IV-B.Tech (Sem- I/)

STUDENT HANDBOOK

A.Y.2018-19

Department of EEE

HOLY MARY INSTITUTE OF TECHNOLOGY & SCIENCE

Bogaram (V), Keesara (M), Medchal (Dist)

Hyderabad – 501301, Telangana State

Website: www.hits.ac.in Email: principalhitscoe@gmail.com

VISION STATEMENT

VISION STATEMENT OF HITS

To be a premier institute for the study of engineering, technology and management by maintaining high academic standards which promote the analytical thinking and independent judgment among the prime stakeholders enabling them to function responsibly in the globalized society.

MISSION STATEMENT

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- To impart quality professional education that meets the needs of present and emerging technological world.
- To strive for student achievement and success, preparing them for life and leadership with ethics.
- To provide a scholarly and vibrant learning environment that enables faculty, staff and students achieve personal and professional growth.
- To contribute to advancement of knowledge, in both fundamental and applied areas of engineering, technology & management.
- To undertake research and development works by forging alliances with research institutes, government organizations, industries and alumni and become a center of excellence for quality professional educations and research.

GOALS OF HITS

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Goals of engineering education at undergraduate / graduate level:

- Equip students with industry – accepted career and life skills
- To create a knowledge warehouse for students
- To disseminate information on skills and competencies that are in use and in demand by the industry
- To create learning environment where the campus culture acts as a catalyst to student fraternity to understand their core competencies, enhance their competencies and improve their career prospects.
- To provide base for lifelong learning and professional development in support of evolving career objectives, which include being informed, effective, and responsible participants within the engineering profession and in society.
- To prepare students for graduate study in Engineering and Technology.
- To prepare graduates to engineering practice by learning from professional engineering assignments.

VISION STATEMENT OF DEPARTMENT

To be a world leader and renowned for Electrical and Electronics Engineering and research.

MISSION STATEMENT OF DEPARTMENT

M1: To educate graduates in the basic principles underlying the field of Electrical & Electronics Engineering.

M2: To train our students to think independently in terms to master systematic approach to problem solving.

M3: To develop keen awareness of the role of engineering in the modern society.

PROGRAM EDUCATIONAL OBJECTIVES

PEOI	Be successfully employed as a Software Engineer in the field of Information Technology
PEOII	Be a successful entrepreneur and assume leadership position, responsibility within an organization
PEOIII	Progress through advanced degree or certificate programs in engineering, business, and other professionally related fields

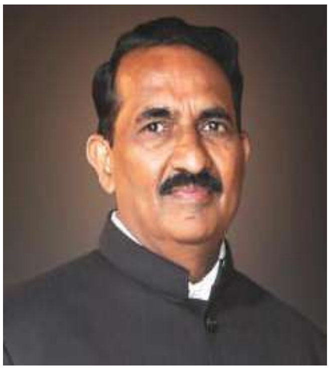
PROGRAMME OUTCOMES

PO1	An ability to apply knowledge of computing, mathematics, science, and engineering fundamentals appropriate to the discipline
PO2	Identify, formulate and analyze complex engineering problems reaching substantiated conclusions using principles of mathematics and engineering sciences
PO3	An ability to design and develop solutions for IT Problems to meet desired needs within pragmatic constraints such as economic, environmental, political, manufacturability, and sustainability
PO4	Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	An ability to use and apply modern technical concepts, tools and practices in the core Information Technologies
PO6	An ability to analyze the local and global impact of computing on individuals, organizations, and society
PO7	An ability to effectively integrate IT-based solutions into the user environment constantly
PO8	An understanding of professional, ethical, legal, security and social issues and responsibilities
PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10	Ability to communicate effectively with all stake holders
PO11	Apply Project Management skills and knowledge in Practice as a team member/ leader to manage projects
PO12	Recognition of the need for and the ability to engage in Life Long Learning

Our Pioneers...

Dr. A.VARA PRASAD REDDY – CHAIRMAN

To strive and ensure 100% employability to the student community by filling the gap between the students and the requirements of the industry through quality education".



- Graduate in Mechanical Engineering.
- Has been in the field of education from the past 25 years.
- Aim of spreading quality education among children at the school & college level.
- Committed personality with an acute interest in Spreading Technical Education.
- Also the founder chairman of Nalanda Group of Institutions, Guntur, A.P.

Dr. A.VIJAYA SARADA REDDY – SECRETARY

"Nothing is permanent in this world except change. We should change ourselves according to the industry. We mould the students as per the need of the hour. Continuous training & learning will make us always ahead from others".

- Doctorate in Management Studies
- Outstanding personality with a vision of building up the standard and quality Educational Institutions.

I sincerely hope that our students will use the facilities provided to them in our campus and find their profession and justify the trust placed in them by their family, Society and Nation in helping the Country in its march towards becoming a developed Country. Let me take this opportunity to congratulate all departments of our Holy Mary and Nalanda Group of Institutions for their untiring efforts and wish all the students the very best in their attempts to build up purposeful careers for them

Dr. P. BHASKARA REDDY – DIRECTOR

Dr.P.Bhaskara Reddy, the Director HITS is a and dynamic Professor of ECE, has 30 years of Industry, Teaching, Research and Administrative experience in Reputed Engineering Colleges & Industry. In 28 years of experience served various positions from Asst. Professor to Principal/Director.

