series Resonant circuit using Matlab
3. To simulate a simple DC circuits using PSpice
4. design the low pass and high pass passive filters for specified cut off frequencies using MATLAB

(11) IMPORTANT QUESTION SETS ON EACH UNIT:

R15

Code No: 123BW

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, March - 2017
ELECTRICAL CIRCUITS
(Common to EEE, ECE, ETM)

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) State Ohm's law and mention its limitations. [2]
b) Explain how voltage source with a source resistance can be converted into an equivalent current source. [3]
c) Mention the disadvantages of low power factor. [2]
d) In a series R-C circuit, R=10Ω and C=25nF. A sinusoidal voltage of 50 mHz is applied and the maximum voltage across the capacitance is 2.5 V. Find the maximum voltage across the series combination. [3]
e) Define mutual inductance and self inductance. [2]
f) Find the total inductance of the three series connected coupled coils shown in the figure 1. [3]

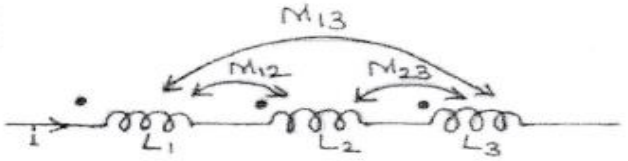


Figure: 1

g) Mention the properties of a tree in a graph. [2]
h) Explain graphical method to draw dual network. [3]
i) State superposition theorem and Reciprocity theorem. [2]
j) Give the proof of Tellegen's theorem. [3]

PART-B

(50 Marks)

2.a) State Kirchoff's voltage and current laws.

b) Find 'i' in the circuit given in figure 2. Check the power balance condition.[3+7]

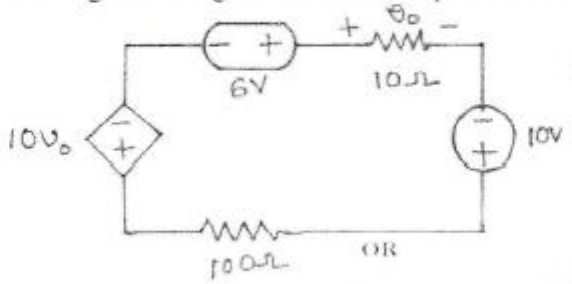


Figure: 2

OR

3.a) Determine the node voltages and the current through the resistors using mesh method for the network given in figure 3.

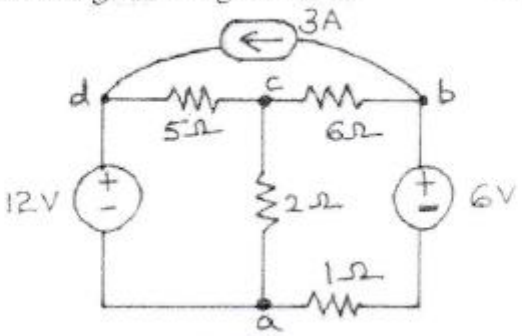


Figure: 3

b) Mention the difference between nodal analysis and mesh analysis. [7+3]

4.a) A series R-L circuit, has resistance of 20Ω and inductance of 0.02H. If the net impedance of the given circuit is $40\angle\Phi^{0}\Omega$, find Φ and the frequency of the circuit.

b) Define RMS value, Average value and Form factor. [4+6]

OR

5. A voltage $v(t) = 200\sin\omega t$ is applied to a series RLC circuit where R=60Ω, L=0.18mH and C=20μF. Find:
a) The power supplied by the source
b) The reactive power supplied by the source
c) The reactive power of the capacitor
d) The reactive power of the inductor and
e) The power factor of the circuit. [10]

6. Derive the equation for quality factor of series resonating circuit and parallel resonating circuit. [10]

OR

7.a) Define quality factor and Bandwidth.

b) In the coupled circuit given in figure 4, find the input impedance as well as the net inductance when L_1=0.2H, L_2=0.5H coefficient of coupling (K) being 0.5. [5+5]

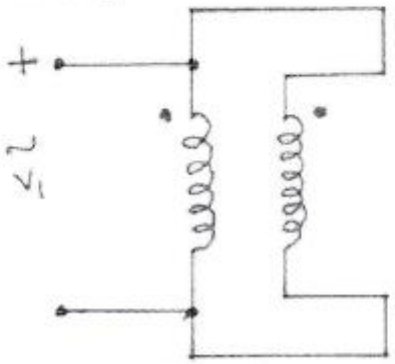


Figure: 4

8.a) Explain the concept of duality.

b) Define a fundamental Tie set and Cut set matrix. Give the procedure for obtaining the same with suitable examples. [3+7]

OR

9.a) The figure 5 represents a graph of a network. Show the tree, twigs and links.

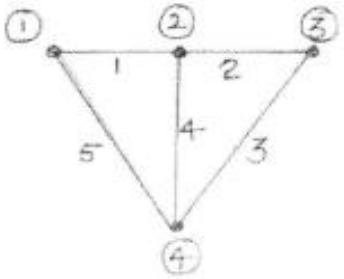


Figure: 5

b) Convert the given current source to voltage source shown in figure 6. [5+5]

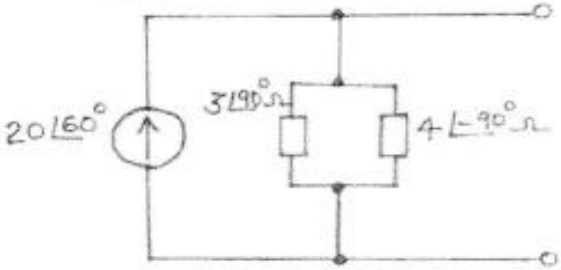


Figure: 6

10.a) State and explain Thevenin's and Norton's theorems.

b) Using Milliman's theorem find the current through R_L and voltage drop in the circuit given in figure 7. [5+5]

R15

Code No: 123BW

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, March - 2017
ELECTRICAL CIRCUITS
(Common to EEE, ECE, ETM)

Time: 3 Hours **Max. Marks: 75**

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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)

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b) Explain how voltage source with a source resistance can be converted into an equivalent current source. [3]
c) Mention the disadvantages of low power factor. [2]
d) In a series R-C circuit, R=10Ω and C=25nF. A sinusoidal voltage of 50 mHz is applied and the maximum voltage across the capacitance is 2.5 V. Find the maximum voltage across the series combination. [3]
e) Define mutual inductance and self inductance. [2]
f) Find the total inductance of the three series connected coupled coils shown in the figure 1. [3]

PART-B

(50 Marks)

2.a) State Kirchoff's voltage and current laws.
b) Find 'i' in the circuit given in figure 2. Check the power balance condition.[3+7]

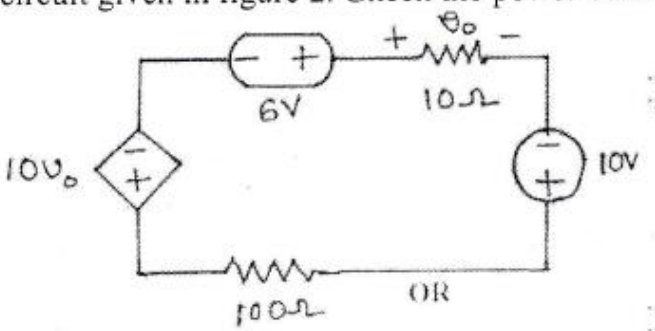

Figure: 2

OR

figure 1.

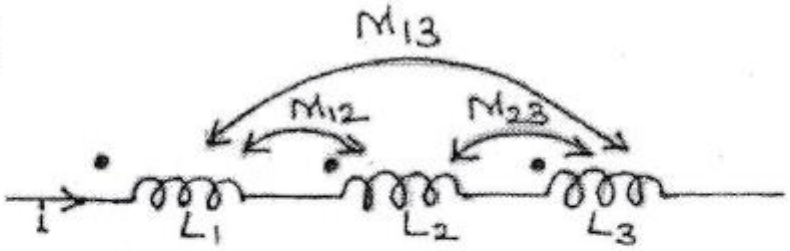

Figure: 1

g) Mention the properties of a tree in a graph. [2]

h) Explain graphical method to draw dual network. [3]

i) State superposition theorem and Reciprocity theorem. [2]

j) Give the proof of Tellegen's theorem. [3]

3.a) Determine the node voltages and the current through the resistors using mesh method for the network given in figure 3.

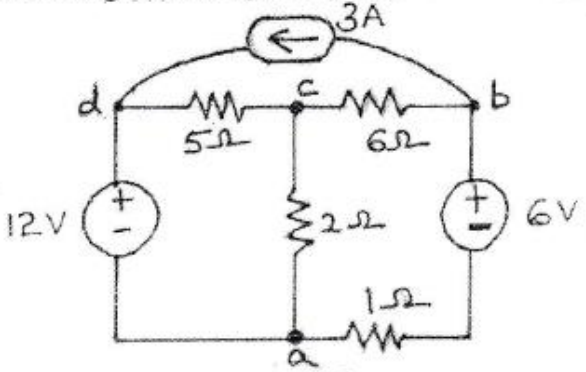

Figure: 3

b) Mention the difference between nodal analysis and mesh analysis. [7+3]

4.a) A series R-L circuit, has resistance of 20Ω and inductance of 0.02H. If the net impedance of the given circuit is $40\angle\Phi^0\Omega$, find Φ and the frequency of the circuit.

b) Define RMS value, Average value and Form factor. [4+6]

OR

5. A voltage $v(t) = 200\sin\omega t$ is applied to a series RLC circuit where R=60Ω, L=0.18mH and C=20μF. Find:

a) The power supplied by the source

b) The reactive power supplied by the source

c) The reactive power of the capacitor

d) The reactive power of the inductor and

e) The power factor of the circuit. [10]

6. Derive the equation for quality factor of series resonating circuit and parallel resonating circuit. [10]

OR

7.a) Define quality factor and Bandwidth.

b) In the coupled circuit given in figure 4, find the input impedance as well as the net inductance when L_1=0.2H, L_2=0.5H coefficient of coupling (K) being 0.5. [5+5]

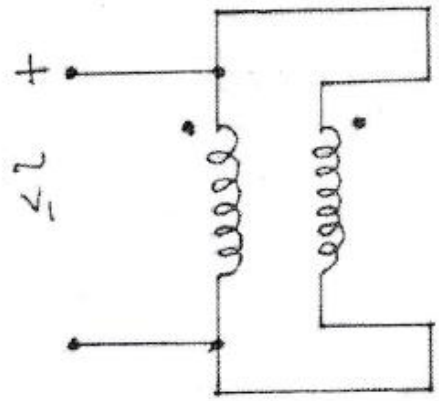

Figure: 4

8.a) Explain the concept of duality.

b) Define a fundamental Tie set and Cut set matrix. Give the procedure for obtaining the same with suitable examples. [3+7]

OR

9.a) The figure 5 represents a graph of a network. Show the tree, twigs and links.

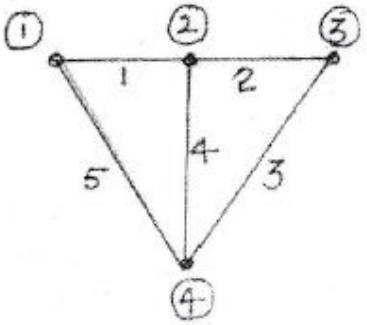

Figure: 5

b) Convert the given current source to voltage source shown in figure 6. [5+5]

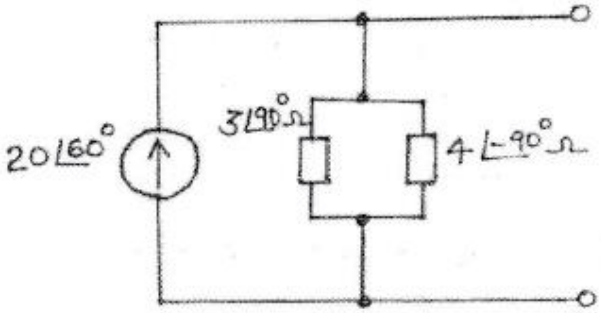

Figure: 6

10.a) State and explain Thevenin's and Norton's theorems.

b) Using Milliman's theorem find the current through R_L and voltage drop in the circuit given in figure 7. [5+5]

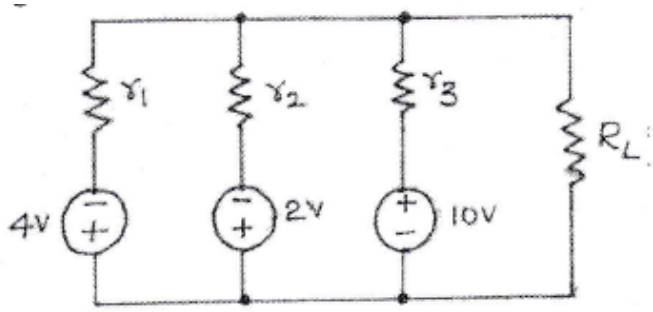

Figure: 7

OR

11.a) State and explain Maximum power transfer theorem and compensation theorem.

b) Find the Norton's equivalent circuit across a-b for the network shown in figure 8. [5+5]

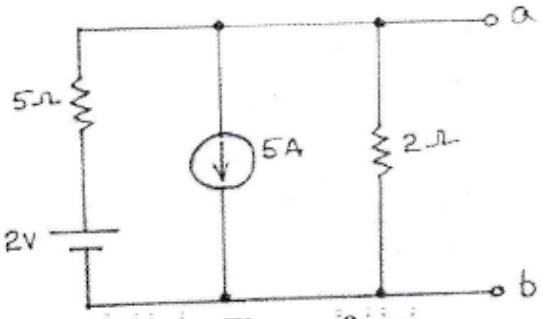

Figure: 8

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Code No: 123BW

R15

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, November/December - 2016

ELECTRICAL CIRCUITS

(Common to EEE, ECE, ETM)

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)	Define capacitance. What is V-I relation of capacitance?	[2]
b)	What are the properties of super mesh?	[3]
c)	Define RMS value.	[2]
d)	What is the significance of power factor?	[3]
e)	What is resonance?	[2]
f)	What are the circuit variables of a magnetic circuit?	[3]
g)	Define graph.	[2]
h)	Draw a connected graph and explain.	[3]
i)	Define Norton's current.	[2]
j)	What are the limitations of superposition theorem?	[3]

PART-B

(50 Marks)

.a) Give the detailed classification of independent sources.

b) Using Mesh analysis, find the voltage across 5Ω resistor in the circuit below shown in figure 1. [5+5]

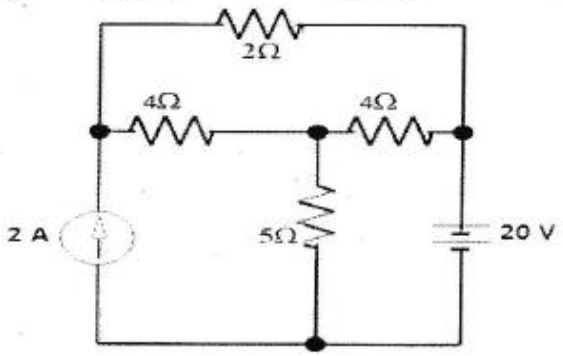


Figure: 1

OR

3.a) With an example explain about Kirchoff's laws.

b) Using Nodal analysis, find the voltage 'V' in the circuit below shown in figure 2. [5+5]

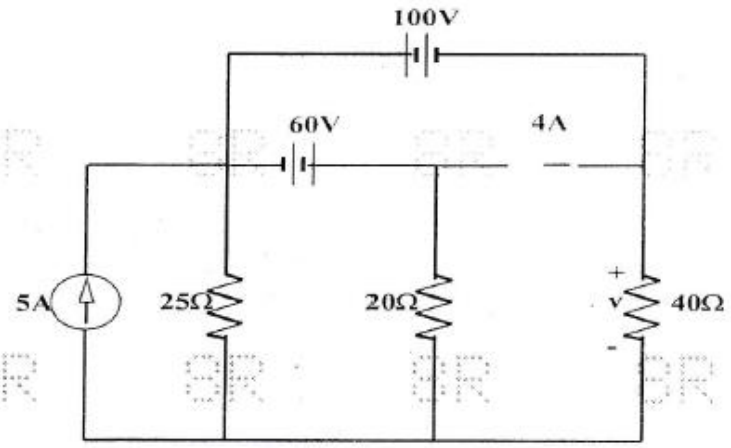


Figure: 2

4.a) Derive the expression for the average value and form factor of a sinusoidal waveform.

b) In the circuit shown below in figure 3, if the power consumed by the 5Ω resistor is 20 W, Find the power factor and reactive power of the circuit w = 100 rad/sec. [5+5]

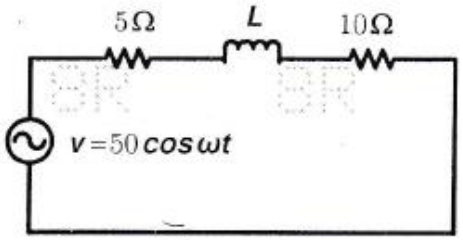


Figure: 3

OR

OR

5.a) Derive the relationships for real and reactive powers in a series RL circuit with sinusoidal excitation.

b) Find the RMS voltage of the signal below in figure 4. [5+5]

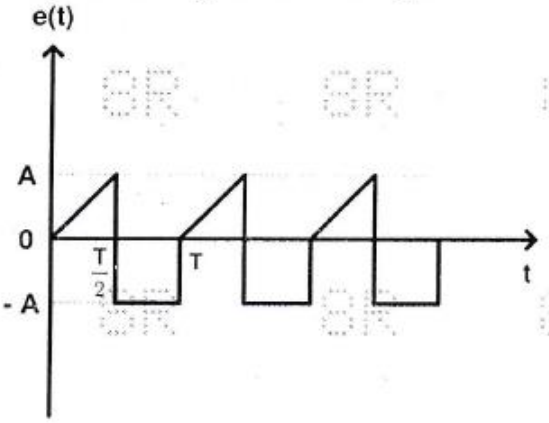


Figure: 4

6.a) Draw the impedance locus diagram of a parallel RC circuit and explain.

b) For the magnetic current shown in figure 5, find the current 'I' in the coil needed to produce a flux of 5.5 mWb in the air gap. The magnetic circuit has a uniform cross sectional area of 5 cm^2. Assume the relative permeability of the magnetic material as 3523, neglect leakage and fringing effect. [5+5]

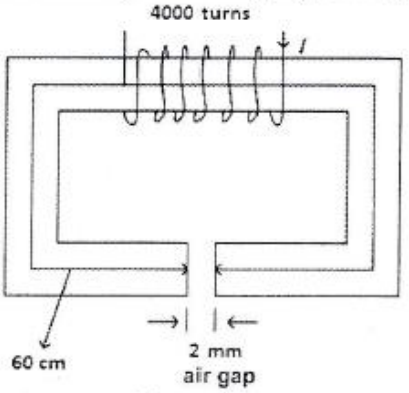


Figure: 5

OR

7.a) Explain in detail about Faraday's law of electromagnetic induction.

b) In a series circuit of L=10mH and C=0.01μF and R=50Ω. Calculate the resonant frequency and also the impedance at the resonant frequency. [5+5]

8.a) What is loop method? Explain the analysis of networks with this method in detail.

b) For the graph shown in figure 6, determine the number of branches, sub graphs, trees and draw them. [5+5]

1

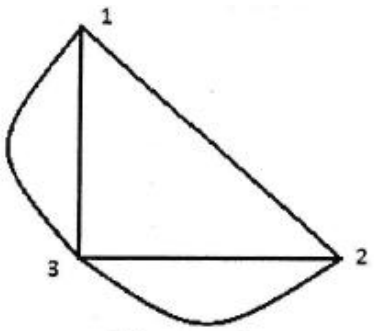


Figure: 6

OR

9.a) Define Duality. Explain with the help of an example.

b) With the help of an example, explain the procedure of formulating the Basic tie set matrix. [5+5]

12. List of topics for student seminar

1. Magnetic levitation
2. Transformer Basics and Types
3. Electric Traction Systems
4. Increasing Electrical Damping in Energy Harnessing Transducers
5. Magnetic amplifiers
6. High voltage testing of transformer
7. Automatic Star 2 using Relays and Adjustable Electronic Timer for Induction Motor
8. Production of electricity by the method of road power generation
9. Wireless Power Transfer

Subject: Digital Logic Design

(1) - Preamble/Introduction

(2) - Prerequisites

(3) - Objectives and Outcomes

(4) - Syllabus

1. JNTU/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.geeksforgeeks.org, www.schools.com, Coursera ,edX, Udemy, Khan Academy*, NPTEL etc along Registration procedures*)*

(10) - Question Banks

1.JNTUH/Model papers

2. GATE

(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) *OBJECTIVES AND RELEVANCE*

- To understand common forms of number representation in logic circuits
- To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
- To understand the concepts of combinational logic circuits and sequential circuits.
- To understand the Realization of Logic Gates Using Diodes & Transistors.

(2) ***SCOPE***

The scope of this subject is to provide an insight into designing the DTl, TTL ECL circuits which are useful in digital devices. This concept is more useful in further applications of minimizing the complexity of logic circuits.

(3) **Course Outcomes:** Upon completing this course, the student will be able to

- Understand the numerical information in different forms and Boolean Algebra theorems – co4
- Evaluate the Postulates of Boolean algebra and to minimize combinational functions – co2
- Design and analyze combinational and sequential circuits – co1
- Analyze the Finite state machines – co2
- IIustrate the logic families and realization of logic gates – co1

(4) ***PREREQUISITES:***

This subject recommends continuous practice of various simple arithmetic operations like addition, subtraction. It needs requisite knowledge about assuming and designing the logic circuits. How to reduce the size and complexity of the digital circuits.

UNIT-I

SYLLABUS

(4.1) *SYLLABUS - JNTU*

OBJECTIVE

- To know the different types of numbering system
- Complement representations like the decimal complements
- To detect the errors and to correct the errors in digital circuits that are find with the coding
- The fundamental concepts of Boolean algebra
- Basic theorems to reduce the complexity and size of the digital circuits
- Introduces the universal gates

Number Systems: Number systems, Complements of Numbers, Codes- Weighted and Non-weighted codes and its Properties, Parity check code and Hamming code.

Boolean Algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, Universal Gates, Multilevel NAND/NOR realizations.

UNIT – II

OBJECTIVE

- Map method
- Minimization of SOP and POS forms
- Tabular method and simplifications
- **Gates using diodes and transistors**
- Logic Families and its Comparison
- Gate- Analysis & characteristics

SYLLABUS

Minimization of Boolean functions: Karnaugh Map Method - Up to five Variables, Don't Care Map Entries, Tabular Method,

Realization of Logic Gates Using Diodes & Transistors: AND, OR and NOT Gates using Diodes and Transistors, DCTL, RTL, DTL, TTL, CML and CMOS Logic Families and its Comparison, Classification of Integrated circuits, comparison of various logic families, standard TTL NAND Gate- Analysis &

characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tri- state outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL.

UNIT – III

OBJECTIVE

- Designing of various combinational circuits
- This will be useful for doing arithmetic operations
- Designing of Encoder, Decoder, Multiplexer, Demultiplexer

SYLLABUS

Combinational Logic Circuits: Adders, Subtractors, Comparators, Multiplexers, Demultiplexers, Encoders, Decoders and Code converters, Hazards and Hazard Free Relations.

Sequential Circuits Fundamentals: Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Timing and Triggering Consideration, Conversion from one type of Flip-Flop to another.

UNIT – IV

OBJECTIVE

- To know the algorithmic representation like designing the State machines, which is the another way to reduce the complexity and size of digital circuits
- This introduces the concept of Mealy Moore Machines

SYLLABUS

Registers and Counters: Shift Registers – Left, Right and Bidirectional Shift Registers, Applications of Shift Registers - Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters.

Sequential Machines: Finite State Machines, Synthesis of Synchronous Sequential Circuits- Serial Binary Adder, Sequence Detector, Parity-bit Generator, Synchronous Modulo N –Counters. Finite state machine-capabilities and limitations, Mealy and Moore models.

UNIT – V

OBJECTIVE

- Salient features of ASM charts

SYLLABUS

Finite state machine: capabilities and limitations, Mealy and Moore models, State equivalence and machine minimization, simplification of incompletely specified machines, Merger graphs. Asynchronous design-modes of operation, Hazards, synthesis of SIC fundamental mode circuits, synthesis of burst mode circuits. Introduction to ASM Charts

(4.2) *SYLLABUS - GATE*

Number Representations

- Binary Number system
- Integer & floating-point- numbers

Combinatorial circuits

- Boolean algebra
- Minimization of boolean functions using Boolean identities & Karnaugh map
- Logic gates & their static CMOS implementations
- Arithmetic circuits
- Code converters
- Multiplexers & decoders.

Sequential Circuits

- Latches & flip-flops
- Counters & shift-registers
- Finite state machines
- Propagation delay & critical path delay
- Setup and hold time

(4.3) *SYLLABUS – IES*

Boolean Algebra& uses; Logic gates, Digital IC families, Combinatorial/sequential circuits; Basics of multiplexers, counters/registers/ memories /microprocessors, design& applications.

(7) SUBJECT (LESSON) PLAN

Topic Name	No. of classes	Text books
UNIT I: NUMBER SYSTEM AND BOOLEAN ALGEBRA		
Number Systems,	01	T1, T2
Base Conversion Methods, Complements of Numbers,	01	T1, T2
Codes- Binary Codes, Binary Coded Decimal Code and its Properties, Unit Distance Codes,	01	T1, T2
Alpha Numeric Codes, Error Detecting and Correcting Codes.	02	T1, T2
Basic Theorems and Properties	01	T1, T2
Switching Functions	01	T1
Canonical and Standard forms, Algebraic simplification of Digital Logic Gates	01	T1, T2
Properties of XOR Gates	01	T1, T2
Universal gates, Multilevel NAND/NOR realizations	01	T1, T2
PREVIOUS UNIVERSITY PROBLEMS	**01**	
Total No. of Classes	**11**	
TEST-I	**01**	
UNIT II: MINIMIZATION OF BOOLEAN ALGEBRA AND DESIGN OF COMBINATIONAL CIRCUITS		
Introduction, The Minimization with theorem,	01	T1, T2
The Karnaugh Map Method, Five and Six Variable Maps,	01	T1, T2
Prime and Essential Implications, Don't Care Map Entries,	01	T1, T2
Using the Maps for Simplifying, Tabular Method	01	T1, T2
Partially Specified Expressions, Multi-output Minimization	01	T1, T2
Gates using diodes and transistors	01	T2, R4
Logic families and its comparison	02	T2, R4
Classification of Integrated circuits	01	T2, R4
standard TTL NAND Gate- Analysis & characteristics	02	T2, R4
CMOS transmission gate, IC interfacing	02	T2, R4
TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tri- state outputs	02	T2, R4
PREVIOUS UNIVERSITY PROBLEMS	**01**	
Total No. of Classes	**16**	
TEST-II	**01**	
UNIT-III :COMPBINATIONAL CIRCUITS AND SEQUENTIAL MACHINES		

FUNDAMENTALS		
Combinational Design, Arithmetic Circuits	02	T2, R4
Comparator, Multiplexers	01	T1, T2
Code Converters	01	T1,R4
Wired Logic, Tristate Bus System	01	T1,R4
Practical Aspects related to Combinational Logic Design	01	T1,R4
Hazards and Hazard Free Relations.	01	T1,R4
Introduction: Basic Architectural Distinctions between Combinational and Sequential circuits,		
Latches, Flip Flops: SR, JK, Race Around Condition in JK, JK Master Slave, D and T Type Flip Flops,	02	T2, R4
Introduction: Basic Architectural Distinctions between Combinational and Sequential circuits,		
Latches, Flip Flops: SR, JK, Race Around Condition in JK, JK Master Slave, D and T Type Flip Flops,	02	T2, R4
PREVIOUS UNIVERSITY PROBLEMS	**01**	
Total No. of Classes	**13**	
TEST-III	**01**	
UNIT IV: REGISTERS AND SEQUENTIAL MACHINES		
Shift Registers, Data Transmission in Shift Registers	01	T2, R4
Operation of Shift Registers, Shift Register Configuration	01	T2, R4
Bidirectional Shift Registers, Applications of Shift Registers	01	T2, R4
, Design and Operation of Ring and Twisted Ring Counter	01	T2, R4
Operation Of Asynchronous And Synchronous Counters	01	T2, R4
Introduction, State Diagram, Analysis of Synchronous Sequential Circuits	01	T2, R4
Approaches to the Design of Synchronous Sequential Finite State Machines	02	T2, R4
Synthesis of Synchronous Sequential Circuits, Serial Binary Adder	02	T2, R4
Sequence Detector, Parity-bit Generator.	01	T2, R4
Design of Synchronous Modulo N – Counters.	01	T2, R4
PREVIOUS UNIVERSITY PROBLEMS	**01**	
Total No. of Classes	**13**	
TEST-IV	**01**	
UNIT V: FINITE STATE MACHINE		
Mealy and Moore models-minimization of completely specified and incompletely specified sequential machines	02	T2, R4
State equivalence and machine minimization	02	T2, R4
simplification of incompletely specified machines,	02	T2, R4
Merger graphs. Asynchronous design-modes of operation	02	T2, R4
Hazards, synthesis of SIC fundamental mode circuits	01	T2, R4
synthesis of burst mode circuits	01	T2, R4
Introduction to ASM Charts	01	T2, R4
PREVIOUS UNIVERSITY PROBLEMS	**01**	
Total No. of Classes	**12**	

TEST-V	01
ASSIGNMENT-II	
TOTAL CLASSES REQUIRED	65

(8) *SUGGESTED BOOKS*

TEXT BOOKS:

1. Switching & Finite Automata theory – Zvi Kohavi, TMH,2nd Edition.
2. Digital Design – Morris Mano, PHI, 3rd Edition, 2006.
3. Modern Digital Electronics – R. P. Jain, 3rd Edition, 2007- Tata McGraw-Hill

REFERENCES:

1. An Engineering Approach To Digital Design – Fletcher, PHI. Digital Logic – Application and Design – John M. Yarbrough, Thomson.

2. Fundamentals of Logic Design – Charles H. Roth, Thomson Publications, 5th Edition, 2004.

3. Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2006.

4. Switching Theory and Logic Design – A Anand Kumar, PHI, 2013

(8) *WEBSITES*

1. www.ieee.org
2. www.2dix.com
3. www.xillinx.com
4. www.cdac.com
5. www.vlsi.edu

6. www.vlsi.iitkgp.ernet.in
7. www.educypedia.be/electronic/digital.com
8. www.iitb.ac.in
9. www.iitm.ac.in
10. www.iitr.ac.in
11. www.iitg.ernet.in
12. www.bits-pilani.ac.in
13. www.metorgraphics.com
14. www.vlsi-reasearch.com
15. www.iisc.ernet.in
16. www.samsung.com
17. www.vedaiit.com

(8) *EXPERT DETAILSSUGGESTED BOOKS*

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. **Prof. K Subbarangaiah** is Director of VEDA IIT, Hyderabad

NATIONAL

1. Dr.K. LAL KISHORE, Ph.D., MIEEE, FIETE, MISTE, MISHM, JNTU, Hyderabad
2. Mr .Sundaram, AGM, CAD R&D, ECIL, Hyderabad..
3. Mr. Rajendra naik, Asst Prof, Dept of ECE, Osmania University, Hyderabad.

REGIONAL

1. Dr. N.S.Murthy, Professor and Head Dept. of ECE, REC,Warangal - 506004 (India) email: nsm@recw.ernet.in
2. ***S.G Vinayaka Prasad, Sr. App. Engineer, Silicon Micro Systems***
3. DR. M. Madhavi Latha, JNTU, Hyderabad
4. Dr. Sarat Chandra Babu, Centre Head C-DAC, Hyderabad email: Sarat_chandra@hotmail.com

(9) JOURNALS

INTERNATIONAL

1. IEEE transactions on DIGITAL DESIGNS
2. IEEE proceedings circuits, devices and systems
3. International journal of circuit designs and applications
4. IEEE transactions on IC design
5. VSI vision

NATIONAL

1. DIGITAL DESGIN MAGAZINE
2. JOURNAL FOR DIGITAL SYSTEMS
3. IBM system magazine

(10) QUESTION BANK- JNTU

DLD IMP QUESTION & MODEL QP.rar

(11) TWO CASE STUDY PRESENTATIONS WITH PROJECT/PRODUCT/MODEL /PROTOTYPES/ INDUSTRIAL APPLICATIONS.

DLD CASE STUDY.rar

(12) ASSIGNMENT QUESTION/INNOVATIVE ASSIGNMENTS SETS.

MID-I ASSIGNMENT QUESTION SAMPLE

SET-I

1.a)Convert the given Gray code number to equivalent binary 001001011110010. (BTL3)(CO1)

b) Convert $(A0F9B.0DC)_{16}$ to decimal, binary, octal. (BTL5)(CO1)

2.a) Encode the message bits (1110) into 7-bit even parity hamming code. (BTL3)(CO1)

b) Perform the following arithmetic using 2's complement method. (BTL1)(CO1)

i) 101111-100110 ii) 111001-011010

3.a) Simplify the following Boolean expressions using the Boolean theorems(BTL5)(CO2)

(i) (A+B+C) (B□+C) + (A+D) (A□+C) (ii) (A+B) (A+B□) (A□+B).

b) Why a NAND and NOR gates are known as universal gates? Simulate all the basic Gates. (BTL1)(CO2)

4.a) Minimize the following expressions using K-map and realize using NAND Gates.(BTL 5)(CO2)

f = ∑m (1, 3, 5, 8, 9, 11, 15) +d (2, 13).

b) Simplify the following boolean function using Tabular method. (BTL5)(CO2)

F(A,B,C,D)=∑m(0,1,2,5,7,8,9,10,13,15).

5.Design and implement a multiplexer having 3 data select inputs to implement the logic for the function given below and also realize the same using 16:1 MUX. (BTL6)(CO3)

f = ∑m (0,1,2,3,4,10,11,14,15)

SET-II

1.a) Obtain dual of the following Boolean expressions. (BTL3)(CO1)

i).AB+A(B+C)+B□(B+D)

ii).A+B+A□B□C.

b)Obtain the compliment of the following Boolean expressions. (BTL 3)(CO1)

i) A□B+A□BC□+A□BCD+A□BC□D□E

ii) ABEF+ABE□F□+A□B□EF.

2. a)Minimize the following expression using K-map and realize using NAND Gates.(BTL5)(CO2)

F (A,B,C,D) = ∑m (0,1,2,9,11) +d(8,10,14,15).

b) Minimize the following expression using K-map and realize using NOR Gates. (BTL5)(CO2)

f = □ M(0,4,6,7,8,12,13,14,15).

3. a) Explain the differences between a MUX and a DEMUX. Realize 16-input multiplexer by cascading of two 8-input multiplexers. (BTL2)(CO3)

b) Realize the function f(A,B,C,D)=□(1,4,6,10,14)+d(0,8,11,15) using (BTL4)(CO3)

i) 16:1 MUX
ii) 8:1 MUX.

4. The message below has been coded in the 7 bit Hamming code and transmitted through noisy channel. Decode the message assuming that at most a single error has occurred in each code word 1001001, 0111001, 1110110, and 0011011. (BTL3)(CO1)

5. Design a full adder and realize using NAND and NOR logic gates. (BTL3)(CO3).

SET-III

1.a) Solve for X (BTL 3)(CO1)
i) (F3A7C2)16 = (X)10

ii) (2AC5)16 = (10949)X

iii) (0.93)10 = (X)8

iv) (4057.06)8 = (X)10

b) Encode the message bits (1011101) into 11-bit odd parity hamming code. (BTL6)(CO1)

2.a) Prove that AB′C+B+BD′+ABD′+A′C=B+C. (BTL1)(CO1)

b) Expand minterms and maxterm AB′+ABD′+A+ABC′D. (BTL1)(CO1)

3.a) Design and realize the 2-bit comparator. (BTL4)(CO3)
b) Minimize the following expression in POS form using K-map .(BTL3)(CO1)

F = ∑m (0,1,4,5,6,13,14,15,22,24,25,28,29,30,31).