Research & Guidance: Published 2 Books 1. "Information Technology in Technical Education – Economic Development by "LAMBERT Academic Publishing" 2. Innovative Methods of Teaching Electronic Devices and Circuits by "Hi Tech Publisher" Published 9 Laboratory Manuals, 126 Research papers at National and International Level journals / Conferences on Education, Electronics Communication, I.T, Computer Networks, E-Commerce etc. Guided 5 Research Scholars for their Doctorates, about 50 M.Tech., M.C.A. and B.Tech projects and completed 2 DST Projects an amount of Rs.72.83 Lakhs.

Symposiums Conducted: 12 National Level Technical Symposiums on various topics in Electronics & Communications, Computers etc.

Awards Received: 1). Bharath Jyothi Award in 2003 from IIFS, New Delhi, 2). Rastraprathiba Award in 2004 from ICSEP, New Delhi, 3). Knowledge Award from Alumni of SVHCE for the year 2001

1. GENERAL INFORMATION

ABOUT THE COLLEGE

1.0 BEAUTIFUL CAMPUS

Set in Sylvan surroundings away from the hustle & bustle of city life yet only 4 kms away from Hyderabad – Warangal National Highway (near Ghatkesar), the Institute is extremely conducive to academic, co-curricular and extra-curricular activities. It has large and well ventilated buildings with modern equipment in place and "State of the art", sports facilities.

HIGHLIGHTS:

1.1 PERFORMANCE

- Top 13th Rank in Telangana and Top 19th Rank in AP & Telangana and Top 107th Rank in Overall India by The Week Magazine Top 150 Engineering Colleges Ranking 2018 for the A.Y.2018-19.
- Top 04th Rank in Telangana and Top 05th Rank in AP & Telangana and Top 57th Rank in Overall India by Outlook Magazine Top 100 Engineering Colleges Ranking 2018 for the A.Y.2018-19.
- Top 17th Rank in Telangana and Top 27th Rank in AP & Telangana and Top 148th Rank in Overall India by i3RC Times of India Top 150 Engineering Institute Rankings 2018 for the A.Y.2018-19.
- Top 17th Rank in Telangana and Top 33rd Rank in AP & Telangana and Top 153rd Rank in Overall India by India Today Best 165 Engineering Colleges in India Rank 2018 for the A.Y.2018-19.
- Holy Mary Institute of Technology & Science, recognized as Business Incubator (BI) / Host Institute (HI) for implementation of the scheme "Support for Entrepreneurial and Managerial development of SMEs through Incubator" by Ministry of Micro, Small & Medium Enterprises, Govt. of India, New Delhi on 14-03-2018

1.2 FACULTY

The College is proud to have the best faculty, a blend of experienced and academics with eminent academicians team IIT's, NIT's and other reputed organizations teaching at the Institute that makes HITS as one of the best Institute pursue B.Tech, M.Tech and MBA as one of the under JNTU Hyderabad. The faculty is constantly encouraged to upgrade their qualifications and a number of them have enrolled for Ph.D.

1.3 INFRASTRUCTURES

- Spacious campus and natural surroundings with plenty of greenery
- College Transport facilities from twin cities for students and staff from all corners of the city
- Air Conditioned auditorium for organizing events, workshops and seminars
- Good Canteen facility
- Bank ATM in the campus
- Fully equipped Laboratories with the state-of-art equipment's

1.4 LABORATORIES

The Institute has State of the art laboratories with 1000 plus Branded Systems equipped with latest hardware and software with online testing facility catering to the needs of CSE. The Institute also has well equipped ECE, EEE, Civil, Mechanical Engineering Labs and Workshops for Engineering Students.

1.5 ENGLISH LANGUAGE LABORATORY

The Institute has established Ultramodern Computerized English language Laboratory with 60 plus Computer Systems loaded with latest Software to enhance the Soft skills of Students to make the Students Industry ready.

The Library also have the previous University Exam Question papers and previous project reports from all the departments. The library contains recorded lectures of all IIT professors from NPTEL.

1.6 R&D CELL

The Institute has an R&D Cell under the Chairmanship of Dr.P.Bhaskara Reddy. The R&D cell undertakes externally funded R&D projects from agencies like AICTE, DST, UGC and other similar state, private and society / trust bodies. It also undertakes research publications and interactions of faculty members with outside world.

1.7 LIBRARY

The Institute Library has over 49500 books and 150 National and International journals and 15 Magazines that are required to all branches of Engineering. The Institute has the unique distinction of becoming Member of DELNET, Infotrac engineering online journals that connects more than 700 libraries in Asia Pacific Region. The Library has 30 Computers with 10 Mbps, Internet Facility that makes our knowledge Savvy Students to be technically competent on par with Industry professionals. NPTEL Videos and e-books, MIT courses also available.