4. Realize the expression F=Σm(0,1,3,5,8,11,12,14,15)using 8×1 MUX. (BTL4)(CO3)

5. Simplify the following boolean function using Tabular method. (BTL 5)(CO2)

F(A,B,C,D)=∑m(0,1,2,5,7,8,9,10,13,15)

MID-II ASSIGNMENT QUESTION SAMPLE

SET-I

1. Design and explain synchronous up/down counter using JK flip flop.(CO3)
2. Convert **(CO3)**
   a) SR to D flip flop
   b) SR to JK flip flop
3. With neat circuit diagram explain about JK master slave flip flop. **(CO3)**
4. Design and explain MOD 6 counter using MOD-8 counter. **(CO4)**
5. With the help of neat circuit diagram explain the operation of a TTL totem pole NAND gate **(CO5)**

SET-II

1. Design and explain MOD 6 counter using MOD-8 counter. **(CO3)**

2. Convert **(CO3)**
   a) SR to D flip flop

   b) SR to JK flip flop

3. Design a synchronous sequential circuit of even parity generator. **(CO4)**
4. With the help of neat circuit diagram explain the operation of a TTL totem pole NAND gate **(CO5)**
5. a) Write the comparison of logic families. **(CO5)**
   b) Explain in detail about ROM,PAL and PLA. **(CO4)**

SET-III

1. Design and explain MOD 6 counter using MOD-8 counter. **(CO3)**
2. With neat circuit diagram explain about JK master slave flip flop. **(CO3)**
3. a) Write the comparison of logic families. **(CO5)**
   b) Explain in detail about ROM,PAL and PLA. **(CO4)**
4. Design a finite state machine which can detect sequence 1010 using D flip flop. **(CO4)**
5. With the help of neat circuit diagram explain the operation of a TTL totem pole NAND gate **(CO5)**

(13) SEMINAR TOPICS:

1. BCD to gray code converter

2. Digital Oscilloscopes

3. Logic gates emulator

4. The bio chips

5. Air Brake System

(14) STEP/COURSE MATERIAL IN SOFTCOPY

DLD STEP MATERIAL.rar

(15) EXPERT LECTURES WITH TOPICS & SCHEDULES (IF ANY)

Subject: Probability Theory and Stochastic Processes

S.NO		CONTENT
(1)	-	Objectives and Relevance
(2)	-	Scope
(3)	-	Prerequisites
(4)	-	Syllabus
	1.	JNTU
	2.	GATE
	3.	IES
(5)	-	Suggested Books
(6)	-	Websites and Useful URLs
(7)	-	Expert Details
(8)	-	Journals
(9)	-	Subject (lesson) Plan
(10)	-	Question Bank

1. JNTU

2. GATE

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

(12) Assignment Questions & Innovative assignment Questions

(13) - Tutorial Question sets on each unit

(14) - List of topics for student's seminars

(15) - Multiple choice questions

(1) OBJECTIVES AND RELEVANCE

This course introduces the basic principles of random signals and to provide tools where one can deal with systems involving such signal which is the foundation for all subjects of the communication engineering discipline. The emphasis of this course is laid on the basic analysis of random variables, operations on random variables, random processes, spectral characteristics and random noise.

(2) SCOPE

The scope of this subject is to provide an insight into the basics of random signals, random noise, random processes in communications theory and modeling of various noise sources. Also, it provides clear and concise exposure to the principles and applications of probability concepts to solve complex problems in the design of communication networks.

(3) PREREQUISITES

This subject recommends continuous study of various signals. It needs requisite knowledge about mathematical fundamentals, set theory and applications of mathematics like Integrations and differentiation.

(4.1) SYLLABUS - JNTU

UNIT-I

Objective

- Discussing Basics of set theory
- Classification of sample spaces with general examples
- Different Probability definitions
- Joint probability
- Conditional probability
- Bayes theorem
- Defining a Random Variable and types
- Defining Functions with random variables with properties
- Distribution and Density functions.

SYLLABUS

Probability & Random Variable: Probability introduced through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Bay's Theorem, Independent Events, Random Variable- Definition, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Methods of defining Conditioning Event,

Conditional Distribution, Conditional Density and their Properties.

UNIT - II

OBJECTIVE

- Operations On Single & Multiple Random Variables
- Applications Of Expectation
- Moments Calculation
- Chebychev's Inequality,
- Functions used to generate Moments –Characteristic function, Moment Generating Function
- Transformations of Random Variable.
- Conditional density and distribution functions and properties.
- Central Limit Theorem
- Joint Central Moments
- Transformations of Multiple Random Variables

SYLLABUS

Operations On Single & Multiple Random Variables – Expectations: Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic and Non-monotonic Transformations of Continuous Random Variable, Transformation of a Discrete Random Variable.

Vector Random Variables, Joint Distribution Function and its Properties, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence. Sum of Two Random Variables, Sum of Several Random Variables.

Central Limit Theorem, (Proof not expected). Unequal Distribution, Equal Distributions. Expected Value of a Function of Random Variables: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT -III

OBJECTIVE

- The Random Process Concept
- Deterministic and Nondeterministic Processes
- Time Averages and Ergodicity
- Autocorrelation Function and Its Properties

- Covariance Functions
- Gaussian Random Processes
- Cross-Correlation Function and Its Properties
- Random Signal Response of Linear Systems

SYLLABUS

Random Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second Order and Wide-Sense Stationarity, (N-Order) and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.

UNIT - IV

OBJECTIVES

- Random Processes – Spectral Characteristics.
- The Power Spectrum: Properties
- Relationship between Power Spectrum and Autocorrelation Function
- Spectral Characteristics of System Response
- Power Density Spectrum of Response

SYLLABUS

Random Processes – Spectral Characteristics: The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output.

UNIT - V

OBJECTIVE

- Noise Sources & Information Theory
- Power Spectrum and its Properties
- Average Noise Figures
- Quadrature representation of narrow band noise & its properties
- Entropy
- Source coding Huffman coding, Shannon Fano coding
- Shannon-Hartley law

SYLLABUS

Noise Sources & Information Theory: Resistive/Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Noise equivalent bandwidth, Average Noise Figures, Average Noise Figure of cascaded networks, Narrow Band noise, Quadrature representation of narrow band noise & its properties. Entropy, Information rate, Source coding: Huffman coding, Shannon Fano coding, Mutual information, Channel capacity of discrete channel, Shannon-Hartley law; Trade -off between bandwidth and SNR.

(4.2) SYLLABUS - GATE

UNIT I

- Probability, Joint Probability, Conditional Probability
- Total Probability, Bay's Theorem

UNIT II

- Random variables, Discrete and continuous distributions
- Poisson, Normal and Binomial distribution
- probability density function, Mean and standard deviation.

UNIT III

- Random process temporal and spectral characteristics.

UNIT IV

- Correlation and regression, Power spectral density.

UNIT V

- Noise Sources & Information Theory.

(4.3) SYLLABUS - IES

UNIT I

- Probability, Joint Probability, Conditional Probability

UNIT II

- Random signals and noise.

UNIT III

- Response of linear system to random inputs. Random process temporal.

UNIT IV

- Random process spectral characteristics Correlation functions, Spectral density

UNIT V

- Noise Sources & Information Theory and source coding.

(5) SUGGESTED BOOKS

TEXT BOOKS

T1. Probability, Random Variables & Random Signal Principles – Peyton Z. Peebles, 4ed., 2001. TMH.
T2. Probability, Random Variables and Stochastic Processes – Anthanasios Papoulis and S. Unnikrishna Pillai, 4ed., TMH.

REFERENCE BOOKS

R1. Theory of Probability and Stochastic Processes – Pradip Kumar Gosh, University Press.
R2. Probability Methods of Signal and System Analysis – George R. cooper, Clave D. Mc.Gillem, 3ed. 1999, Oxford.

R3. Probability and random processes for engineers and scientists-A. B Clarke, Ralph L. Disney
R4. Principles of Communication systems-H.Taub,Donald.L.Schilling, Goutam Saha, 3 ed., 2007,TMH

R5. Probability Theory and Stochastic Processes-Mallikarjuna Reddy CengageLearning

R6. Probability and Random Processes with Application to Signal Processing-

Henry Stark and John W. Woods, 3 ed., PE

Course outcomes

Course	Course Outcomes (COs)
At the end of the course student will be able to	
CO 1	**Define** events & different concets of probability.
CO 2	**Explain** single & multiple Random Variables and operations performed on them
CO 3	**Define** the concepts of Random Process and its Characteristics.
CO 4	**Evaluate** the response of linear time Invariant system for a Random Processes.
CO 5	**Evaluate** Spectral characteristics of Random Signals.
CO 6	**Discuss** the concepts of Noise, Source coding in Communication system

Course Outcome (CO)-Program Outcome (PO) Matrix:

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3	3	2	3		1	-	-	-	-	-
CO 2	3	2	-	2	-	-	-	-	-	-	-
CO 3	3	3	-	3	-	-	-	-	-	-	-
CO 4	3	2	-	2	-	-	-	-	-	-	-
CO 5	3	2	-	2	-	1	-	-	-	-	-
CO 6	2	2	2	2	-	1	-	-	-	-	-

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

Course Outcomes (COs)	PSO1	PSO2
CO 1	2	-
CO 2	2	-
CO 3	2	-
CO 4	2	-
CO 5	2	-
CO 6	2	-

(6) Websites and Useful Links

1. www.mit.edu
2. www.soe.stanford.edu
3. www.grad.gatech.edu

4. www.gsas.harward.edu
5. www.iitk.ac.in
6. www.iitd.ernet.in
7. www.iitb.ac.in
8. www.iitm.ac.in
9. www.iitr.ac.in
10. www.iitg.ernet.in

Useful URLs

1. http://www.nptel.iitm.ac.in/video.php?subjectId=117105085
2. http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP000391.html
3. http://www.handbook.unsw.edu.au/undergraduate/courses/2013/MATH3901.html

4. http://www.gobookee.net/probability-and-stochastic-processes-yates-solution-manual/
5. http://freepdfdb.com/pdf/probability-theory-and-stochastic-processes-peebles
6. http://www.uq.edu.au/study/course.html?course_code=STAT4403
7. http://www.maths.unsw.edu.au/courses/math5846-introduction-probability-and-stochastic-processes
8. http://en.wikipedia.org/wiki/Stochastic_process
9. http://www.math.niu.edu/~rusin/known-math/index/60-XX.html
10. https://studyat.anu.edu.au/courses/ENGN8538;details.html

(7) EXPERT DETAILS

INTERNATIONAL

1. Peyton z. Peebles, jr., is Professor Emeritus of Electrical and Computer Engineering at the University of Florida.
2. Anthanasios Papoulis was a member of the faculty of the Polytechnic Institute of New York University

NATIONAL

1. Mrs.Chitralekha Mahanta, Ph. D.Professor,EEE Department, IIT Guwahati, Guwahati
   Phone: +91 361 2582507 (O), Fax : +91-361-2582542
   email: chitra@iitg.ernet.in
2. Mr.Gupta, Sanjeev, Ph.D.(Communication Engineering),Dhirubhai Ambani Institute of Information and Communication,Gandhinagar,Gujrat.
   email:sanjeev_gupta@daiict.ac.in
   Office : (+91) 079-3051-0594
3. Bansal R.K,Ph.D,ECE dept,IIT kanpur
   phone: +91-512-2597075, Fax: +91-512-2590063
   Email: rkb@iitk.ac.in

REGIONAL

1. Dr.S. ANURADHA, Assistant Professor, ECE Department, NIT, Warangal
   E-Mail: anu_praise2004@yahoo.co.in
   Phone No. :08702462446

2. SRI.SRIDHAR KV, Assoc Professor, ECE Department, NIT, Warangal
   E-Mail: sridhar@nitw.ac.in

(8) JOURNALS

INTERNATIONAL

1. IEEE transactions on Automatic Control
2. Stochastic: An International Journal of Probability and stochastic Processes, Taylor & Francis Group
3. International Journal of Stochastic Analysis
4. Centre for Modeling of Stochastic Systems, Monash University(Russia)
5. IEEE transactions on Signal Processing

NATIONAL

1. Electronic Journal of Probability
2. Stochastic Processes and their Applications
3. Indian Society for Probability and Statistics

9) SUBJECT (LESSON) PLAN

TEACHING SCHEDULE 2022-2023

Subject code	Name of the subject	Year/Branch	Name of the Faculty
EC305ES	Probability Theory and Stochastic Processes	II B.Tech I Sem ECE	Dr. S Rama Kishore Reddy

S.No	Topic (JNTU syllabus)	Sub-Topic	No. of Lecturers Required	Text Books
	Probability & Random Variables.	**UNIT-I**		
1		Introduction to probability, Set theory	01	T1,R5
2		Experiments and Sample Spaces, Discrete andContinuous Sample Spaces, Events	01	T1,R5
3		Probability Definitions and Axioms, Mathematical	02	T1,R5

		Model of Experiments, Probability as a Relative Frequency		
4		Joint Probability, Conditional Probability	01	T1, R5
5		Total Probability, Bayes' Theorem, Independent Events	02	T1,R5
6		Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable	02	T1,R5
7		Distribution and Density functions, Properties	01	T1,R5
8		Gaussian and Rayleigh distributions	01	T1,R5
9		Distribution and Density functions, Properties	01	T1,R5
10		Conditional Density and their Properties.	01	T1,R5
11		Problems	02	T1,R5
		No. Of classes taken to complete unit-1: 15		
	Operations On Single & Multiple Random Variables	**UNIT II**		
12		Operations On Single & Multiple Random Variables	02	T1,T2,R5
13		Binomial, Poisson, Uniform and Exponential distribution	01	T1,T2,R5
14		Gaussian and Rayleigh distributions	01	T1,T2,R5
15		Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties	02	T1,T2,R5
16		Expected Value of a Random Variable, Function of a Random Variable	02	T1,T2,R5
17		Moments about the Origin, Central Moments, Variance and Skew	02	T1,T2,R5
18		Chebychev's Inequality	01	T1,T2,R5
19		Characteristic Function, Moment Generating Function	01	T1,T2,R5
20		Monotonic Transformations for a Continuous Random Variable Non monotonic Transformations of Continuous Random Variable	02	T1,T2,R5
21		Transformation of a Discrete Random Variable	01	T1,T2,R5
22		Central Limit Theorem	01	T1,T2,R5

23		Expected Value of a Function of Random Variables	01	T1,T2,R5
25		Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.	02	T1,T2,R5
		No. Of classes taken to complete unit- II: 19		
	Random Processes – Temporal Characteristics	**UNIT III**		
25		Random Processes – Temporal Characteristics	01	T1,T2,R5
26		The Random Process Concept, Classification of Processes, Deterministic and Non deterministic Processes	02	T1,T2, R5
27		Distribution and Density Functions	01	T1,T2,R5
28		Concept of Stationarity and Statistical Independence	01	T1,T2,R5
29		Time Averages and Ergodicity	01	T1,T2,R5
30		Mean-Ergodic Processes, Correlation-Ergodic Processes	01	T1,T2,R5
31		Autocorrelation Function and Its Properties	01	T1,T2,R5
32		crosscorrelation Function and Its Properties	01	T1,T2,R5
33		Covariance Functions	01	T1,T2,R5
34		Gaussian Random Processes, Poisson Random Process	01	T1,T2,R5
35		Random Signal Response of Linear Systems	01	T1,T2,R5
36		Autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.	01	T1,T2,R5
		No. Of classes taken to complete unit-3 : 14		
	Random Processes – Spectral Characteristics	**UNIT IV**		
37		Random Processes – Spectral Characteristics	01	T1,T2,R5
38		The Power Spectrum: Properties, Relationship between Power Spectrum and AutocorrelationFunction	02	T1,T2,R5
39		The Cross-Power Density Spectrum, Properties	01	T1,T2,R5
40		Relationship between Cross-Power Spectrum and Cross-Correlation Function	01	T1,T2,R5

41		Spectral Characteristics of System Response	01	T1,T2,R5
42		Power Density Spectrum of Response	01	T1,T2,R5
43		Cross-Power Density Spectrums of Input and output.	01	T1,T2,R5
		No. Of classes taken to complete unit-IV :08		
	Noise Sources & Information Theory	**UNIT V**		
44		Noise Sources & Information Theory	01	T1, R4,R5
45		Resistive/Thermal Noise Source, Arbitrary Noise Sources	01	T1, R4,R5
46		Effective Noise Temperature, Noise equivalent bandwidth	01	T1, R4,R5
47		Average Noise Figures, Average Noise Figure of cascaded networks	01	T1, R4,R5
48		Narrow Band noise, Quadrature representation of narrow band noise & its properties	01	T1, R4,R5
49		Entropy, Information rate	01	T1, R4,R5
49		Source coding: Huffman coding	01	T1, R4,R5
50		Channel capacity of discrete channel, Shannon-Hartley law, Problems	02	T1, R4,R5
51		Trade -off between bandwidth and SNR.	01	T1, R4,R5
		No. Of classes taken to complete unit-V :10		
TOTAL NO. OF CLASSES REQUIRED			**67**	

(10) QUESTION BANK

Unit – I

1. What is sample space? Explain the Discrete sample space and Continuous sample space each with a suitable example.
2. In a game of dice a "shooter" can win outright if the sum of the two numbers showing up is either 7 or 11 when two dice are thrown. What is his probability of winning outright?
3. Define and explain random experiment with an example.
4. Four cards are drawn from a well shuffled pack of playing cards. Find the probability that
   i) All are clubs
   ii) Two are spades & two are hearts
   iii) Four cards are from different suits.
5. a) Give the classical definition of probability.
   b) A card is drawn from a pack of 52 cards. Find the probability of getting a king or a heart or a red card (GATE 2009)
6. a) Aircrafts arrive at an airport according to a Poisson process at a rate of 12 per hour. All aircrafts are handled by one air traffic controller. If the controller takes a 2 minute coffee break, what is the probability that he will miss one or more arriving aircrafts?
   b) Telephone calls are initiated through an exchange at the average rate of 75 per minute and are described by a Poisson process. Find the probability that more than 3 calls are initiated in any 5 second period.
7. a) What is the probability of getting 53 Sundays in a leap year? (GATE 2011)
   b) In a box there are 500 colored balls: 75 black, 150 green, 175 red, 70 white and 30 blue. What are the probabilities of selecting a ball of each color? (GATE 2010)
8. (a) Explain the terms Joint probability and Conditional probability.
   (b) Show that Conditional probability satisfies the three axioms of probability.
9. Two cards are drawn from a 52-card deck (the first is not replaced):
   i. Given the first card is a queen. What is the probability that the second is also a queen?
   ii. Repeat part (i) for the first card a queen and second card a 7.
   iii. What is the probability that both cards will be the queen?
10. Show that Conditional probability satisfies the three axioms of probability. (IES 2008)
11. Explain discrete and continuous sample spaces with examples.
12. A batch of 50 items contains 10 defective items. Suppose 10 items are selected at random and tested. What is the probability that exactly 5 of the items tested are defective?
13. i) When do you say that two events are independent?
    ii) The probability, P, assigned to an event must satisfy certain conditions. What are they?
14. A block of 100 bits is transmitted over a binary communication channel with probability of bit error $P = 10^{3}$. Find the probability that the block contains three or more errors.

15. a) State and prove Bayes theorem for conditional probability.

b) An urn contains 10 white and 12 red chips. Two chips are drawn at random and, without looking at their colors, are discarded. What is the probability that a third chip drawn is red?

16. Explain the following with examples

i) Relative frequency definition of probability

ii) Conditional probability and

iii) Total probability.

17. A computer manufacturer uses chips from three sources. Chips from sources A, B, and C are defective with probabilities 0.001, 0.005 and 0.01 respectively. If a randomly selected chip is found to be defective, find the probability that the manufacturer was A; that manufacturer was C.

Unit-II

1. Determine E[X] and VAR[X] of Poisson random variable X.
2. State any four properties of probability density function.
3. Discuss the conditions for a function to be a random variable.
4. Determine the cumulative distribution function and probability density function of Y given that Y = 2X+3 and that $f_X(x) = 2e^{-x} u(x)$.