1.8 NATIONAL PROGRAMME ON TECHNOLOGY ENHANCED LEARNING (NPTEL)

The main objective of NPTEL program is to enhance the quality of engineering education in the country by developing curriculum based video and web courses. This is being carried out by seven IITs and IISc Bangalore as a collaborative project. In the first phase of the project, supplementary content for 129 web courses in engineering / science and humanities have been developed. Each course contains materials that can be covered in depth in 60 or more lecture hours. In addition, 110 courses have been developed in video format, with each course comprising of approximately 60 or more one-hour lectures. In the next phase other premier institutions are also likely to participate in content creation.

1.9 CO-CURRICULAR ACTIVITIES

The Institution organizes Local Industrial Visits to Organizations like Infosys, CPRI, TSRTC, and to Student Conferences. The Institute focuses on Techno Management Events like Elysium to enhance the Technical Skills and Soft Skills to make them Employable.

1.10 PROFESSIONAL BODIES

Holy Mary Institute of Technology & Science has the unique distinction of becoming Institutional Member in Professional bodies such as Confederation of Indian Industry (CII), The Associated Chambers of Commerce of India (ASOCHAM)), Confederation Of Women Entrepreneurs (COWE), Computer Society of India (CSI), Institute of Electronics and Telecommunication Engineering (IETE), Indian Society of Technical Education (ISTE) and Indian Institutions of Production (IIP)

1.11 EXTRA-CURRICULAR ACTIVITIES

HITS has State of the art facilities like Olympic Style Basketball Court, Volleyball Court, Gymnasium, Indoor Stadium, Cricket Stadium. HITS has been regularly conducting JNTU Zonal Games and Annual Open Invitational Volleyball, Football, Cricket Tournaments.

The Institute also organizes various Cultural Events like Traditional Day for freshers, "ELYSIUM" A National Level Technical Fest, The Annual Day Celebrations, Farewell Party for final year students, Alumni Meet for Ex. Students and Graduation Day for graduated students every year to imbibe a spirit of Oneness.

NSS Activities:

A Sense of social responsibility is inculcated in Young Minds by organizing Plantation Programmes, Health Awareness Camps, Blood Donation Camps, Flood Relief Camps and Distribution of Books to School Childrens by HITS NSS Volunteers.

1.12 IN HOUSE PROJECTS

The students are taking part in International Project competitions hosted by major MNCs, like IBM, Microsoft and Infosys. The Great Mind Challenge hosted by IBM, Microsoft Imagine Cup and project work as part of foundation programme conducted under the aegis of Infosys are some of the important projects presently being undertaken by the students of HITS. Further, the students are encouraged to do In House Projects under the supervision of expect faculty members. In addition, students are encouraged to give innovative ideas and do projects under the aegis of Microsoft academic innovative alliance.

1.13 MOUs

- Ramtech Industries
- Tata Strive
- Bhartiya Skill Development University
- Arrow Constructions
- Techona Enterprises
- Surya Tech Solutions
- EDS Technologies Pvt Ltd
- Seoul National University (Korea)
- Ark Infosolutions Pvt Ltd
- Steinmetz Integrated Learning Solutions Pvt Ltd

- IBM
- Oracle
- Microsoft
- Abigya Training & Consultant
- Ramsys Infocad

For giving special training programmes to engineering students and Faculty members of the institute

1.14 STUDENT ACHIEVEMENTS

- Mr. D Bala Koti student of 3rd year Mechanical has got Rs. 7.00 Lakhs project fund from AICTE-New Delhi and project entitle SAE Baha.
- Mr. D Bala Koti student of 3rd year Mechanical has participated in the workshop on Automobile Engine Mechanics and won Campus Ambassador Award organized by IIT, Hyderabad held on 06th & 07th January 2018.
- Ms. V Veda & Mr. K Vishal students of 3rd year Civil have participated in the event of poster presentation and won 1st prize at Advitiya-2K18 organized by TKR College Engineering & Technology, Hyderabad held on March 2018.
- Mr. V Srikanth Raju, Mr.K Saicharan Reddy, Mr. P Saikiran Reddy, Mr. J Rajashekar Reddy & Mr. D Hari Prasad students of 3rd year ECE have participated and won 1st prize in Utkraanti, A National Level Championship on IOT workshop organized by HITS, Hyderabad held on 27th & 28th February 2018.
- Mr. D Bala Koti student of 3rd year Mechanical has participated and won 3rd prize in Utkraanti, A National Level Championship on IOT workshop organized by HITS, Hyderabad held on 27th & 28th February 2018.
- Ms. A K Keerthi Supraja & Ms.Ayushee students of 2nd year Civil have participated in the event of paper presentation and won 1st prize at National level students Technical Symposium (Tech Samprathi 2018) organized by NREC, Hyderabad held on 05th & 06th January 2018.
- Mr. J Anoop Sai & Mr.K Bharat Kumar students of 2nd year ECE have participated in the event of poster presentation and won 2nd prize at National level Inter College Technical Championship (HAVANA-Trigger Your Skills) organized by GITAM University, Hyderabad held on 19th & 20th December 2017.
- Mr. K Satish, Mr. B Ajay & Mr. M.Vijay students of 4th year EEE have participated in the event of project Expo Competition and won 2nd prize at Prajwalan-2K18 organized by Vignan's Institute of Management & Technology for Women, Hyderabad held on 03rd February 2018.
- Ms. P Chaitanya & Mr. P Mahesh Kumar students of 3rd year EEE have participated in the event of paper presentation and won 1st prize at TechVeda-18 organized by Tirumala Engineering College, Hyderabad held on 19th - 23rd February 2018.
- Mr. M Vijay & Mr. K Satish students of 4th year EEE have participated in the event of Tech Expo and won 1st prize at Reva-2K18 organized by Tirumala Engineering College, Hyderabad held on 19th - 23rd February 2018.
- Mr. B Ajay & Mr. K Satish students of 4th year EEE have participated in the event of paper presentation and won 1st prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.
- Mr. A Dhanunjay & Mr. P Sandesh students of 2nd year Mechanical have participated in the event of paper presentation and won 1st prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.
- Mr. Y S J Srivathsa & Mr.M.Sai Nikhil students of 2nd year Mechanical have participated in