5. A discrete random variable X has possible values which occur with probabilities 0.4, 0.25, 0.15, 0.1 and 0.1 respectively. Find the mean value (GATE 2008)

6. List the properties of conditional density function.

7. Define a random variable? Explain its importance with an example

8. What is Probability distribution function? Explain its properties

9. A random variable has probability density function

$f_X(x) = cx(1-x) \quad 0 \le x \le 1$

0 else where

Find a) c b) $p(1/2 \le X \le 3/4)$ c) $F_X(x)$

10. The probability density function (Pdf) of the amplitude of speech waveforms is found to decay exponentially at a rate α, so the following Pdf is purposed:

$f_X(x) = C \exp(-\alpha|x|)$, Find the constant C.

11. The waiting time X of a customer in a queuing system is zero if he finds the system idle and an exponentially distributed random length of time if he finds the system busy. The probabilities that he finds the system idle or busy are P and 1-P, respectively. Find the cumulative distribution function of X

12. i) Define the expected value of continuous random variable X.

ii) Determine the mean for a uniform random variable.

13. Find the mean and variance of the binomial random variable?

14. Determine the relationship between central moments and moments about origin.

15. The time X between customer arrivals at a service station has an exponential probability density function with parameter λ. Find the mean inter arrival time.

16.Calculate E[X] when X is binomially distributed with parameters n and p.

5. The characteristic function for a Gaussian random variable X, having a mean value of 0, is $\Phi_X(w)=\exp(-\sigma_X^2 w^2/ 2)$

Find all the moments of X using $\Phi_X(w)$.

17. a) Calculate $E[X^3]$, if X is uniformly distributed.

b) State and prove any four properties of characteristic function.

18. a) Calculate E[X] if X is a Poisson random variable with parameter λ.

b) Show that a linear transformation of a Gaussian random variable produces another Gaussian random variable.

19. a) Calculate the expectation of an exponential distributed random variable having parameter λ.

b) Define the moment generating function(MGF) and discuss about the disadvantage of MGF over the characteristic function

20. (a) Find the expected value of the random variable X, whose probability density function is $f(x) = (1/2^k)$, for k = 1,2,3 etc

(b) Find the variance of a random variable X with a density function

$f_X(x) = 1/2\exp(-|x|)$.

Unit-III

1. Define and explain conditional probability mass function. Give its properties

2. The joint probability density function of two random variables X and Y is given by

$f(x,y) = c(2x+y)$; $0 \le x \le 1, 0 \le y \le 2$ 0; else where

Find:

i. The value of 'c'.

ii. Marginal distribution function of x and y.

3. .A joint pdf is

$f_{xy}(x,y) = 1/ab$; $0<x<a, 0<y<b$ 0;elsewhere

i.find and sketch $F_{xy}(x,Y)$

ii.if $a<b$ find $P[x+y \le 3a/4]$

4. Find the value of constant b so that $f_{xy}(x,y) = bxy^2\exp(-2xy)u(x-2)u(y-1)$ is valid jointpdf.

5. State and prove any four properties of probability distribution function.

6. Let the random variable Y be defined by $Y=X^2$ Where X is continuous random variable. Find the cumulative distribution function and probability density function of Y.

7. The joint density function of random variables X and Y is

$f_{xy}(x,y) = 8xy$; $0 \le x<1, 0<y<x$

$=0$ elsewhere

Find f(y/x) and f(x/y)

8. The density function of two random variables X and Y is $f_{xy}(x, y) = u(x)\, u(y) 4e^{-2(x+y)}$.Find the mean value of the function $e^{-(x+y)}$.

9. The joint density function of X and Y is

$f_{x,y}(x,y) = xy/9$ $0<x<2$ and $0<y<3$

Show that X and Y are uncorrelated.

10. a) Derive the expressions for the distribution and density functions of sum of two statistically independent random variables.

b) Find the conditional density functions for the joint distribution

$F_{x,y}(x,y)=4xy\exp(x^2+y^2)u(x)u(y)$

11. Define joint central moments for two random variables X and Y and explain the covariance of two random variables.

12. a) Explain Gaussian density function for N random variables.

b) State and prove the properties of joint moment generating function.

13. State and prove any four properties of cross-correlation function.

14. a) Define covariance of random variables X and Y and explain correlation coefficient.

b) State and prove the properties of joint characteristic function.

15. a) State and prove the properties of covariance function.

b) State and prove the properties of joint moment generating function.

16. Explain the physical significance of variance of a random variable. If X and Y are two

√7. If X is a random variable with mean "m" = 0 and variance of σ2, find the mean and

variance of the random variable Y =(x-m)/σ.

17. Verify that two uncorrelated jointly Gaussian random variables are independent Gaussian random variables.

18. If X1, X2, X3, ... Xn are 'n' number of independent and identically distributed random variables such that Xk = 1/2 with a probability 1/2 = – 1/2 with a probability 1/2. Find the characteristic function of the random variable Y =(X1+X2+X3…+Xn)/2√n

Unit-IV

1. a) Explain the following
   i) Wide – sense stationary process and ii) Strict – sense stationary process.
   b) Discuss about the following ergodic process
   i) Mean Ergodic process. ii) Correlation ergodic process.
2. a) Explain the following with examples
   i) Discrete time stochastic process and ii) Continuous time stochastic process.
   b) Explain the first and second order stationary random processes.
3. Explain the classification of random processes.
4. Let X and Y be the random variables defined as X=cosΦ and Y=sinΦ, where Φ is a uniform random variable over (0,2π).
   a) Are X and Y uncorrelated?
   b) Are X and Y independent?
5. Verify that the density of the sum of two independent Random Variables is equal to the convolution of their individual densities. (IES 2010)

6. X (t) is a stationary random process with a mean of 3 and an auto correlation function of 6+5exp (-0.2|τ|).Find the second central moment of the random variable Y=Z-W,where Z and W are the samples of the random process at t=4sec and t=8sec respectively.

7. Find the cross correlation between the processes X (t)=Acoswt+Bsinwt and Y(t)=Bcoswt-Asiwt,where A and B,where A and B are two standized Gaussian Random variables.

8. Z (t) = X Cos ω0t –Y Sinω0t is a random process, where X and Y are Poisson randomvariables with zero mean and variance K.Find the variance of the Process.

9. X (t) is a WSS process and Y (t) = A cos (ωct + θ) is a random process which is independent of X(t). Here, θ is a uniform random variable over (– π, π). If the auto-correlation function of X (t) is $R_{XX}(\tau)$, Find the auto correlation of Z(t)=X(t)Y(t).

1. The input to an LTI system with Impulse response $h(t)=\delta(t)+t^2 \exp(-at)u(t)$. is a WSS Process with mean of 3.Find the mean of the output of the system.
2. Derive the relation between the input PSD and the output PSD of an LTI system.
3. For a random process X(t) derive the expression for power density spectrum.
4. State at least 4 properties of power density spectrum of a random process.
5. A random process X (t) = $A_0\cos(\omega_0 t + \Theta)$ where A_0, ω_0 are real constants and is a

randomvariable uniform on (0, Θπ/2). Find the average power of the random process.

6. Derive the relationship between cross-power spectral density and cross correlation function.

(IES 2011)

Unit-V

1. a) Define Joint entropy; and Conditional entropy.
   b) What are instantaneous codes?
   c) What is meant by constraint length and free distance of a convolution code?
   d) How syndrome is calculated in Hamming codes and cyclic codes?
   e) State the channel coding theorem for a discrete memoryless channel.
   f) Define mutual information.
   g) Find entropy of a source emitting symbols x, y, z with probabilities of 1/5, 1/2, 1/3 respectively. h) What is meant by cyclic code?
   i) What is the difference between block codes and convolutional codes?
   j) What is meant by stop-and-wait ARQ? Explain.
2. Define Mutual Information. Explain how it is related to entropy for a lossless channel, prove that H(X/Y)=0.
3. Define BCH code and brief about Reed-Solomon code.
4. Write the steps involved in Huffman coding algorithm.
5. State Hartley -Shannon Law. 6. Given an AWGN channel with 4kHz bandwidth and the noise power spectral density η/2 =10-12 W/Hz. The signal power required at the receiver is 0.1mW. Calculate the capacity of this channel.

(IES 2010)

11. Case studies:

The Applications of Probability:

The measurement of the possibility of an event to occur is called probability. There are many applications associated with probability. Some of the real life applications of probability are listed below:

Application of Probability in Weather Forecast

Meteorologists collect the database related to weather and its changes worldwide by using different instruments and tools. They collect the weather information worldwide to estimate the temperature changes around the world and the weather conditions for a particular hour, day, week, month and year.

Thus, a probability forecast assesses how weather changes in terms of percentage and recording the risks associated with the weather or temperature changes to alert the people, especially in the coastal areas.

Application of Probability in Election Results

In our country, elections play a vital role in our politics. Political analysts use exit polls to measure the probability of winning or losing the candidate or parties in the elections. The probability technique is used to predict the results of voting after the election.

Application of Probability in Business

The marketing persons or salespersons promote the products to increase sales. They use the probability technique to check how much the particular product is going well in the market or not. The probability technique helps to forecast the business in future.

Application of Probability in Medicines

The doctors give medicines to the patients to recover from the illness and build immunity power also. Doctors prefer the probability technique to check the risk factor of the patient. While giving medicines, doctors also use the concept of probability to estimate how far it is going to cure and how far it takes to recover etc.

.Application of Probability in Games

Cricket, volleyball, soccer, football, tennis, badminton, poker, blackjack, gambling and all the board games use the concept of probability, which gives the idea about how likely a particular person or team is going to win or lose.

Application of Probability in Sports Strategies

In sports, with the help of probability, analyses are conducted to understand the strengths and weaknesses of a particular player or team. By using probability, analysts forecast the odds and outcomes regarding the team's performance and members in the team.

By using the probability as a tool, coaches determine in which areas their team is strong enough and which areas they have to work more for the victory.

12. Assignment Questions

MID-1

SET-1

1. a) Give the axiomatic approach of probability. (CO1)

   b) A card is drawn from a pack of 52 cards. Find the probability of getting a king or a heart card. (CO1)

2. a) What is Probability distribution function? Explain its properties. (CO1)

b)A random variable has probability density function (CO2)

$f_x(x) = c\,x(1-x) \quad 0 \le x \le 1$

0 else where

Find a) c b) $p(1/2 \le X \le 3/4)$ c) $F_x(x)$

3. a) Determine the relationship between central moments and moments about origin. (CO2)

b) Calculate $E[X^3]$, if X is uniformly distributed. (CO2)

4. a) Define and explain joint probability density function. Give its properties (CO2)

5. The joint density function of random variables X and Y is

$f_{xy}(x,y) = 8xy \;;\; 0 \le x < 1,\; 0 < y < x$

$= 0$ elsewhere

Find f(y/x) and f(x/y) (CO2)

SET-2

Answer any TWO.

1. a) What is a Random Variable? Discuss the conditions for a function to be a random variable. Classify RVs with examples. (CO2)

b) A RV X has probabilities

X	-3	-2	-1	0	1	2
P(X)	0.2	0.5k	k	0.1	0.3k	k

i) Find the value of k. ii) Find $F_X(x)$. (CO2)

2. Write various Distribution & Density functions with diagrams (CO2)

3. Consider two random variables X and Y such that X = -8Y +40, the mean value and the Variance of X are 6 and 3 respectively. Find out the correlation. (CO2)

4. Find the moment generating function of a random variable with density function

$f_x(x) = x$ for $0<x<1$

$2-x$ for $1<x<2$ also find m1. (CO2)

5. State and prove Bay's theorem. (CO1)

SET-3

1. Explain i) Relative frequency approach of probability ii) Conditional Probability iii) Statistical Independence v)Total Probability (CO1)

2. a)Define the characteristic function . State & prove properties of it. (CO2)

b) A RV X has pdf $f(x) = 1/2x \quad 0 \le x \le 1$

$= 0$ otherwise

Then find MGF. (CO2)

3. Define joint central moments for two random variables X and Y and explain the covariance of two random variables. Also explain the correlation coefficient. (CO2)

4. A RV X has probabilities

X	-3	-2	-1	0	1	2
P(X)	0.2	0.5k	k	0.1	0.3k	k

Find the value of k. ii) Find $F_X(x)$. (CO2)

5. Let X and Y be the random variables defined as X=cosΦ and Y=sinΦ, where Φ is a uniform random variable over $(0,2\pi)$. (CO2)

i) Are X and Y uncorrelated? ii) Are X and Y independent?

MID-2

SET-1

1.(a) Explain the following

i) Wide – sense stationary process and ii) Strict – sense stationary process.

iii) Ergodic Theorem (CO3)

(b) Find the power density spectrum of a random process whose autocorrelation function is $R_{XX}(\tau)=A\cos(w_0\tau)$. (CO5)

2.(a) Determine the cross correlation function corresponding to the cross power density spectrum

$S_{XY}(w)=8/(\alpha+jw)^3$. (CO5)

(b) Let X and Y be the random variables defined as X=cosΦ and Y=sinΦ, where Φ is a uniform random variable over $(0,2\pi)$.

A) Are X and Y uncorrelated?
B) Are X and Y independent? (CO3)

3. (a) A DMS have 5 symbols X1, X2, X3, X4, X5 characterized by probability distribution as 0.4, 0.2, 0.1, 0.2&0.1 respectively. Evaluate two distinct variable length Huffman codes for the source to illustrate non uniqueness of Huff man technique. Calculate the variance and conclude the result. (CO6)

(b) Given the autocorrelation function, for a stationary ergodic process with no periodic components is, $R_{XX}(\tau) = 25 + 4/(1+6\tau^2)$

Find the mean and variance of the process X(t) (CO3)

4 . Define power spectral density (PSD) and write its properties. (CO5)

5. Given $Y(t)= X(t)A_0\cos w_0 t$, where A_0 and w_0 are constants. Here X(t) & Y(t) are random process. Find the autocorrelation of Y(t) in terms of $R_{XX}(\tau)$ and power spectrum $S_{YY}(w)$ in terms of $S_{XX}(w)$. (CO5)

SET-II:

1. (a)For a discrete memory less source with the symbols s1,s2,s3,s4,s5 and their Probabilities of occurrences are 0.4, 0.2, 0.2, 0.1, 0.1 find the efficiency of the code using Shannon-fano coding?

b) Prove that I(X; Y) =H(X)-H(X/Y)**?** (CO6)

2. (a) A random process is defined by X(t)=A, where A is a continuous random variable uniformly distributed on (0,1)

i) Determine the form of sample functions

ii) Classify the process

iii) Is it deterministic? (CO3)

(b) Cross correlation function of two process X(t) and Y(t) be $R_{XY}(t,t+\tau)=AB/2\{\sin w_0\tau + \cos(w_0(2t+ \tau))\}$. Find the cross power spectrum. (CO5)

3. (a) Write properties of power spectral density of random process. (CO5)
(b) A wide sense stationary process X(t) has an autocorrelation function (CO5)

$R_{XX}(\tau) = A_o[1-(|\tau|/T)]$ $-T<t<T$

0 otherwise

where $T>0$ and A_0 are constants. Find Power Spectral Density (PSD) and sketch $R_{XX}(\tau)$.

4. Write about power density spectrum of Response of Linear system. (CO4)

5. Find the Power Spectral Density (PSD) for the random process X(t), whose autocorrelation function is given by $R_{XX}(\tau) = (A_o^2 / 2) \cos w_0 t$, where A_o,and w_0 are constants. (CO5)

SET-III

1. Explain the following (CO3)

i)First and second order stationary random processes. ii) Random Process/ Stochastic Process

iii) Deterministic process/Non-Deterministic process

2. Assume that an ergodic random process X(t) has an autocorrelation function (CO3)

$R_{XX}(\tau) = 18 + (2/6+ \tau^2)(1+4\cos 12\tau)$

i) Find E[X(t)]
ii) Does this process have a periodic component?
iii) What is the average power in X(t)?

3 a) Derive an expression for Auto correlation function of response of a linear system with random input. (CO5)

(b) A wide sense stationary noise process N(t) has an auto correlation function $R_{NN}(\tau)=Pe^{-3|\tau|}$, where P is a constant. Find its power spectrum. (CO5)

4.(a) Write the relationship between cross power spectrum and cross correlation function. (CO5)

(b)Given the random process (CO3)

$X(t) = A \sin(w_o t+ \theta)$, where A and w_o are the constants and θ is a random variable uniformly distributed on the interval $(-\pi, \pi)$. Define a new random process $Y(t) = X^2(t)$.

- Find the autocorrelation function of Y(t)
- Find the cross correlation function of X(t) & Y(t)
- Are X(t) and Y(t) WSS?
- Are X(t) and Y(t) jointly WSS?

5. (a) Define cross power density spectrum and write its properties. (CO5)

(b) State and Prove Wiener Khintchine Relation. (CO5)

Innovative Assignment Questions:

1. Study the complete process of DLS method.
2. Consider the following switching network shown in Figure1.It is equally likely that a switch will or will not work. Find the probability that a closed path will exists between the terminals a and b.

3. Prepare a report to this journal paper Probability Theory in the Use of Diagnostic Tests

13. TUTORIAL QUESTION SET

Unit – I

SET-1

1. What is sample space? Explain the Discrete sample space and Continuous sample space each with a suitable example. (CO1)
2. In a game of dice a "shooter" can win outright if the sum of the two numbers showing up is

either 7 or 11 when two dice are thrown. What is his probability of winning outright? .(CO1)

3. Define and explain random experiment with an example. .(CO1)

4. Four cards are drawn from a well shuffled pack of playing cards. Find the probability that

   i) All are clubs

   ii) Two are spades & two are hearts

   iii) Four cards are from different suits. .(CO1)

SET-2

1. a) Give the classical definition of probability. .(CO1)

   b) A card is drawn from a pack of 52 cards. Find the probability of getting a king or a heart or a red card . (CO1)

2. a) Aircrafts arrive at an airport according to a Poisson process at a rate of 12 per hour.All aircrafts are handled by one air traffic controller. If the controller takes a 2 minute coffee break, what is the probability that he will miss one or more arriving aircrafts?

   b) Telephone calls are initiated through an exchange at the average rate of 75 per minute and are described by a Poisson process. Find the probability that more than 3 calls are initiated in any 5 second period. .(CO2)

3. a) What is the probability of getting 53 Sundays in a leap year?

   b) In a box there are 500 colored balls: 75 black, 150 green, 175 red, 70 white and 30 blue. What are the probabilities of selecting a ball of each color? .(CO1)

4. (a) Explain the terms Joint probability and Conditional probability.