the event of Assembly & Dissembly and won 1st prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.

- ❖ Mr. P Yashwanth & Mr.K Sridhar Goud students of 2nd year Mechanical have participated in the event of Assembly & Dissembly and won 2nd prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.
- ❖ Mr. M Nuthan Kumar, Mr. A Vikesh & Mr.G Mahesh students of 2nd year Mechanical have participated in the event of Assembly & Dissembly and won 3rd prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.
- ❖ Mr. M Aravind student of 2nd year Mechanical has participated in the event of Tools & Part Identification and won 2nd prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.
- ❖ Mr. K Ashish Patel & Mr. V Naveen Reddy students of 2nd year Mechanical have participated in the event of paper presentation and won 2nd prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.
- ❖ Mr. K Tilak, Mr. Ahmed Humzah & Mr. Rajneesh Kumar Singh students of 2nd year Mechanical have participated in the event of paper presentation and won 3rd prize at Texzellenz-18 organized by Anurag College of Engineering, Hyderabad held on 16th & 17th February 2018.
- ❖ Mr. K Satish & Mr. B Ajay students of 4th year EEE have participated in the event of paper presentation and won 1st prize at Prajwalan-2K18 organized by at Vignan's Institute of Management & Technology for Women, Hyderabad held on 03rd February 2018.
- ❖ Ms. K Lavanya & Mr. B Prakash students of 4th year ECE have participated in the event of Mehandi Competition and won 2nd prize at Prajwalan-2K18 organized by at Vignan's Institute of Management & Technology for Women, Hyderabad held on 03rd February 2018.
- ❖ Ms. U Ashmita student of 3rd year ECE has participated in the event of paper presentation and won 1st prize at Prajwalan-2K18 organized by at Vignan's Institute of Management & Technology for Women, Hyderabad held on 02nd February 2018.
- ❖ Mr. D Bala Koti student of 3rd year Mechanical has participated in the workshop organized by IIT, Hyderabad and awaded with appreciation certificate held on 26th & 27th January 2018.
- ❖ Mr. P Chaitanya student of 3rd year EEE has participated in the event of paper presentation and won 2nd prize in CSI Brainwaves-2K18 organized by MREC, Hyderabad held on 25th January 2018.
- ❖ Our Voleyball team participated and bagged Runners in the sports fest held at Samskruthi Engineering College, Hyderabad.
- ❖ Our Voleyball team participated and bagged Runners in the sports fest held at MRCET, Hyderabad on 02nd & 03rd February 2018.
- ❖ Our Football team participated and bagged Runners in the sports fest held at MRCET, Hyderabad on 02nd & 03rd February 2018.
- ❖ Ms.P.Sandhya student of ECE has participated in the Carrom and bagged 2nd Place in the sports fest held at Vignan's Institute of Management & Technology for Women, Hyderabad.
- ❖ Ms.K Anushkala Sinha student of ECE has participated in the Chess and bagged 2nd Place in the sports fest held at Vignan's Institute of Management & Technology for Women, Hyderabad.
- ❖ Mr. D Shashank student of 1st year CSE has participated in the event of Telangana 4th senior inter district Sepaktakraw Championship 2017 and won 3rd place organized by Adilabad District Sepaktakraw Association held on 06th & 07th January 2018.

1.15 ALUMNI OUTREACH

- The Institute has Alumni Association under the name and Style of HITS Alumni Association and conducted the First Alumni Meet on Feb 2010 at Ramada Manohar Hotel Hyderabad with the batches 0f 2005, 2006, 2007 & 2008 passed out B.Tech & MBA students attending the meet.

- The Association conducted 2nd Alumni meet for B.Tech & MBA students on February 2011 at our college Auditorium.
- The Association conducted 3rd Alumni meet for B.Tech & MBA students on February 2012 at our college Auditorium.
- The Association conducted 4th Alumni meet for B.Tech & MBA students on February 2013 at our college Auditorium.
- The Association conducted 5th Alumni meet for B.Tech, M.Tech & MBA students on February 2014 at our college Auditorium.
- The Association conducted 6th Alumni meet for B.Tech, M.Tech & MBA students on February 2015 at our college Auditorium.
- The Association conducted 7th Alumni meet for B.Tech, M.Tech & MBA students on February 2016 at our college Auditorium.
- The Association conducted 8th Alumni meet for B.Tech, M.Tech & MBA students on February 2017 at our college Auditorium.

1.16 CONTACT INFORMATION

Principal	- Dr.P.Bhaskara Reddy	- 9848511063
Dept. Head Civil	- Dr.M.S.Chauhan	- 7331139087
Dept. Head CSE	- Dr.Ch.V.Raghavendran	- 9848261114
Dept. Head ECE	- Mr.Y.D.Solomon Raju	- 9618111744
Dept. Head EEE	- Mr.S.Radha Krishna Reddy	- 9618111799
Dept. Head Mech	- Dr.B.S.Reddappa	- 9618111877
Dept. Head MBA	- Dr.K.Madhava Rao	- 9963343546
Dept. Head S&H	- Mr. Pratyush Kumar Patnayak	- 9948437913

2. PLACEMENT & HIGHER STUDIES

A separate T & P cell is constituted for career guidance, training & placements. Training programmes in technical, aptitude and soft skills. Several training programmes were conducted for personality development and life skills to make the students industry ready. Holy Mary Institute of Technology & Science is the only institute in Telangana to conduct online & written examination for campus recruitments where more than 35000 students from all over Telangana have taken the recruitment test conducted by MNCs like., Tata Consultancy Services, Infosys, HCL Technologies Ltd, Cognizant Technology Solutions, Mahindra Satyam, iGATE Global Solutions, Mphasis, IBM, Dell and Infotech Enterprises Ltd. The Placement Cell interacted with 156 Companies and placed more than 1000 students for Internships & Placements.

2.1 INDUSTRY GRADE SKILLS REQUIRED FOR EMPLOYMENT

Behavioral and Communication Skills are recognized as important elements in professional development of an Engineer including English for specific purposes. Employers give considerable value to these diverse set of skills at the time of interviews.

In addition to course curriculum, every student will gain the following skills during the study period:

- Analytical and Problem solving skills
- Subject – specific knowledge
- Research and improved decision making abilities
- Oral communication skills
- Managerial skills
- Understanding of other cultures
- Confidence and competence to work in International environment

As students are the future leaders, the Responsibility, Accountability and exhibiting the leadership skills should start from the first year of engineering. Every student is advised to read/practice from the following books;

- Verbal and Nonverbal by R S Agarwal
- Baron GRE
- Wren and Martin English Grammar Book

2.2 IMPORTANT CRITERIA OF EMPLOYMENT

In addition to the industry grade skills required for employment, the most important criteria for employment is that the student should get a minimum of 60% in academics with no backlogs to make them eligible for campus recruitments. In the recent past, many companies stipulated a cut of 68% for attending the interview / writing the test. Every student should Endeavour to achieve a minimum of 68% with no backlogs to make them suitable for picking up by good companies.

Job Portals:

1. www.freshersworld.com
2. www.monster.com
3. www.naukri.com

2.3 HIGHER STUDIES M.TECH

The Graduate Aptitude Test in Engineering (GATE) is an all-India examination administered and conducted in eight zones across the country by the GATE Committee comprising faculty from Indian Institute of Science, Bangalore and seven Indian Institutes of Technology on behalf of the National Coordinating Board - GATE, Department of Education, Ministry of Human Resources Development (MHRD), and Government of India.

Objective

To identify meritorious and motivated candidates for admission to Post Graduate Programmes in Engineering, Technology, Architecture and Pharmacy at the National level. To serve as benchmark for normalization of the Undergraduate Engineering Education in the country.

This provides an opportunity for advanced engineering education in India. An M.E or M.Tech degree is a desirable qualification for our young engineers seeking a rewarding professional career. Engineering students, while in the final year of their degree course, spend considerable time in seeking an opening for studies in foreign universities. The students are advised to pursue M.Tech in IIT's/NIT's/University Colleges.

MBA

Earning a Master's of Business Administration (MBA) degree can provide you with management skills and business expertise that open new career opportunities to you. An MBA program will also launch you into the much higher pay range that upper level managers and executives enjoy. Furthermore, in the high-level positions, an MBA degree will allow you to hold and your work will often be more interesting and rewarding. The students are advised to pursue M.BA in IIM's/XLRI/Reputed Business Schools.

Higher Studies Abroad

TOEFL is mandatory for seeking admission in any academic course at any level- undergraduate, graduate or post graduate, in USA and Canada. Similarly UK Universities ask for IELTS for seeking admission to graduate and past graduate courses.

GRE the Graduate Record Examination (GRE) is administered by the Educational Testing Services (ETS) for admission into all graduate academic programs (except management) in universities across USA and Canada and some selected universities across the world including India. The exam is a Computer Adaptive Test and is administered at any of the Sylvan testing centers in the country after prior registration.

The GMAT is a Computer Adaptive Test administered online by Educational Testing Services (ETS) through Sylvan testing centers located in all the major cities in India. Those who wish to enroll for courses in Business Management in American universities have to take the GMAT test and submit their scores to the department.