   (b) Show that Conditional probability satisfies the three axioms of probability. .(CO1)

SET-3

1. Two cards are drawn from a 52-card deck (the first is not replaced): .(CO1)

   i. Given the first card is a queen. What is the probability that the second is also a queen?

   ii. Repeat part (i) for the first card a queen and second card a 7.

   iii. What is the probability that both cards will be the queen?

2. Show that Conditional probability satisfies the three axioms of probability. .(CO1)

3. Explain discrete and continuous sample spaces with examples. .(CO1)

4. A batch of 50 items contains 10 defective items. Suppose 10 items are selected at random and tested. What is the probability that exactly 5 of the items tested are defective? .(CO1)

SET-4

1. i) When do you say that two events are independent? .(CO1)
   ii) The probability, P, assigned to an event must satisfy certain conditions. What are they?
2. A block of 100 bits is transmitted over a binary communication channel with probability of bit error $P = 10^{-3}$. Find the probability that the block contains three or more errors. .(CO1)
3. a) State and prove Bayes theorem for conditional probability.
   b) An urn contains 10 white and 12 red chips. Two chips are drawn at random and, without looking at their colors, are discarded. What is the probability that a third chip drawn is red? .(CO1)
4. Explain the following with examples .(CO1)
   i) Relative frequency definition of probability
   ii) Conditional probability and
   iii) Total probability.

Unit -II

SET-1

1. a Determine E[X] and VAR[X] of Poisson random variable X. (CO2)
   b. State any four properties of probability density function.
2. a. Discuss the conditions for a function to be a random variable.
   b. Determine the cumulative distribution function and probability density function of Y given that Y = 2X+3 and that $f_X(x) = 2e^{-x}\,u(x)$. (CO2)
3. a. i) Define the expected value of continuous random variable X.
   ii) Determine the mean for a uniform random variable.
   b. Find the mean and variance of the binomial random variable? (CO2)
4. a. Determine the relationship between central moments and moments about origin.
   b. The time X between customer arrivals at a service station has an exponential probability density function with parameter λ. Find the mean inter arrival time. (CO2)

SET-2

1. a .A discrete random variable X has possible values which occur with probabilities 0.4, 0.25, 0.15, 0.1 and 0.1 respectively. Find the mean value

b. List the properties of conditional density function. (CO2)

2. a. Define a random variable? Explain its importance with an example

b. What is Probability distribution function? Explain its properties. (CO2)

3. a) Calculate $E[X^3]$, if X is uniformly distributed.

b) State and prove any four properties of characteristic function. (CO2)

4. a) Calculate E[X] if X is a Poisson random variable with parameter λ.

b) Show that a linear transformation of a Gaussian random variable produces another Gaussian random variable. (CO2)

SET-3

1. a. A random variable has probability density function

$f_X(x) = cx(1-x) \quad 0 \le x \le 1$

$= 1$ else where

Find a) c b) $p(1/2 \le X \le 3/4)$ c) $F_X(x)$ (CO2)

b.The probability density function (Pdf) of the amplitude of speech waveforms is found to decay exponentially at a rate α, so the following Pdf is purposed:

$f_X(x) = C \exp(-\alpha|x|)$, Find the constant C. (CO2)

2. a .The waiting time X of a customer in a queuing system is zero if he finds the system idle and an exponentially distributed random length of time if he finds the system busy. The probabilities that he finds the system idle or busy are P and 1-P, respectively. Find the cumulative distribution function of X. (CO2)

b. What is Probability density function? Explain its properties

3. Calculate E[X] when X is binomially distributed with parameters n and p. (CO2)

4. The characteristic function for a Gaussian random variable X, having a mean value of 0, is $\Phi_X(w)=\exp(-\sigma_x^2 w^2/ 2)$ Find all the moments of X using $\Phi_X(w)$. (CO2)

SET-4

1.a. A random variable has probability density function

$f_X(x) = cx(1-x) \quad 0 \le x \le 1$

$= 2$ else where

Find a) c b) $p(1/2 \le X \le 3/4)$ c) $F_X(x)$

b. List the properties of conditional density function (CO2)

2. a. Determine the cumulative distribution function and probability density function of Y given that Y = 2X+3 and that $f_X(x) = 2e^{-x} u(x)$.

b. Discuss the conditions for a function to be a random variable. (CO2)

3.a. Calculate the expectation of an exponential distributed random variable having parameter λ.

b. Define the moment generating function(MGF) and discuss about the disadvantage of MGF over the characteristic function (CO2)

4.a. Find the expected value of the random variable X, whose probability density function is $f(x) = (1/2^k)$, for k = 1,2,3 etc

b.Find the variance of a random variable X with a density function $f_X(x) = 1/2\exp(-|x|)$. (CO2)

Unit-III

SET-1

1. a. Define and explain conditional probability mass function. Give its properties

   b. The joint probability density function of two random variables X and Y is given by

   $f(x,y) = c(2x+y)$; $0 \le x \le 1, 0 \le y \le 2$ 0; else where

   Find:

   i. The value of 'c'.

   ii. Marginal distribution function of x and y. (CO2)

2. a. A joint pdf is

   $f_{XY}(x,y) = 1/ab$; $0<x<a, 0<y<b$ 0;elsewhere

   i.find and sketch Fxy(x,Y)

   ii.if a<b find $P[x+y \le 3a/4]$

   b. Find the value of constant b so that $f_{XY}(x,y) = bxy^2\exp(-2xy)u(x-2)u(y-1)$ is valid joint pdf.(CO2)

3. a Define joint central moments for two random variables X and Y and explain the covariance of two random variables.

   b. Explain Gaussian density function for N random variables. (CO2)

4. a. State and prove the properties of joint moment generating function.

   b. State and prove any four properties of cross-correlation function. (CO2)

SET-2

1. a. State and prove any four properties of probability distribution function.

   b. Find the value of constant b so that $f_{XY}(x,y) = bxy^2\exp(-2xy)u(x-2)u(y-1)$ is valid jointpdf. (CO2)

2 .a. State and prove any four properties of probability distribution function.

   b. Let the random variable Y be defined by $Y=X^2$ Where X is continuous random variable. Find the cumulative distribution function and probability density function of Y. (CO2)

3 .a. Define covariance of random variables X and Y and explain correlation coefficient.

   b. State and prove the properties of joint characteristic function. (CO2)

4. a. State and prove the properties of covariance function.

   b. State and prove the properties of joint moment generating function. (CO2)

SET-3

The joint density function of random variables X and Y is

$f_{XY}(x,y) = 8xy$; $0 \le x < 1, 0 < y < x$

$= 0$ elsewhere

Find f(y/x) and f(x/y). (CO2)

b.The density function of two random variables X and Y is

$f_{XY}(x, y) = u(x)\, u(y)\, 4e^{-2(x+y)}$.Find the mean value of the function $e^{-(x+y)}$.

2. a. The joint density function of X and Y is

f x,y(x,y) = xy/9 0<x<2 and 0<y<3

Show that X and Y are uncorrelated.

b. Derive the expressions for the distribution and density functions of sum of two statistically independent random variables. (CO2)

3. a. Explain the physical significance of variance of a random variable. If X and Y are two √7. If X is a random variable with mean "m" = 0 and variance of σ2, find the mean and variance of the random variable Y =(x-m)/σ. (CO2)

b. Verify that two uncorrelated jointly Gaussian random variables are independent Gaussian random variables.

4. a. If X1, X2, X3, ... Xn are 'n' number of independent and identically distributed random variables such that Xk = 1/2 with a probability 1/2 = – 1/2 with a probability 1/2. Find the characteristic function of the random variable Y =(X1+X2+X3…+Xn)/2√n

b. State and prove the properties of covariance function. (CO2)

SET-4

1. Find the conditional density functions for the joint distribution

Fx,y(x,y)=4xyexp(x^2+y^2)u(x)u(y). (CO2)

2. The density function of two random variables X and Y is

fxy(x, y) = u(x) u(y) $4e^{-2(x+y)}$.Find the mean value of the function $e^{-(x+y)}$. (CO2)

3. Let the random variable Y be defined by Y=X^2 Where X is continuous random variable. Find the cumulative distribution function and probability density function of Y. (CO2)

4. Derive the expressions for the distribution and density functions of sum of two statistically independent random variable. (CO2)

Unit-IV

SE

T-1

1. Explain the following

i) Wide – sense stationary process and ii) Strict – sense stationary process. (CO3)

2. Discuss about the following ergodic process

i) Mean Ergodic process. ii) Correlation ergodic process. (CO3)

3. Explain the following with examples

i) Discrete time stochastic process and ii) Continuous time stochastic process. (CO3)

4. Explain the first and second order stationary random processes. (CO3)

SET-2

1. Explain the classification of random processes. (CO3)

2. Let X and Y be the random variables defined as X=cosΦ and Y=sinΦ, where Φ is a uniform

random variable over (0,2π). (CO3)

A)Are X and Y uncorrelated?

B)Are X and Y independent?

3. Verify that the density of the sum of two independent Random Variables is equal to the convolution of their individual densities. (CO3)

4.X (t) is a stationary random process with a mean of 3 and an auto correlation function of 6+5exp (-0.2|τ|). Find the second central moment of the random variable Y=Z-W,where Z and W are the samples of the random process at t=4sec and t=8sec respectively. (CO3)

SET-3

1. Find the cross correlation between the processes X (t)=Acoswt+Bsinwt and Y(t)=Bcoswt-Asiwt,where A and B,where A and B are two standized Gaussian Random variables. (CO3)
2. Z (t) = X Cos ω0t –Y Sinω0t is a random process, where X and Y are Poisson randomvariables with zero mean and variance K.Find the variance of the Process. (CO3)
3. X (t) is a WSS process and Y (t) = A cos (ωct + θ) is a random process which is independent of X(t). Here, θ is a uniform random variable over (– π, π). If the auto-correlation function of X (t) is $R_{XX}(\tau)$, Find the auto correlation of Z(t)=X(t)Y(t) (CO3).

SET-4

1. Explain the classification of random processes. (CO3)
2. Let X and Y be the random variables defined as X=cosΦ and Y=sinΦ, where Φ is a uniform random variable over (0,2π).
   A) Are X and Y uncorrelated?
   B) Are X and Y independent? (CO3)
3. Verify that the density of the sum of two independent Random Variables is equal to the convolution of their individual densities. (CO3)

4.X (t) is a stationary random process with a mean of 3 and an auto correlation function of 6+5exp (-0.2|τ|). (CO3)

B) Find the second central moment of the random variable Y=Z-W,where Z and W are the samples of the random process at t=4sec and t=8sec respectively.

Unit-V

SET-1

1. For a random process X(t) derive the expression for power density spectrum. (CO3)
2. State at least 4 properties of power density spectrum of a random process. (CO3)

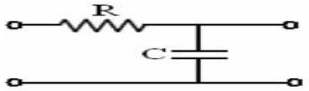
3. A random process X (t) = A0cos(ω0t + Θ) where A0, ω0 are real constants and is a random variable uniform on (0, Θπ/2). Find the average power of the random process. (CO3)
4. Derive the relationship between cross-power spectral density and cross correlation function. (CO3)

SET-2

1.For a random process X(t) derive the expression for power density spectrum. (CO3)
2.State at least 4 properties of power density spectrum of a random process. (CO3)
3.A random process X (t) = A0cos(ω0t + Θ) where A0, ω0 are real constants and is a random variable uniform on (0, Θπ/2). Find the average power of the random process. (CO3)
4.Derive the relationship between cross-power spectral density and cross correlation function. (CO3)

SET-3

1.Evaluate the cross power spectral density given the cross correlation of two processes X(t) and Y(t) is $(AB/2)[\sin\omega_0 t + \cos\omega_0(2t+\tau)]$,where A, B and 0ω are constant. (CO3)
2.Derive the relationship between power spectral density and autocorrelation function. (CO3)
3.Determine the resultant output spectral density if a white noise of spectral density unity is passed through a RC LPF with a transfer function H(w). (CO3)



4. Is power density spectrum an even function of 'ω' or odd function of 'ω'? Justify.

(a) A WSS random process X(t) has $R_{XX}(\tau) = A_0\left[1 - \frac{|t|}{\tau}\right] \quad -\tau \le t \le \tau$
$= 0 \qquad$ else where
Find power density spectrum.

(b) $R_{XX}(\tau) = \frac{A_0^2}{2}\sin\omega_0\tau$. Find $S_{xx}(\omega)$

SET-4

1. "The Power Spectral density of any random waveform and its autocorrelation function are related by means of Fourier transform". Prove and illustrate the above statement. (CO3)
2. Derive the relationship between power spectral density and autocorrelation function. (CO3)
3. A random process X (t) = A0cos(ω0t + Θ) where A0, ω0 are real constants and is a

random variable uniform on (0, Θπ/2). Find the average power of the random process. (CO3)

4. Derive the relationship between power spectral density and autocorrelation function. (CO3).

14. TOPICS FOR STUDENT'S SEMINARS

- Applications of probability distribution functions
- Probability Density Functions (PDF): Application to Forex (FX) / Currency Analysis.
- Multivariate random vector
- Probability functions with matlab tools
- Signals and noise in communications
- Random data analysis and measurement procedures
- A central limit theorem for random ordered factorizations of integers
- Moment genarating functions
- Correlation and covariance in signal processing
- Ergodic theorem

15. Unit wise multiple choice questions

UNIT-1

1. The sample space for the experiment of measurement of the output voltage V from a minimum of which one +5 and -5V respectively is [D]
A) {V: 0≤V≤5} B) {V:-∞≤V≤∞} C) {V: 1≤V≤5} D) {V:-5≤V≤5}

2. Let S1 and S2 be the sample spaces of two sub experiments. The combined sample space S is given by [A]
A) S1 X S2 B) S1 - S2 C) S1 + S2 D) S1 | S2

3. The relation between conditional probabilities P (A|B) and P (B|A) is derived using one of the
Following theorems [D]
A) Bernoulli's B) Maxwell's C) De Moivre D) Bayes

4. A mixed random variable is one having [C]
A) Discrete values only B) - ∞ to 0 only C) both continuous and discrete D) continuous values only

5. If P(A) = 1/4, P(B) = 1/3, and P(A ∩ B) = 1/5 then P(A U B). [A]
a) 23/60 b) 17/60 c) 1/10 d) 1/4

6. If A and B are mutually exclusive events the P(A ∪ B) = ---------- [A]
a)P(A) + P(B) b) P(A).P(B) c) P(A) - P(B) d) P(A/B)

7. If A & B are independent events & P(A) = 2/3 & P(B) =3/5 then P(A ∪ Bc) =---- [C]
a)1/5 b) 3/5 c) 2/7 d) 1/3

8. A bag contains 6 black and 8 white balls. One ball is drawn at random. What is the probability that the ball drawn is white? [B]
A) 3/4 b)4/7 c)1/8 d)3/7

9. Two dice are tossed. The probability that the total score is a prime number is [C]
a)1/6 b) 1/2 c) 5/12 d) 7/9

10. Given some event B with non zero probability P(B) > 0 the conditional probability of an event A is
A. P(A | B) = P(A ∩ B)/P(A) C. P(A | B) = P(A ∩ B)/p(B) [B]
B. P(A | B)= P(A)/ P(A ∩ B) D. P(A | B)=P(A)/P(B)

11. A die is thrown 256 times. An even digit turns up 150 times. Then the die is (B)
a)Biased b) Un biased c)not determined d) none

12. A population consisting of all Integers is an example of (B)
a)Finite b)Infinite c)sample d) None

13. The Probability that a leap year will have 53 Mondays is (C)
a) 4/7 b)3/7 c)2/7 d) 1/7

14. If a coin is tossed 6 times in Succession, the Probability of getting at least one tail is (B)
a) 62/63 b)63/64 c)6/32 d) 1/64

15. Two dice are thrown simultaneously. What is the probability of getting two numbers whose product is even? [B]
a) ½ b)3/4 c) 3/8 d)5/16

16. Two events A & B with probability P(A) & P(B) are said to be statistically independent if [A]
A)P(AB)=P(A)P(B) B)P(A)/P(B)=0 C)both D)none

17. The probability P(A ∩ B) is known as the----for two events A & B. [A]
a) Joint probability b)event c)total probability d)sample space

18. The conditional probabilities are sometimes called transition------- in a communication

context.
a)event b)sample space c)probability d)set [C]

19.For mutually exclusive events, the joint probability is [A]
a) 0 b)1 c)infinity d)all

20. The conditional probability for two events can be denoted as [B]
a)P(AB) B)P(A/B) C)P(A+B) D)NONE

21. Let A be any event defined on a sample space, the P(A) is [A]
a) greater than or equal to zero b)less than or equal to zero
c) both d)none

22. If S is a sample space, E1,E2 are any events is S then P(E1) = _____ [A]
a)P(E1)+P(E2)-P(E1 ∩E2) b)P(E1)+P(E2)+ P(E1∩E2)
c) P(E1)-P(E2)-P(E1∩E2) d)none

23. The probability of getting 2 Tails in tossing 5 coins is_____[C]
a) 251/256 b)1/256 c)5/256 d)0

24. P (A/B) =_____ [B]
a) P(A ∩ B)/p(A) b) P(A ∩ B)/P(B) c)P(A)/ P(A ∩ B) d)P(B)/ P(A ∩ B)

25. If $P(A^c) = 3/8$, $P(B^c) = 1/2$, $P(A \cap B) = 1/4$ then P(B/A) value is [B]
a)0 b)0.4 c)0.6 d)1

26. By Baye's Theorem P(E1/E2) = [A]
a) P(E2/E1)P(E1)/[P(E1)P(E/E1)+P(E2)P(E/E2)] B)
P(E2/E1)P(E1)*[P(E1)P(E/E1)+P(E2)P(E/E2)]
c) both d)none

27. A_____is one for which some of its values are discrete and some are continuous.[C]
a) continuous b)discrete c)mixed d)all

28. If sample space contains finite set of events then it is said to be [B]
a) continuous b)discrete c)mixed d)all

29.If a random variable X takes infinite or all possible values between certain limits, it is called a _____ [A]
a) continuous b)discrete c)mixed d)all

30. If the sample space contain uncountable infinite number of events, then the sample space is called as _____ [A]
a) Continuous b) discrete c)mixed d)all

31. If a random variable X takes only of finite or countable number of infinite values, it is

called a
_____ [B]

a) Continuous b) discrete c)mixed d)all

32. Two coins are tossed, find the probability that two heads are obtained [A]
a)1/4 b)1/2 c)0 d)1/8

33. A card is drawn at random from a deck of cards.
Find the probability of getting the 3 of diamond. [A]
a)1/52 b)3/52 c)4/52 d)1/13

34. A jar contains 3 red marbles, 7 green marbles and 10 white marbles. If a marble is drawn from the jar at random, what is the probability that this marble is white? [A]
a)1/2 b)1/10 c)4/10 d)7/10