2.4 VARIOUS SCHOLARSHIPS AVAILABLE IN INDIA

Bharat Petroleum Scholarship For Higher Studies | Balarama Digest Scholarship | Central Institute of Indian Languages | Fair & Lovely Foundation - Project Saraswati Scholarships | Government Of India Office of the Director General of Civil Aviation Scholarship | Homi Bhabha Centre For Science Education Tata Institute of Fundamental Research Research Scholarships | HSBC Scholarships | Indian Council Of Agricultural Research Award Of National Talent Scholarship In

Agriculture | Indian Institute Of Geomagnetism Research Scholars | Invention Awards For School Children | Indian Oil Corporation Ltd (IOCL) - Scholarships | Jawaharlal Nehru Memorial Fund Jawaharlal Nehru Scholarships For Doctoral Studies | Junior Research Scholarships For Cancer Biology Tata Memorial Centre & Tata Memorial Hospital | Jaigopal Garodia Vivekananda Trust Scholarships | Lalit Kala Akademi - Scholarship | Mahindra All India Talent Scholarships For Diploma courses In Polytechnics | National Brain Research Centre Scholarships | NTPC Scholarships | National Institute Of Science Communication And Information Resources(NISCAIR) | National Board For Higher Mathematics(NBHM) | National Thermal Power Corporation Ltd.Scholarships | National Olympiad Programme | National Level Science Talent Search Examination - 2005 | Narotam Sekhsaria Scholarship Programme | National Brain Research Centre Scholarships, Post-Doctoral Fellowships | National Aptitude Test | NIIT National IT Aptitude Test | Oil And Natural Gas Corporation Ltd (ONGC) Scholarships To SC/ST Students | Office Of The Director General of Civil Aviation Scholarships Stipend to the SC/ST Candidates | Rashtriya Sanskrit Sansthan - Scholarships | Scholarships To Young Artistes | Saf-Madanjeet Singh Scholarship | Sports Authority Of India - Sports Scholarships | SAF-Madanjeet Singh Scholarship | Spic Macay Scholarships | The Childrens Foundation - Scholarships | The L&T Build-India Scholarship | The Hindu-Hitachi Scholarships | The Paul Foundation Scholarships | Technology Information Forecsting and Assessment Council(TIFAC) Women Scientist Scholarship Scheme | The Young Talent IT Scholarship The Dr.GB Scholarships Foundation |

2.5 VARIOUS INTERNATIONAL SCHOLARSHIPS AVAILABLE IN INDIA

A * STAR India Youth Scholarship | A.M.M. Arunachalam-Lakshmi Achi Scholarship For Overseas Study | British Chevening Scholarships | Bharat Petroleum - Scholarships for Higher Studies | Cambridge Nehru Scholarships | Commonwealth Scholarship and Fellowship | Czech Government Scholarship | Chevening Technology Enterprise Scholarship Programme | Chinese Government Scholarship | Greek Government Scholarships | Israel Government Scholarship | Iranian Government Scholarship | Offer of Italian Government Scholarship | Japanese Government Scholarships | K.C.Mahindra Scholarships For Post-Graduate Studies Abroad | Lady Meherbai D.Tata Scholarships | Mexican Government Scholarship | Norwegian Government Scholarships | National Overseas Scholarships/Passage Grant for ST Candidates | Portuguese Government Scholarships | Sophia Merit Scholarships Inc | Slovak Government Scholarship | SIA Youth Scholarships | The Rhodes Scholarships India | The Ramakrishna Mission Institute Of Culture Award of Debesh-Kamal Scholarships For Studies Abroad | The Inlaks Foundation - Scholarships |

Website for Higher Studies:

1. www.higherstudyabroad.org
2. www.highereducationinindia.com

3. STUDENT CAREER ORIENTED PROFESSIONAL CERTIFICATION COURSES

As per the career plan for students of Holy Mary Institute of Technology & Science with a view to bridge the gap between Industry and Academia, it has been planned to equip every student with at least three International / National certification by the time he / she completes the course of study. The details of the certification courses are given below:

Branch	**Year**	**Name of the Certification Course**
Computer Science and Engineering	2nd Year	Certificate Information Technology
	3rd Year	IBM Certified DB2 Database Associate, Infosys Campus Connect
	4th Year	IBM Certified Rational Application Developer
	4th Year	SUN Certified Java Programmer
Electrical and Electronics Engineering	2nd Year	Institute of Electronics and Telecommunication Engineering
	3rd Year	Motorola @ CAMPUS
	4th Year	IBM Certified DB2 Database Associate
Mechanical and Civil Engineering	2nd Year	Certificate in AutoCAD
	3rd Year	Certificate in HighPerMesh
	4th Year	Certificate in CATIA

4. PERFORMANCE MONITORING AND GUIDANCE

4.1 STUDENT FEEDBACK

In case the students find it difficult to cope up / understand a particular subject, they are advised to discuss it with

a. The Concerned Teacher
b. The Class Teacher
c. The Department Head
d. The Principal

Students can use the suggestion boxes for communicating feedback. Students should mention their names so that they can be informed of the progress / more details / clarifications can be obtained.

4.2 CLASS TEACHER

Every class is assigned a Class Teacher (a faculty member). Students can directly discuss their college related or personal problems related to studies with them. The Class Teachers are accessible to the students and they can talk to the Class Teacher or whenever they are free from class / lab work. Class Teacher will meet with the class representative on daily basis to discuss their day-to-day difficulties if any.