35. A card is drawn at random from a deck of cards.
Find the probability of getting the King of heart [A]
a)1/52 b)3/52 c)4/52 d)1/13

36. A bag contains 2 red, 3 green and 2 blue balls. Two balls are drawn at random. What is the probability that none of the balls drawn is blue? [A]
A. 10/21 B.11/21 C.2/7 D.5/7

37. What is the probability of getting a sum 9 from two throws of a dice? [C]
A. 1/6 B.1/8 C.1/9 D.1/12

38. Three unbiased coins are tossed. What is the probability of getting at most two heads?
a.3/4 b.1/4 c.3/8 4.7/8 [D]

39. From a pack of 52 cards, two cards are drawn together at random. What is the probability of both the cards being kings? [D]
A.1/15 B.25/57 C)35/256 D.1/221

40. One card is drawn at random from a pack of 52 cards. What is the probability that the card drawn is a face card (Jack, Queen and King only)? [B]
A.1/13 B.3/13 C.1/4 D.9/52

UNIT-2:

1. The PDF fx(x) is defined as [B]
A) Integral of CDF B) derivative of CDF C) equal to CDF D) partial derivative of CDF

2. The value of Fx(– ∞) is [D]
A) ∞ B) 1 C) 0.5 D) 0

3. The probability density function of the sum of a large no. of random variables approaches [C]
A) Rayleigh distribution B) Uniform distribution
C) Gaussian distribution D) Poisson distribution

4. the variance of the random variable, taking values of getting heads if two coins are tossed is [B]
A) 2 B) 1/2 C) 1 D) 0

5. The moment generating function of X, Mx(v) is expressed as [B]
A) E[ev] B) E[evx] C) evx D) E(e2x)

6. If a continuous random variable has the probability density is
$f(x) = 2e^{-2x}$, $x > 0$
$= 0$, $x \leq 0$ then $p(1 \leq x \leq 3) =$ [D]
a) 0.2 b) 0.312 c) 0.425 d) 0.133

7. The probability density function, denoted by $f_X(x)$, is defined as the _____ of the distribution function. [C]
A. integral B. exponential C. derivative D. none of the above

8. Which of the following is not a property of conditional distribution [C]
A. $F_X(-\infty | B) = 0$ B. $F_X(\infty | B) = 1$ C. $F_X(-\infty | B) = 1$ D. $0 \leq F_X(x | B) \leq 1$

9. The conditional distribution function of a random variable X, given some event B, was defined as
[A]
A. $F_X(x | B) = P\{X \leq x | B\} = P\{X \leq x \cap B\} / P(B)$ B. $F_X(x | B) = P\{X \geq x | B\} = P\{X \geq x \cap B\} / P(B)$

C. $F_X(x | B) = P\{X \leq x | B\} = P\{X \leq x \cup B\} / P(B)$ D. $F_X(x | B) = P\{X \leq x | B\} = P(B) / P\{X \leq x \cap B\}$

10. The distribution function of a ------- will be sum of two parts, one of stair step form, the other continuous [C]
A. continuous random variable B. discrete random variable
C. mixed random variable D. none of the above

11.The Poisson density function $f_X(x)$ is given by [A]

A. $f_X(x) = e^{-b} \sum_{K=0}^{\infty} \frac{b^K}{K!} \delta(x - K)$ B. $f_X(x) = e^{b} \sum_{K=0}^{\infty} \frac{\underline{b}^K}{K!} \delta(x - K)$

C. $fX(x) = e^{-b} \sum_{K=0}^{\infty} \frac{K}{K!} \delta(x+K)$ D. $fX(x) = e^{b} \sum_{K=0}^{\infty} \frac{\underline{b}^{K}}{K!} \delta(x+K)$

12. The skew of a density function is also called as third central moment of the random variable and is given by [B]

A. μ3 = E[(X − m)2] B. μ3 = E[(X − m)3] C. μ3 = E[(X + m)2] D. μ3 = E[(X + m)3]

13. If n=40, Error is 0.5, σ = 1.6 minutes then Z(α/2) is (B)

a) 1.86 b)1.96 c)2.76 d)2.86

14. The Probability distribution of a statistic is called (D)

a)Normal b) Binomial c) Poisson d) Sampling

15. Variance of Poisson distribution V(x) is (C)

a)E(x) b)$E(x)^2$ c) $E(x^2) – [E(x)]^2$ d) None

16. The probability that a continuous random variable X assumes a value between x1 and x2 is [B]

a) 0 b)1 c)infinity d)none

17. The area under the probability density function is always equal to [B]

a) 0 b)1 c)infinity d)256

18. The probability density function of a discrete random variable is represented by a set of [B]

a) step b)impulse c)sine d)ramp

19. A Gaussian density function is a_____density function. [A]

a) Continuous b) discrete c) mixed d)none

20.The characteristic function ϕx(ω) at ω = 0 is _____ [B]

a)0 b)1 c)3.14 d)infinity

21. The normalized third central moment is known as_____ [D]

a) mean b)variance c)skew d)skewness of the density function

22.If a continuous random variable X has the probability density function $f(x)=3/2(1-x^2)$, $0<x<1$, then the mean of X is _____ [C]

a)0 b)1/8 c)3/8 d)7/8

23.If the probability density function of a random variable X is f(x) = kx(x-1) in $1 \le x \le 4$ and

p(1≤x≤3) =1/3, the value of k is _____ [A]
a)1/14 b)3/8 c)2/3 d)0

24. If FX,Y(∞,Y)=FY(y), it is a----------function [B]
A) Marginal density function b)marginal distribution function
c) Conditional density function d) conditional distribution function

25. Central limiting theorem is mostly applicable to statistically [A]
a)independent RVs b)dependent RVS c)both d)none

26. For Continuous Probability distribution variance is _____ [C]
a)μ12 b)μ c)σ12 d)σ^2

27. Standardized random variable z = [B]
a)0 b)(x-μ)/σ c)(x-σ)/μ d)μ/σ

28. ____Were developed as valuable measures of a random variable's characteristics.[B]
a)expectations b)moments c)variances d)sets

30. The characteristic function of a random variable X is defined by _____ [A]
a) Φ X (ω) = E[e j ω X] b)MX(V)=E[evx] c)0 d)both a and b

31. The following are the probability distributions for two random variables, *X* and *Y*:

X	$P(X = x)$
3	$\frac{1}{3}$
5	$\frac{1}{2}$
7	$\frac{1}{6}$

Y	$P(Y = y)$
1	$\frac{1}{8}$
3	$\frac{3}{8}$
4	?
5	$\frac{3}{16}$

[C]

If *X* and *Y* are independent, what is $P(X = 5 \text{ and } Y = 4)$?

a. $\frac{5}{16}$
b. $\frac{13}{16}$
c. $\frac{5}{32}$
$\frac{3}{32}$

$\frac{3}{16}$

e.

32. Given that the following is the probability distribution for a DRV, find $P(X = 3)$. [A]

X	2	3	4	5	6
$P(X)$	0.15		0.2	0.2	0.35

a) 0.1 b)0.3 c)1.2 d)0.7

33. A continuous Random Variable, X, follows a Uniform Distribution so that the probability of any value between 2 and 5 is p. What is the value of p? [B]

a)1/5 b)1/3 c)1/4 d)1/2

34. What is the probability that a fair coin will land heads up exactly five times in seven flips? [A]

a) 0.164 b)0.125 c)0.235 d)0.172

35. How is the variance related to the standard deviation? [A]

A) The standard deviation is equal to the square root of the variance.

B) the variance is equal to the standard deviation.

C) not related D)equal

36. The uniform probability density function in the range {a, b} can be expressed as [B]

a)ab b)1/(b-a) c)1/(b+a) b/a

37. The value of FX(-∞/B) [C]

A) 1 B)-1 C)0 D)∞

38. If a continuous random variable x has the probability density function $f(x)=k(1-x^2),0<x<1$,then the value of k is [b]

a) 1 b)3/2 c)2 d)5/2

39. If a continuous random variable x has the probability density function $f(x)=3/2(1-x^2),0<x<1$,then the mean of X is [C]

a)1/8 b)1/4 c)3/8 d)1

40. The variance of the random variable, taking values of getting heads if two coins are tossed is

a)2 b)1/2 c)1 d)0 [B]

Unit-3:

1. Two independent random variables X, Y are always

[B]
A. Correlated B. Uncorrelated C. Have cov (X, Y) =0 D. Have correlation coefficient -1

2. Independent random variables with zero mean are
[A]
A. Orthogonal B. Non-orthogonal C. Correlated D. Have RXY≠0

3. X and Y are Gaussian random variables with the same variance and ρxy = -1. The angle θ of a coordination rotation that generates non-random variables that are statically independent is
[C]
A. π B. π/2 C. π/4 D. n

4. Random samples of 200 men & 100 women were asked whether they want bus-stop in their colony. 50 men and 80 women said yes. Then standard error of proportion is --- [A]
a) 16.2 b) 18.2 c) 15.4 d) 17.9

5. In a locality 50 persons were randomly selected and enquired about education achievements the results are expected frequency e21 --- [D]

	School	College	Total
Male	15	15	30
Female	5	15	20
Total	20	30	50

a) 10 b) 18 c)12 d) 8

6. E[X+Y] = E[X] +E[Y] for [B]
a) Only independent X&Y b) any X&Y c) orthogonal X&Y d) uncorrelated X&Y

7. Which of the following is not a property of Joint distribution [D]

A. $F_{X,Y}(-\infty,-\infty) = 0$ B. $F_{X,Y}(x,-\infty) = 0$ C. $F_{X,Y}(-\infty, y) = 0$ D. $F_{X,Y}(-\infty,-\infty) = 1$

8. For N random variables, the sum YN = X1+X2+….XN, has Gaussian random variable as N tends to
[D]
_____
a)linear b)0 c)1 d)infinity

9.If X and Y are independent random variables, then E(XY) = _____ [A]
A)E[X]E[Y] B)E[X] C)E[Y] D)0

10. For two random variables X and Y, the joint probability density function, denoted f X ,Y (x, y) , is
defined by the----of the joint distribution function [ ]

11. A transformation T is called monotonically if T(x1)>T(x2) for any x1<x2 [ ]

12.If X, Y and Z are three independent random variables of the same mean and variance, the mean square value of (Y-Z) is given by_____ [ ]

13.If independent random variables X and Y have the variances 36 and 16 respectively, the correlation coefficient between (X+Y) and (X-Y), assuming X and Y possesses zero mean, is_____ [A]
a)20/52 b)51/52 c)28/52 d)52/20

14. The second joint moment about origin of two random variables x and y is given by_____. [A]
a) ∞∫ ∞∫ xyfx , y (x , y) dxdy b) ∞∫ ∞∫ xyfx , y (x , y) dxdy c) ∞∫ ∞∫ xyfx (x) dx d)none

−∞ −∞ 0 0

15.If (X, Y) are two-dimensional random variables, then_____is called joint characteristic function of (X, Y) [A]
a)Φxy(x,y) b)σxy(x,y) c)FXY(x,y) d)fxy(x,y)

16. If X and Y are two random variables, then --- called joint central moments of X and Y.[A]
a)μxy b)mxy c)σxy d)all

17. If (X, Y) are two-dimensional random variables, then E(ejω1X+jω2Y) is called _____

function of (X, Y) [A]

a)joint characteristics functionb)moment generating function
c)joint distribution function d)all

18. The $(n + K)^{th}$ order joint moment of two R.V's X and Y is defined as m_{n_1} [D]

a. $\int_{-\infty}^{\infty} x^n f(x,y)dx$

b. $\int_{-\infty}^{\infty} y^K f(x,y)dy$

c. $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(x,y)dxdy$

d. $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x^n y^K f(x,y)dxdy$

19. The $(n + K)^{th}$ order joint central moment of the R.V's X and Y is defined as m_{n_1}

[B]a. $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x^n y^K f(x,y)dxdy$

$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} g(x,y)dxdy$

b.

c. $\int_{-\infty}^{\infty}(X-m_x)^n f(x,y)dx$

d. $\int_{-\infty}^{\infty}(Y-m_y)^K f(x,y)dy$

20. Two R.Vs X and Y have the joint characteristic function [A]

ΦX,Y (w1, w2) = exp $\left(-2w_1^2-8w_2^2\right)$

themeans of X and Y respectively are

a. 0, 0
b. 0, 1
c. 1, 0
d. 1, 1

21.21.

To convert correlated R.V's X and Y into two statistically independent Gaussian r.v.'s, the co -ordinate rotation through an angle is θ = [A]

a. $\frac{1}{2}Tan^{-1}\left[\frac{2\rho\sigma_X\sigma_Y}{\sigma_X^2-\sigma_Y^2}\right]$

b. $Tan^{-1}\left[\frac{2\rho\sigma_X\sigma_Y}{\sigma_X^2-\sigma_Y^2}\right]$

c. $\frac{1}{2}Tan^{-1}\left[\frac{\rho\sigma_X\sigma_Y}{\sigma_X^2-\sigma_Y^2}\right]$

d. $Tan^{-1}\left[\frac{\rho\sigma_X\sigma_Y}{\sigma_X^2-\sigma_Y^2}\right]$

22. The R.V's X and Y are transformed to get new r.v's V and W as [B]

V = X cosθ + Ysinθ

W = X sinθ - Ycosθ

If f(x, y) = $\frac{1}{2\pi\sigma^2}\exp\left[-\frac{(x^2+y^2}{2\sigma^2}\right]$ then f(V, W) is

a. $f(x,y)\big|_{x=V;y=w}$

b. $f(x,y)\big|_{x=V;y=w}$

c. $f(x,y)\big|_{x=\cos\theta,y=\sin\theta}$

d. $f(x,y)\big|_{x=\sin\theta,y=\cos\theta}$

23. The marginal density function of X is given by fX(x) = [A]

a. $\frac{1}{\sqrt{2\pi\sigma_X^2}}\exp\left[\frac{-(x-\overline{X})^2}{2\sigma_X^2}\right]$

$\frac{1}{\sqrt{2\pi}}\exp\left[\frac{-(x-\overline{X})^2}{2\sigma_X^2}\right]$

b.

c.

d. $\frac{1}{\sqrt{2\pi}}\exp\left[\frac{(x-\overline{X})^2}{2\sigma_X{}^2}\right]$

24. X and Y are Gaussian r.v's with variances σ_X^2 and σ_y^2 . Then the R.V's V = X + KY and w = X - KY are statistically independent for K equal to [C]

a. $\sigma x \quad \sigma y$

b. $\frac{\sigma_X}{\sigma_y}$

c. $\frac{\sigma_y}{\sigma_X}$

d. $\sigma x + \sigma y$

25. Two R.V's X and Y are said to be jointly Gaussian if their joint density function is of the form $f_{X,Y}(x, y)$ =

[B]

a. $\frac{1}{2\pi\sigma_x\sigma_y}.\exp\left\{\frac{-1}{2(1-\rho^2)}\left[\frac{(x-\overline{X})}{\sigma_x{}^2}-\frac{2\rho(x-\overline{X})(y-\overline{Y})}{\sigma_x\sigma_y}+\frac{(y-\overline{Y})^2}{\sigma_y{}^2}\right]\right.$

b. $\frac{1}{2\pi\sigma_x\sigma_y\sqrt{1-\rho^2}}.\exp\left\{\frac{-1}{2(1-\rho^2)}\left[\frac{(x-\overline{X})}{\sigma_x{}^2}-\frac{2\rho(x-\overline{X})(y-\overline{Y})}{\sigma_x\sigma_y}+\frac{(y-\overline{Y})^2}{\sigma_y{}^2}\right]\right.$

c. $\frac{1}{2\pi\sqrt{1-\rho^2}}.\exp\left\{\frac{-1}{2(1-\rho^2)}\left[\frac{(x-\overline{X})}{\sigma_x{}^2}-\frac{2\rho(x-\overline{X})(y-\overline{Y})}{\sigma_x\sigma_y}+\frac{(y-\overline{Y})^2}{\sigma_y{}^2}\right]\right.$

d. $\frac{1}{\sqrt{1-\rho^2}}.\exp\left\{\frac{-1}{2(1-\rho^2)}\left[\frac{(x-\overline{X})}{\sigma_x{}^2}-\frac{2\rho(x-\overline{X})(y-\overline{Y})}{\sigma_x\sigma_y}+\frac{(y-\overline{Y})^2}{\sigma_y{}^2}\right]\right.$

26. Gaussian R.V's are completely defined through only their [C]

a. first order moments

b. Second order moments

c. first order momentst & Second order moments D.Covariance

27. Any uncorrelated Gaussian R.V's are always [B]

a. not independent

b. independent

c. have non-zero covariance
d. has correlation coefficient of unity

28. The independent R.V's with zero mean are [A]
a. orthogonal
b. non-orthogonal
c. correlated
d. have $R_{XY} \neq 0$

29. Which of the following is correct [D]
a. $\rho > 1$
b. $-\infty < \rho < \infty$
c. $0 \leq \rho \leq 1$
d. $-1 \leq \rho \leq 1$

30. X and Y are two independent normal r.v's $N(m, \sigma^2) = N(0, 4)$. Consider $V = 2X + 3Y$ is a _ R.V. [B]
a. Rayleigh
b. Gaussian
c. poisson
Binomial

31. X and Y are two independent R.V's with density $f(x) = 2.e^{-2x}$ for $x > 0$ and $f(y) = 2e^{-2y}$ for $y > 0$. The density of the R.V $Z = X - Y$ in the region $Z > 0$ is
a. e^{-2z} [A]
b. e^{2z}
c. e^{-z}
d. e^{z}

32. Let x and y be jointly Gawssian r.V's where $\sigma_X^2 = \sigma^2$ and e = -1, Find the Transformationsmatrix such that new r-V's y_1 and y_2 are statistically independent. [C]

a. $T = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

b. $T = \begin{pmatrix} \frac{1}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$

c. $T = \begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$

d. $T = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

33. Two Gaussian r.v's X_1 and X_2 have zero means and variances $\sigma_{X_1}^2 = 4$ and $\sigma_{X_2}^2 = 9$. Their Covariance $C_{X_1X_2} = 3$. [A]

If $Y_1 = X_1 - 2X_2$

$Y_2 = 3X_1 + 4X_2$ then

$\sigma_{Y_2}^2 and \sigma_{Y_1}^2$ are respectively a. 28, 252

b. 252, 28

c. 66, 142

d. 142, 66

34. Zero mean Gaussian R.V's X_1, X_2 and X_3 having a covariance matrix [C]

$$[C_X] = \begin{bmatrix} 4 & 2.05 & 1.05 \\ 2.05 & 4 & 2.05 \\ 1.05 & 2.05 & 4 \end{bmatrix}$$

are transformed to new variables $Y_1 = 5X_1 + 2X_2 - X_3$
$Y_2 = -X_1 + 3X_2 + X_3$ $Y_3 = 2X_1 - X_2 + 2X_3$

The covariance matrix of Y_1, Y_2 and Y_3 is [CY]

a. $\begin{bmatrix} 142.3 & 30 & 40.6 \\ 40.15 & 53 & 28 \\ 40.6 & 12 & 28 \end{bmatrix}$

b. $\begin{bmatrix} 142.3 & 30.3 & 41.6 \\ 40.6 & 53 & 26 \\ 41.6 & 12 & 28 \end{bmatrix}$

c. $\begin{bmatrix} 142.3 & 30.9 & 40.6 \\ 40.15 & 53.15 & 28 \\ 40.6 & 12.6 & 28 \end{bmatrix}$

d. $\begin{bmatrix} 142.3 & 30.9 & 40.6 \\ 40.6 & 12.6 & 26 \\ 40.15 & 53.15 & 28 \end{bmatrix}$

35. X_1 and X_2 be two Gaussian R.V's and let they also jointly Gaussian and let

$$Y_1 = a_{11} X_1 + a_{12} X_2$$

$$Y2 = a21\ X1 + a22$$

$$X_2$$

Define by [Y] = [T] [X] then the covariance matrix of Y1, and Y2 is

[D]a. [CY] = [T^{-1}] [CX] [T^{t}]$^{-}$1

b. [CY] = [T] [CX] [T^{t}]$^{-}$1 $C_{y_1y_2}$

c. [CY] = [T] [CX]$^{-1}$ [T^{t}]$^{-}$1

d. [CY] = [T] [CX] [T]^{t}

36 .If X and Y are independent R.V's then density of Z = X + Y is----- of the individual densities of X and Y. [A]

a. Convolution
b. Fourier Transform
c. Laplace transform
d. Z - Transform

37. Two Gaussian R.V's X1 and X2 are defined by the mean and covariance matrices [D]

$$\overline{X} = \begin{bmatrix} 2 \\ -1 \end{bmatrix}; [C_X] = \begin{bmatrix} 5 & -2/\sqrt{5} \\ -2/\sqrt{5} & 4 \end{bmatrix}$$

Two new R.V's Y1 and Y2 are formed using the transformation.

$$[T] = \begin{bmatrix} 1 & \frac{1}{2} \\ \frac{1}{2} & 1 \end{bmatrix}$$ Then $\rho_{y_1y_2}$ is

a.0.628 b.0.203 c.0.379 d. 0.826

38.If X, Y and Z are three independent R.V's of same mean and variance, the mean square value of (Y - Z) is [A]

a.2σx2

b. $2\sigma_Y^2$

c. $2\sigma_Z^2$

d. 0

39. X(t1) = X1 and X(t2) = X2, the correlation between X1 and X1 is R(t1, t 2) = [D]

a. $\int_{-\infty}^{\infty} f(x_1, x_2 : t_1, t_2) dx_1$

b. $\int_{-\infty}^{\infty} f(x_1, x_2 : t_1, t_2) dx_2$

c. $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x_1 x_2 f(x_1, x_2 : t_1, t_2) dt_1 dt_2$

d. $\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x_1 x_2 f(x_1, x_2 : t_1, t_2) dx_1 dx_2$

40. The auto covariance of random process X(t) is CovXX(t1, t 2) [C]

a. RXX (t1, t2) - E[X(t1)]
b. RXX (t1, t2) + E[X(t2)]
c. RXX (t1, t 2) - E[X(t1)] . E[X(t2)]
d. RXX (t1, t2) + E[X(t1)] + E[X(t2)]

Unit-4:

1. Two processes X(t) and Y(t)are called mutually orthogonal if for every t1 and t2, [A]

A. RXY(t1,t2)=0 B. RXY(t1,t2)>0 C. RXY(t1,t2)<0 D. RXY(t1,t2)=1

2. Which of the following relation is correct [A]
A. $|\sigma XY| \leq \sigma X \sigma Y$ B. $|\sigma XY| < \sigma X \sigma Y$ C. $|\sigma XY| \geq \sigma X \sigma Y$ D. $|\sigma XY| > \sigma X \sigma Y$

3. The collection of all the sample functions is referred to as [A]
A. Ensemble B. Assumble C. Average D. Sset.

4. Two processes X(t) and Y(t)are called mutually orthogonal if for every t1 and t2, [A]
A. RXY(t1,t2)=0 B. RXY(t1,t2)>0 C. RXY(t1,t2)<0 D. RXY(t1,t2)=1

5. A random process X(t), has time averages equal to ensemble averages, such a random process is called [B] a) stationary b) ergodic
c) cyclostationary d) None

6. Two wss processes x(t) and y(t) are jointly wide sense stationary if [C]
a) E[x(t) y(t)] = E[x(t)] E[y(t)] b) cov[x(t) y(t)] = var[x(t)] var[y(t)]
c) Rxy(t, t+ τ) = Rxy(τ) d) E[x(t)] = const & E[y(t)]= const

7. Correlation coefficient can take values in the range [B]
a) (0,1) b) (-1,1) c) (-1,0) d) (0, ∞)

8. A random process is a function of [C]
a) Sample space b) time c) sample space and time d) None

9. A random process X(t) is said to be strict sense stationary if
f X 1 X 2 .... X N (x1 , x2 ..... x N ; t1 , t 2 ,.....t N) = f X (x1 , x2 ,..... x N : t1 +Δ, t 2 +Δ,... t N +Δ)
for [D]
a) N=2 b) N= 10 c) N=5 d) any value of 'N'

10. Two random variables X & Y are orthogonal whose covariance is CXY = E[XY]-20. What is the value of cross correlation RXY = [B]
a) 10 b) 20 c) 5 d) None

11. The covariance of two random variables X and Y denoted by CXY is given by [A]
A. RXY - E[X] E[Y] B. RXY - E[X] / E[Y] C. RXY + E[X] E[Y] D. RXY+E[X] / E[Y]

12. The power density spectrum of ---is inversely proportional to frequency. [A]
A. Gaussian noise B. white noise C. resistor noise D. flicker noise

13. A stationary random process is defined as [A]
a) Statistical characteristics do not change with time
b) Statistical characteristics do not change with space
c) Temporal characteristics do not change with space
d) none

14. If the future value of a sample function can be predicted based on its past values, the process is referred to as_____process [A]
a)deterministic b)non deterministic c)stationary d)all

15.A random process X(t) of mean 3 is applied to a delay element. The mean of the output process is
_____ [A]
a)3 b)5 c)7 d)12

16. A random process is defined as X(t) =A cos(ω1t+θ), where X(t) is a uniform random variable over (0,2π). Then RXX(τ) is given by [A]
a) $(A^2/2)\cos\omega c\tau$ b) $(A^2/2)\sin\omega c\tau$ c) $(A^2/2)$ d)0

17.If X, Y and Z are uncorrelated random variables with the same variance, the correlation between (X+Y) and (Y+Z) is [B]
a)0 b)1/2 c)1 d)infinity

18.The mean square value for the Poisson process X(t) with parameter λt is given by
_____ [A]
a) λt + (λt)2 b) λt c) (λt)2 d)0

19. Binomial distribution Poisson are discrete distributions whereas the normal distribution is---[A]

a) Continuous distribution b) discrete distribution c)both d)none

20. A random process with time averages equal to ensemble averages is referred to as --- process. [B]
A) Stationary B)Ergodic C)Correlation D)All

21.The collection of all sample functions constitutes ---------- of a random process. [A]
A) EnsembleB)Assemble C)Both D)None

22.This probability ------ is called the Binomial distribution. [B]
A)Density B)Distribution C)Set D)Stationary

23. A random variable that is a function of------- is called a random process. [B]
A)Frequency B)Time C)Space D)None
24. An ergodic random process has E[X(t)]=5, then A[X(t)]= [C]
A)0 B)3 C)5 D)1

25. If two processes are ergodic and has a time cross-correlation function equal to the statistical cross correlation function then those processes are called_____. [A]
A)Correlation Ergodic B)Mean Ergodic C)Both D)None

26. Te collection of all the sample functions is referred to a as [A]
a. Ensemble
b. Assemble
c. Average
d. Set

27.If sample of X(t) is a R.V then the cumulative distribution function FX(x1 : t 1) is [C]
a.P(X(t1)) b.P(X(t1) ≤ 0) c.P (X(t1) ≤ x1) d. P (X(t1) ≥ x1)

28. The random process X(t) and Y(t) are said to be independent, if f_{XY} (x1, y1 : t 1, t 1) is = [C]
a.fX (x1 : t1) b.fY(y1 : t2) c.fX(x1 : t 1) fY(y1 : t 2) d. 0

29. A random process is defined as X(t) = cos(wo t + θ), where θ is a uniform random variable over (-π, π). The second moment of the process is [B]
a. 0 b.1/2 c.1/4 d.1

30. For the random process X(t) = A coswt where w is a constant and A is a uniform R.V over (0, 1) the mean square value is [C]
a.1/3 b.cos wt c.1/3cos^{2}wt d.1/9

31. A stationary continuous process X(t) with auto-correlation function $R_{XX}(\tau)$ is called autocorrelation-ergodic or ergodic in the autocorrelation if, and only if, for all τ [B]

a. $\frac{1}{2T}\int_{-T}^{T} X(t).X(t+\tau)dt = R_{XX}(\tau)$

$\underset{T\to\infty}{Lt}\frac{1}{2T}\int_{-T}^{T} X(t).X(t+\tau)dt = R_{XX}(\tau)$

b.

c. $\int_{-\infty}^{\infty} X(t).X(t+\tau)dt = R_{XX}(\tau)$

d. $\int_{-\infty}^{\infty} X(t).dt = 0$

32. For an ergodic process [D]

a. mean is necessarily zero
b. mean square value is infinity
c. all time averages are zero
d. mean square value

is independent if sine

33. Two processes X(t) and Y(t) are statistically independent if [D]

a. $F_{X,Y}(x_1,.....x_N,y_1.....y_M) = F_X(x_1.....x_N)F_Y(y_1.....y_M)$

b. $f_{X,Y}(x_1,.....x_N,y_1.....y_M) = f_X(x_1.....x_N)f_Y(y_1.....y_M)$

c. $F_{X,Y}(x_1,...x_N,y_1.....y_M;t_1.....t_N,t_1^1.....t_M^1) = f_X(x_1....x_N;t_1....t_N)f_Y(y_1.....y_M;t_1^1.....t_M^1)$

d. $f_{X,Y}(x_1,...x_N,y_1.....y_M;t_1.....t_N,t_1^1.....t_M^1) = f_X(x_1....x_N;t_1....t_N)f_Y(y_1.....y_M;t_1^1.....t_M^1)$

34. Let X(t) is a random process which is wide sense stationery then [C]

a. E[X(t)] = constant
b. E[X(t) . X[t + τ)] = RXX(τ)
c. E[X(t)] = constant and E[X(t) . X[t + τ)] = RXX (τ)
d. $E[X^2(t)] = 0$

35.A process stationary to all orders N = 1, 2, ---- &. For Xi = X(ti) where i = 1, 2,------- N is
called [A]

a. Strict-sense stationary b. wide-sense stationary
c. strictly stationary d. independent

36. Consider a random process X(t) defined as X(t) = A coswt + B sinwt, where w is a constant and A and B are random variables which of the following its a condition for its stationary. [A]

a. E (A) = 0, E(B) = 0

b. E (AB) $\neq$ 0 $\int_0^1 X(t).dt$

c. $E(A) \neq 0; E(B) \neq 0$

d. A and B should be independent

37. X(t) is a Gaussian process with mean = 2 and auto correlation function $5.e^{-0.2|\tau|}$.
Thenthe variance of the random variable X(2) is [D]
a.21 b.25 c.4 d. 1

38. A stationary random process X(t) is periodic with period 2T. Its auto correlation function is
a. non periodic [C]
b. periodic with period T
c. periodic with period 2T
d. periodic with period T/2

39. Which of the following is correct [A]
a. $|R_{XX}(\tau)| \leq R_{XX}(0); R_{XX}(-\tau) = R_{XX}(\tau)$
b. $|R_{XX}(\tau)| < R_{XX}(0); R_{XX}(-\tau) = -R_{XX}(\tau)$
c. $|R_{XX}(\tau)| \geq R_{XX}(0); R_{XX}(-\tau) = R_{XX}(\tau)$
d. $|R_{XX}(\tau)| > R_{XX}(0); R_{XX}(-\tau) = -R_{XX}(\tau)$

40. Let X(t) and Y(t) be two jointly stationary random process. Than $R_{YX}(-\tau)$= [A]
a. $R_{XY}(\tau)$
b. $R_{YX}(\tau)$
c. $R_{XY}(-\tau)$
d. $-R_{YX}(\tau)$

1. The time average of the autocorrelation function and the power spectral density form a pair of [C]
A. Z-transform B. Laplace transforms C. Fourier transform D. Convolution
2. If X(t) and Y(t) are orthogonal, then [B]
A. $S_{XY}(\omega) = 1$ B. $S_{XY}(\omega) = 0$ C. $S_{XY}(\omega) > 1$ D. $S_{XY}(\omega) < 1$
3. The average power PXY is [A]
A. P*YX B. - PYX C. – P*YX D. PYX
4. A system is said to be linear system if the system satisfies the [A]
A. Principle of superposition
B. Principle of homogeneity
C. Principle of superposition and principle of homogeneity
D. Reciprocity principle

5. A random process n(t) has a PSD $G(f)=\eta/2$ for $-\infty \leq f \leq \infty$. The random process is passed through a
Low pass filter which has a transfer function H(f)=2 for $-fm \leq f \leq fm$ and H(f)=0 otherwise.

Find the
PSD of the waveform at the output of the filter. [A]

a) 2 η b) η/3 c) η4 d) η/4

6. Consider a random process x(t) = cos(ωt + Θ) where ω is a real constant and Θ is a uniform random
Variable in (0, π/2). Find the average power in the process. [C]

a)2/7 b) ¼ c) 1/2 d) 1/6

7. A system is said to be linear time invariant if it satisfies_____property. [A]

A. linearity B. time invariance C. both A and B D. none

8. For_____, power spectral density at zero frequency gives the area under the graph of auto
Correlation. [A]

A. stationary random process B. wide-sense-stationary random process
C. non-stationary random process D. both A and B

9. The power density spectrum of is inversely proportional to frequency. [A]

A. Gaussian noise B. white noise C. resistor noise D. flicker noise

10. A system is said to be linear if it satisfies principles. [A]

A. superposition B. homogeneity C. both A and B D. none

Unit-5:

11. Power spectral density of real-valued random process is_____function of frequency. [A]

A. an odd B. an even C. both A and B D. none

12. The delta function is specified by spectral density function which has an amplitude spectrum associated with a_____.

13. If the input for an LTI system is a Gaussian process, the output is [B]

a) Uniform b) Gaussian c) Poisson d) binomial

14. The mean square value of a process equals the area under the graph of a power Spectral density [A]

a) λt + (λt)2 b) λt c) (λt)2 d)0

15. Wiener –khinchine relation states that---------- [A]

A) Auto correlation & PSD of random process from a Fourier transform pair
B) Auto correlation & PSD of random process from a Laplace transform pair
c) Both D) none

16. When two noisy resistors are connected in series the overall mean square noise voltage is equal to
--------- of individual mean square noise voltages. [B]

A) SUBTRACTION B) SUM C) MULTIPLICATION D) DIVISION

17. The PSD of the thermal noise is ---------- of frequency. [B]

A) Dependent B) Independent C) Depends D)none

18. The noise bandwidth is the bandwidth of --------- filter such band real and idealized filters pass the same amount of noise. [A]

a)Idealized b)LPF C)HPF D)BPF

19. Expression for power spectral density of random process X(t) is_____[A]

A) B)ΓXX(W) C)BOTH D)NONE

$$\lim_{T \to \infty} \frac{E\left[\left|X_T(\omega)\right|^2\right]}{2T} = S_{XX}(\omega)$$

20. $R_{XX}(\tau) = 4 + \cos\omega\tau$. Find average power in the process which as zero mean _____ [A]

A)4 B)5 C)7 D)9

21. The power density spectrum and the time average of_____function form a Fourier transform pair. [A]

A) Correlation B)Distribution C)Density D)All

22. The PSD of a random process X(t) = A.cos(Bt + Y), where Y is a uniform r.v over $(0, 2\pi)$ [C]

a. $\frac{\pi A^2}{2}$

b. $\frac{\pi A^2}{2}[\delta(w+B) - \delta(w-B)]$

c. $\frac{\pi A^2}{2}[\delta(w+B) + \delta(w-B)]$

d. $\frac{\pi^2 A}{2}[\delta(w-B) - \delta(w+B)]$

23. The rms bend-width interms of PSD is [A]

a. $\frac{\int_{-\infty}^{\infty} w^2 S_{XX}(w)dw}{\int_{-\infty}^{\infty} S_{XX}(w)dw}$

b. $\frac{\int_{-\infty}^{\infty} S_{XX}(w)dw}{\int_{-\infty}^{\infty} w^2 S_{XX}(w)dw}$

c. $\frac{\int_{-\infty}^{\infty} S_{XX}(w)dw}{2\pi\int_{-\infty}^{\infty} w^2 S_{XX}(w)dw}$

$\frac{2\pi\int_{-\infty}^{\infty} w^2 S_{XX}(w)dw}{\int_{-\infty}^{\infty} S_{XX}(w)dw}$

d.