4.3 CLASS REPRESENTATIVES AND THEIR ROLES

Two students from each class are selected as the Class Representatives from the department basing on their academic performance and discipline. Department Head makes the selections.

Responsibilities of the Class Representatives:

- Communicating the departmental / college directives & information to the students.

- Collecting the feedback of difficulties faced by the students and communicating Suggestions for improvements.
- Coordinating academic events and co-curricular activities.
- Encourage students to interact for better studies, sharing books and notes.
- Compilation and submission of MIS form to class teacher at the end of the period.

4.4 PERFORMANCE COUNSELLING

Mentors will evaluate the student individually for the following:

a. Less marks in internal exams
b. Continuous absence (3 days) and shortage of attendance
c. Not understanding the subject
d. Students from Telugu medium
e. Assistance for back log subjects etc.
f. Communication with parents
g. Provide help to back log students

4.5 REMEDIAL CLASSES / TUTORIAL / REVISIONS

Remedial Classes are conducted for students who are weak and who do not perform well in their internal examinations / class tests or for the students who want extra help. Slots in the time table have been reserved for Tutorial where in the students are helped to solve the question in the class itself.

4.6 BACKLOG MANAGEMENT

The Mentors maintain a complete record of Examination results of each student and they counsel and guide them in preparing for backlogs. Students are provided with material and important questions are discussed.

4.7 CORRESPONDENCE WITH PARENTS

Parents will be informed about the performance of their ward from time to time in the semester. However, parents are requested to be in touch with the Student mentor / Department Head on a regular basis. Further, parents are sent sms on daily bases if their wards do not attend the college.

5. RULES AND REGULATIONS FOR STUDENTS

5.1 ADMINISTRATIVE

1. Students, admitted into this College, are deemed to have agreed to the rules and regulations of the college, as laid down by the College Authorities from time to time, and the rules lay down in this leaflet, issued at the time of admission.
2. Students should inform **any changes in the addresses/Phone No.** of their parents / guardians to the college office.
3. The college shall communicate to the parents \ guardians of the students from time to time regarding the regularity and performance in the examinations of their wards. The case of serious indiscipline on the part of the students (s) may also be communicated to parent (s) \ guardian (s).

5.2. ACADEMIC

1. Students should **attend the classes in - time**. Late- comers shall not be permitted to enter the class room and they are likely to **lose the attendance**.
2. Students are expected to be regular to the classes. The students shall not absent themselves for classes without prior approval. **Prior permission** shall be taken from concerned **counselor** and submitted to the **Head of the Department**.
3. In case of **ill-health**, the student should submit the **medical certificate** along with prescription, etc., from a **registered medical doctor**. The student should get the medical certificate within **two days** from the date of reporting to the college after iII health and also produce a **letter from Father/ Mother** regarding ill-health. Permission on medical grounds shall not be granted for one or two days.
4. The students should come to the laboratories with the **prescribed uniform**.
5. If a student **disturbs the class** or makes mischief, he / she will be marked absent and may be **expelled from the class**.
6. Students shall spend their **leisure time** in the library/computer center.
7. Students are expected to put up the **minimum aggregate percentage of attendance (75%)** as laid down by the JNT University. Students, falling short of 75% of attendance shall not be promoted to the next Semester \ Class.
8. Parents \ guardians of the students can contact the college authorities either in person or by post regarding discipline, regularity in attending classes, performance in the examinations, etc., of their wards.

5.3 DRESS CODE

1. Students are expected to attend the college **properly dressed**. They should wear the

prescribed uniform while attending laboratory classes.

2. Students are expected to **carry the identity cards**, issued by the college, in the campus. They are required to show the identity cards at the library, computer center, office, etc. Students without Identity Cards are not allowed in to the laboratory classes.

5.4 DISCIPLINE & PUNCTUALITY

1. No student shall **enter or leave** the class room **without the permission** of the teacher.
2. **Calling students** out of their class rooms while the lecture is in progress is prohibited.
3. Students are required to help in keeping the rooms, buildings, and premises **clean and tidy**. Writing or sticking up of posters and notices on the walls is strictly prohibited.
4. Smoking, Consumption of alcohol, intoxicating drinks or drugs is **strictly prohibited** in and around the college premises. Those indulging in such activities will be put severely or expelled.
5. Students are expected to behave well with the staff, other students and the general public. Any **misbehavior**, coming to the notice of the college authorities, will be severely dealt with.
6. The conduct of the students should be exemplary not only within the premises of the college but also outside. This will help in maintaining the **image and status** of the college.
7. Students are required to **observe silence** at all times in the college campus. They shall not talk in loud tone or call each other by shouting.
8. Students are **prohibited** from loitering in the verandahs / campus during class hours, and sitting on the steps, stair-cases or parapet walls.
9. Students are **not permitted** to resort to strikes and demonstrations within the campus. Participation in such activity entails their dismissal from the college. Any problem they face may be represented to the Counselor / Head of the Department / Principal.
10. Students are **prohibited carrying Cell Phones** and organizing any meeting or entertainment in the college campus without the permission of the college authorities.
11. The entry of **outsiders without permission** is prohibited. Any student found responsible for bringing outsiders into the campus for settling personal disputes with other students, shall be **expelled** from the college.
12. The college is entitled to take any **disciplinary action**, which is deemed necessary in the case of any indiscipline on the part of the students. The same will be reflected on the **Conduct Certificate** issued at the time of leaving the college.
13. No Student Unions, except **Professional Associations**, are **permitted** in the college.
14. If the students cause any **damage to the college property** knowingly or unknowingly individually or in a group they have to pay **5 times to cost of property** damaged them. All the students are collectively responsible for the proper maintenance college property i.e. building, furniture, lab equipment, garden, playgrounds, etc., recovery, calculated on semester to semester basis, will be collected along with examination fee for the semester.