24.PSD of a WSS is always [B]
a. Negative b.non-negative c.positive d.can be negative or positive

25. The average power of the periodic random process signal whose auto correlation function $R_{XX}(\tau) = \exp\left[-\frac{\tau^2}{2\sigma^2}\right]$

a. 0
b. 1 [B]
c. 2
d. 3

26. . If $S_{XX}(w) = \frac{16}{w^2+16}$ and $S_{YY}(w) = \frac{w^2}{w^2+16}$ and X(t) and Y(t) are of zero mean, [D]
then let U(t) = X(t) + Y(t). Then

SXU (w) is

a. $\frac{w^2}{w^2+16}$
b. $\frac{w}{w^2+16}$
c. $\frac{4w}{w^2+16}$
d. $\frac{16}{w^2+16}$

27. A random process is given by Z(t) = A. X(t) + B.Y(t) where 'A' and 'B' are real constants and X(t) and Y(t) are jointly WSS processes. The power spectrum SZZ(w) is

a. AB SXY (w) + AB SYX (w) [C]

b. A^2 + $B^{2,}$ + AB SXY (w) + AB SYX (w)

c. A^2 SXX(w) + AB SXY (w) + AB SYX (w) + B^2 SYY (w)

d. 0

28. A random process is given by Z(t) = A. X(t) + B.Y(t) where 'A' and 'B' are real constants and X(t) and Y(t) are jointly WSS processes. If X(t) and Y(t) are uncorrelated then SZZ (w) [B]

a. A^2 + B^2
b. A^2 SXX (w) + B^2 SYY (w)
c. AB SXY(w) + AB SYX(w)

d. 0

29. PSD is------ function of frequency [A]
a.even b.odd c.periodic d.asymmetric
30. For a WSS process, PCD at zero frequency gives [B]

a. the area under the graph of power spectral density
b. area under the graph auto correlation of the process
c. mean of the process
d. variance of the process

31. The mean square value of WSS process equals [A]

c. the area under the graph of PSD
d. the area under the graph of auto correlation of process
e. zero
f. mean of the process

32. If cross correlation is $R_{xy}(t, t+\tau) = \frac{AB}{2}[\sin w_0\tau + \cos w_0(2t+\tau)]$ the cross power spectrum is S_{XY} (w) = [D]

a. $\frac{J\pi AB}{2}[\delta(w-w_0) - \delta(w+w_0)]$

b. $\frac{\pi AB}{2}[\delta(w-w_0) - \delta(w+w_0)]$

c. $\frac{AB}{2}[\delta(w-w_0) - \delta(w+w_0)]$

d. $-J\frac{\pi AB}{2}[\delta(w-w_0) - \delta(w+w_0)]$

33. If X(t) and Y(t) are uncorrelated and of constant means E(X) and E(Y), respectively then S_{XY} (w) is

a. E(X) E(Y) [C]
b. 2E(X) E(Y) δ (w)
c. 2πE(X) E(Y) δ (w)
d. $\frac{E(X)E(Y)\delta(w)}{2}$

34. S_{YX} (w) = [B]

a.S_{XY} (w) b.S_{XY} (-w) c.S_{YX} (-w) d.- S_{YX} (w)

35. . The cross spectral density of two random process X(t) and Y(t) is

S_{XY} (w) = $\frac{}{1+\frac{jw}{K}}$ for - K w K

= 0 elsewhere where K > 0 [D]

The cross correlation function between the processes

a.

b. $\frac{1}{\pi\tau}[\sin K\tau + \cos K\tau]$

c. $\frac{1}{\pi\tau}\sin K\tau$

d. $\frac{1}{\pi\tau}[\sin K\tau + \cos K\tau] + \frac{1}{K\pi\tau^2}\sin K\tau$

$\frac{1}{\pi\tau}[\sin K\tau + \cos K\tau] - \frac{1}{K\pi\tau^2}\sin K\tau$

36. $R_{XY}(\tau)$ in terms of $S_{XY}(w)$ is [B]

a. $\int_{-\infty}^{\infty} S_{XY}(w).e^{jw\tau}dw$

b. $\frac{1}{2\pi}\int_{-\infty}^{\infty} S_{XY}(w).e^{jw\tau}dw$

c. $\int_{-\infty}^{\infty} S_{XY}(w).e^{-jw\tau}dw$

d. $\frac{1}{2\pi}\int_{-\infty}^{\infty} S_{XY}(w).e^{-jw\tau}dw$

37. $S_{XY}(w)$ in terms of $R_{XY}(\tau)$ is [A]

a. $\int_{-\infty}^{\infty} R_{XY}(\tau).e^{-jw\tau}d\tau$

b. $\frac{1}{2\pi}\int_{-\infty}^{\infty} R_{XY}(\tau).e^{-jw\tau}d\tau$

c. $\int_{-\infty}^{\infty} R_{XY}(\tau).e^{jw\tau}d\tau$

d. $\frac{1}{2\pi}\int_{-\infty}^{\infty} R_{XY}(\tau).e^{jw\tau}d\tau$

38. A random process is given by Z(t) = A.X(t) + B.Y(t) where 'A' and 'B' are real constant's ad X(t) and Y(t) are jointly WSS processes. The cross power spectrum $S_{XZ}(w)$ is [C]

a. A $S_{YX}(w)$ + B $S_{YY}(w)$

b. A $S_{XX}(w)$ + B $S_{YY}(w)$

c. A SXX (w) + B SXY (w)

d. A SYY (w) + B SXY (w)

39. If auto correlation function is $R(\tau) = e^{-\alpha|\tau|}\left[1+\alpha|\tau|\right]$ then the power spectrum of randomprocess is [B]

a. $\frac{4}{\left(\alpha^2+w^2\right)^2}$

b. $\frac{4\alpha^3}{\left(\alpha^2+w^2\right)^2}$

40. The auto correlation function of a process with PSD of $\frac{4}{1+0.25w^2}$ is [C]

a. $\frac{4.\exp(-|\tau|)}{\exp(-|\tau|)}$

b. $\frac{4.\exp(-2|\tau|)}{4\left(\alpha^2+w^2\right)^2}$

c.

d. 1

1. Self information should be
   a) Positive
   b) Negative
   c) Positive & Negative
   d) None of the mentioned
2. 2. The unit of average mutual information is
   a) Bits
   b) Bytes
   c) Bits per symbol
   d) Bytes per symbol

5. Explanation: The unit of average mutual information is bits.
6. 3. When probability of error during transmission is 0.5, it indicates that
   a) Channel is very noisy
   b) No information is received
   c) Channel is very noisy & No information is received
   d) None of the mentioned

7. 4. Binary Huffman coding is a
   a) Prefix condition code
   b) Suffix condition code
   c) Prefix & Suffix condition code
   d) None of the mentioned

8. 5. The event with minimum probability has least number of bits.
   a) True
   b) False

9. 7. When the base of the logarithm is 2, then the unit of measure of information is
   a) Bits
   b) Bytes
   c) Nats
   d) None of the mentioned

10. 6. The method of converting a word to stream of bits is called as
    a) Binary coding
    b) Source coding
    c) Bit coding
    d) Cipher coding

11. 7. When the base of the logarithm is 2, then the unit of measure of information is
    a) Bits
    b) Bytes
    c) Nats
    d) None of the mentioned

12. 8. When X and Y are statistically independent, then I (x,y) is
    a) 1
    b) 0
    c) Ln 2
    d) Cannot be determined

13. 9. The self information of random variable is
    a) 0
    b) 1
    c) Infinite
    d) Cannot be determined

14. 10. Entropy of a random variable is
    a) 0
    b) 1
    c) Infinite
    d) Cannot be determined

15. 11. Which is more efficient method?
    a) Encoding each symbol of a block
    b) Encoding block of symbols

c) Encoding each symbol of a block & Encoding block of symbols
d) None of the mentioned

16. 13. Coded system are inherently capable of better transmission efficiency than theuncoded system.
a) True
b) False

□□□*THE END* □□□

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ACADEMIC PLAN

FOR

ACADEMIC YEAR 2023-24

COURSE: II YEAR B.TECH ECE-I-SEM-R22

SUBJECT: SIGNALS AND SYSTEMS (EC304PC)

CREDITS: 4

ACADEMIC PLANNER

Subject: SIGNALS AND SYSTEMS

(1) - Preamble/Introduction
(2) - Prerequisites
(3) - Objectives and Outcomes
(4) - Syllabus
1.R22-CMREC AUTONOMOUS
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.geeksforgeeks.org, www.schools.com, Coursera ,edX, Udemy, Khan Academy, NPTEL etc along Registration procedures*)*
(10) - Question Banks
1.JNTUH/Model papers
2.GATE
(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) PREAMBLE/INTRODUCTION:

Signals analysis is very important in daily life. Hence it is required to study the different signals (continuous and discrete) and their properties. The behavior of the signals in time and frequency domain is important to analyze the response of the network. The Mathematical tools like FS, FT, LT, Z–transforms are used in the analysis of the signals. Gain the knowledge on various types of systems for performing Convolution and Correlation. Sampling of signals is required to convert continuous to discrete signals.

(2) PREREQUISITES:

This course requires the students to be familiar with Engineering Mathematics.

(3) COURSE OBJECTIVES:

- This course gives the basics of Signals and Systems required for all Electronics & Communication Engineering related courses.
- This course gives concepts of Signals and Systems and its analysis using different transform techniques and gives concept of convolution& correlation in time domain and frequency domain.

COURSE OUTCOMES:

1. Characterize various signals, systems and their time and frequency domain analysis, usingtransform techniques.
2. Identify the conditions for transmission of signals through systems and conditions forphysical realization of systems.
3. Use sampling theorem for baseband and band pass signals for various types of sampling andfor different duty cycles.
4. Apply the correlation and PSD functions for various applications.

PROGRAM EDUCATION OUTCOMES

a. Graduates will demonstrate knowledge of mathematics, science and engineering.

b. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

c. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.

d. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.

e. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.

f. Graduate will demonstrate skills to use modern engineering tools, softwares and equipment to analyze problems.

g. Graduates will demonstrate knowledge of professional and ethical responsibilities.

h. Graduate will be able to communicate effectively in both verbal and written form.

i. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

j. Graduate will develop confidence for self education and ability for life-long learning.

k. Graduate who can participate and succeed in competitive examinations.

PROGRAM OUTCOMES (POs)

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. 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.
3. 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, social, and environmental considerations.
4. 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.

5. 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.

6. 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.

7. 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.

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

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

10. 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.

11. 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.

12. 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. 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

Course Name: SIGNALS AND SYSTEMS (EC303PC)

EC304PC.1	racterize various signals, systems and their time and frequency domain analysis, usingtransform techniques.
EC304PC.2	ntify the conditions for transmission of signals through systems and conditions forphysical realization of systems.

EC304PC.**3**	sampling theorem for baseband and band pass signals for various types of sampling andfor different duty cycles.
EC304PC.**4**	ly the correlation and PSD functions for various applications.

CO-PO Matrix:

Course Outcomes (CO)	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11
EC304PC. **1**	3	3	-	-	-	-	-	-	-	-	-
EC304PC. **2**	3	3	2	-	-	-	-	-	-	-	-
EC304PC. **3**	3	3	2	2	-	-	-	-	-	-	-
EC304PC. **4**	3	3	2	2	-	-	-	-	-	-	-

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

Course Outcomes (CO's)	PSO1	PSO2
EC304PC.**1**	3	2
EC304PC.**2**	3	3
EC304PC.**3**	3	3
EC304PC.**4**	3	3

(4) SYLLABUS:

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II YEAR B.TECH ECE-I SEM L/T/P C

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SIGNALS AND SYSTEMS (EC304PC)

UNIT - I

Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

UNIT – II

Fourier series: Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function, Introduction toHilbert Transform.

UNIT - III

Signal Transmission through Linear Systems: Linear System, Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and rise time, Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution.

UNIT – IV

Laplace Transforms: Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis.

Z–Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

UNIT - V

Sampling theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.

Correlation: Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Energy Density Spectrum, Parsevals Theorem, Power Density Spectrum, Relation between Autocorrelation Function and Energy/Power Spectral Density Function, Relation between Convolution and Correlation, Detection of Periodic Signals in the presence of Noise by Correlation, Extraction of Signal from Noise by Filtering.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.

2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.

REFERENCE BOOKS:

1. Signals and Systems – Simon Haykin and Van Veen, Wiley 2 Ed.,

2. Signals and Systems – A. Rama Krishna Rao, 2008, TMH

3. Fundamentals of Signals and Systems - Michel J. Robert, 2008, MGH International Edition.

4. Signals, Systems and Transforms - C. L. Philips, J.M.Parr and Eve A.Riskin, 3 Ed., 2004, PE.

5. Signals and Systems – K. Deergha Rao, Birkhauser, 2018.

GATE SYLLABUS:

Electronics and Communications Engineering: Signals and Systems

Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

IES SYLLABUS:

Electronics and Tele Communications Engineering: Systems and Signal Processing

Systems and Signal Processing: Representation of continuous and discrete-time signals, shifting and scaling operations, linear, time-invariant and causal systems, Fourier series representation of continuous periodic signals, sampling theorem, Fourier and Laplace transform, Z transforms, Discrete Fourier, transform, FFT, linear convolution, discrete cosine transform, FIR filter, IIR filter, bilinear transformation.

(5). SUJECT EXPERTS DETAILS:

REGIONAL:

1. Dr. Nukala Suryanarayana Murthy B.E,M.S,Ph.D
   Professor
   Vasavi College of Engineering
   nsmurthy58@gmail.com

   +91 40 23146003

NATIONAL:

1. Dr. Neelakandan Rajamohan

   Assistant Professor

   Electrical Engineering **Department**

   neelakandan@iitgoa.ac.in ,0832-2490-107

INTERNATIONAL:

1. Vinay Chakravarthy Gogineni
   Post doctoral Research fellow

   Machine Inteligence Departmengt,

   Simula Research Laboratory,Norway

   Contact Number:+47 465 65 641

   Url:https://scholar.google.com/citations?user=8H5s9vEAAAAJ&hl=en

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

1. **https://ieeexplore.ieee.org/document/554425**

   Title: Externally linear, time-invariant systems and their application to companding signal processors
2. **https://ieeexplore.ieee.org/document/790671**

   Title: Fractional Fourier series expansion for finite signals and dual extension to discrete-time fractional Fourier transform

3. **https://ieeexplore.ieee.org/document/7818817**

   Title: Convergence acceleration techniques for proposed numerical inverse Laplace transform method

4. **https://ieeexplore.ieee.org/document/1161523**

   Title: A generalized transform, grouping, Fourier, Laplace and Z transforms

5. **https://ieeexplore.ieee.org/document/8076685**

   Title: Correlation formulation using relationship between convolution and correlation in linear canonical transform domain

(7) Lesson Plan

Name of the topic	Sub topics	No. of classes	Text books	Remarks
UNIT I				
Signal Analysis	What is signal and what is system? Signal types, elementary signals ,representation of signals, Analogy between vectors and signals, orthogonal signal space, Signal approximation using orthogonal functions, Mean square error	8	T1,T2,T3,R1	
	Closed or complete set of orthogonal functions ,Orthogonality in complex functions	3	T1,T2,T3	
	Exponential and sinusoidal signals, concepts of Impulse function, Unit step function , Signum function	2	T1,T2,T3	
		No. of classes required: 13		
UNIT II				
	Representation of Fourier series	2	T1,T2,T3,R1	
	Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series	3	T1,T2,T3	

Fourier series & Fourier Transforms	Exponential Fourier Series, Complex Fourier spectrum.	3	T1,T2,T3	
	Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals	3	T1,T2,T3,R2	
	Fourier Transform of Periodic Signals, Properties of Fourier Transform	4	T1,T2,T3	
	Fourier Transforms involving Impulse function and Signum function. Introduction to Hilbert Transform.	3	T1,T2,T3,R1	
	No. of classes required:15			
UNIT III				
Signal Transmission through Linear Systems	Linear System, Impulse response, Response of a Linear System, Linear Time Invariant (LTI) System, Linear Time Variant (LTV) System,	3	T1,T2,T3,R1	
	Transfer function of a LTI system, Filter characteristics of Linear Systems, Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics	3	T1,T2,T3,R1	
	Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and Rise time Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of	3	T1,T2,T3,R2	

	Convolution.			
	No. of classes required:9			
UNIT IV				
Laplace Transforms & Z–Transforms	Laplace Transforms (L.T), Inverse Laplace Transform,	2	T1,T2,T3,R1	
	Concept of Region of Convergence (ROC) for Laplace Transforms, Constraints on ROC for various classes of signals	2	T1,T2,T3,R1	
	Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis	3	T1,T2,T3	
	Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z- Transforms, Region of Convergence in Z-Transform	3	T1,T2,T3,R2	
	Constraints on ROC for various classes of signals, Properties of Z-transforms, Inverse Z-transform,	3	T1,T2,T3,R2	
	No. of classes required:13			
UNIT V				
	Sampling theorem, Types of sampling. Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling.	2	T1,T2,T3,R1	
	Reconstruction of signal from its samples,			

Sampling theorem & Correlation	Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.	2	T1,T2,T3,R1	
	Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Energy Density Spectrum, Parsevals Theorem, Power Density Spectrum	2	T1,T2,T3	
	Relation between Autocorrelation Function and Energy/Power Spectral Density Function	2	T1,T2,T3	
	Relation between Convolution and Correlation, Detection of Periodic Signals in the presence of Noise by Correlation, Extraction of Signal from Noise by Filtering.	2	T1,T2,T3,R1	
	No. of classes required:10			
	Total No. of Classes :60			

(8) SUGGESTED BOOKS:

TEXT BOOKS:

1. Signals and Systems-A.Anand Kumar ,PHI learning ,3RD edition,2013

2. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.

3. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.

REFERENCE BOOKS:

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2. Signals and Systems – A. Rama Krishna Rao, 2008, TMH

3. Fundamentals of Signals and Systems - Michel J. Robert, 2008, MGH International Edition.

4. Signals, Systems and Transforms - C. L. Philips, J.M.Parr and Eve A.Riskin, 3 Ed., 2004, PE.

5. Signals and Systems – K. Deergha Rao, Birkhauser, 2018.

(9) WEBSITES FOR SELF LEARNING RESOURCES:

1. NPTEL VIDEO LECTURES:

https://nptel.ac.in/courses/117/104/117104074/

https://nptel.ac.in/courses/108/104/108104100/

2. COURSERA:

https://www.coursera.org/learn/dsp1#syllabus

3. MIT OPEN COURSEWARE:

https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/

4. EDX:

https://www.edx.org/course/signals-and-systems-part-1

https://www.edx.org/course/signals-and-systems-part-2

4. UDEMY:

https://www.udemy.com/course/signals-and-systems-from-basics-to-advance/

(10) QUESTION BANK:


ss question bank.rar


ssgatequestions.zip

(11) CASE STUDY

https://www.researchgate.net/publication/3908099_Graphical_study_of_signals_and_systems

Title: Graphical study of signals and systems

(12) ASSIGNMENT:

ASSESSMENT PLAN FOR ACTIONS:

Assessment plan for Assignments:

Content	Weightage
Problems	60%
Descriptive	30%
Analytical/ Reasoning	10%

Assessment plan for Slip Test:

Content	Weightage
Analyzing the problems	60%
Theoretical questions	30%
Reasoning	10%

13) List of topics for student's seminars:

1. Classification of signals and systems
2. Representation of periodic signals
3. Representation on aperiodic signals
4. Filter characteristics of linear systems
5. Concept of signal bandwidth and system bandwidth
6. Concept of ROC of LT and Properties of Laplace Transforms
7. Region of Convergence in Z-Transform
8. Inverse Z-transform, Properties of Z-transforms
9. Concept of sampling theorem and effects of sampling
10. Types of sampling

(14) STEP/COURSE MATERIAL:

ssnotes.zip

(15) EXPERT LECTURE WITH TOPICS & SCHEDULES

S.NO	SUBJECT	TOPIC	YEAR	RESOURCE PERSON	DATE
1	S&S	Introduction to Vectors, Signal	II-I	Others	06/11/2023

		& Systems			
2	S&S	Sampling, Correlation &Tools of F.S,F.T,L.T,Z.T	II-I	Others	03/01/2024