15. Students should keep their **vehicles** only at the **parking place allotted** for the purpose. Vehicle riding in the campus is strictly prohibited.
16. Sitting on the parapet wall and Riding beyond the **parking limits**, the fine will be imposed to Rs.100.00
17. Breakage or loss of equipment /property as decided by the appropriate authority
18. The Principal/Director may, on the recommendation of the Head of the Department, or otherwise, inflict the **following punishments** in the interests of the student discipline and the Institution: fined, curtailment attendance, denial of promotion to next semester,

suspension, expulsion or such other action as deemed necessary for the maintenance of discipline in the campus

5.5 LAB CLASSES

All students must attend lab classes without fail. Those absent shall follow this procedure laid down in the prescribed format explaining valid reasons and obtain permission to attend the future classes.

5.6 FEE

1. All students admitted into this college, will be required to pay the prescribed tuition fee and other specified fees. Failure of the same will result in the cancellation of admission. No portion of fees will be refunded under any circumstances. If any student wishes to change the college or discontinue the course at any point for any reason, he \ she shall not be permitted to do so unless he \ she pays balance amount of four years fees which he \ she would have to pay, if he \she continued till the completion of the course. His \ Her original certificates including I.e., etc., will be issued only after all the dues as stated above, are cleared by the students. All senior students must pay the college fee every year on or before the 15th of July irrespective of the reopening of the college. If they fail the fine will be imposed as per norms of the management.
2. Miscellaneous fee paid for expenditure related to training programs i.e., technical or soft skills etc., is not refundable.
3. Other than the above, if any fees are levied by the University the student has to be pay the same.

5.7. TRANSPORT

All students who are availing the college bus facility must carry the bus-pass and must produce when demanded, failing which they will not allowed traveling in the bus. All students must travel in the allotted bus and routes. They should not change but occupy only their allotted seats throughout. Unauthorized students caught in the bus for not having the bus pass, should pay even if they traveled for one day also. First and second year are not allowed to bring two-wheelers.

5.8. LIBRARY RULES

1. Library Books will be issued for 15 days' time and renewal depends upon the demand of the book.
2. Silence should be strictly maintained in the library.
3. Students are responsible for the library borrower card issued to them. Loss of the library card should be reported in writing to the circulation section immediately. Duplicate library borrower card will be issued on payment of Rs.150/- after a week time from the date of application for duplicate cards.
4. The Library borrower card is not transferable.
5. Students shall not make any sort of conversation in any part of the library, causing inconvenience to others.
6. Students shall not bring their belongings inside the library and should keep them outside the library.

7. Students leaving from the library should be checked at the exit.
8. Tearing of pages/stealing of books will invite suspension from using of the library facilities and further disciplinary action will be taken against such students, as per college norms.
9. The borrower shall replace the **new book within 7 days; otherwise, he/she has to pay 3 times of the book cost, along with fine**. In case of loss of book.

5.9. GENERAL

1. All the students admitted in this college have to give an **undertaking** to abide by the **rules and regulations** of this college in prescribed format given by the college.
2. All the students **should attend** the college after vacations (Dasara / Sankranthi / Christmas / Semester term / summer) on the **re-opening day** without fail.
3. Students must **deposit all the relevant original certificates and documents** at the time of the admission Office and they will not be returned until completion of the course.
4. Admission of any student can be cancelled by the Management at any point during the course for reasons which are not in consonance with the rules and regulations and which are detrin the reputation of the college.
5. All the Students are here by informed that **college authorities will not take any responsibility** for **loss or theft of your valuable items and money** kept in your bags or somewhere else. Hence we request all the students are not to keep your valuables in class room or anywhere without your presence.
6. ***Fee for Issue of Duplicates***
    a) Duplicate Hall ticket Rs. 100.00
    b) Duplicate Identity Card Rs. 100.00
    c) Duplicate College Bus Pass Rs. 50.00
    d) Duplicate Study Certificate for same purpose Rs. 50.00
    e) Xerox copies of OD's Rs. 50.00

All Breakage etc., penalties will be displayed on the Notice Board, and must be paid by the student and no student will be allowed to write examination or internal test or laboratory test, if penalties are not paid by the due date specified in the notice or circular.

5.10. RAGGING

Ragging in any form inside or outside the college campus is banned/Prohibited vide Ragging Act 26 of AP. legislative Assembly 1997. Those who indulge in this uncivilized activity are liable for severe disciplinary actions besides being liable for prosecution.

SALIENT FEATURES

Ragging means doing an act which causes or is likely to cause insult 'or annoyance or fear or apprehension or threat or intimidation or outrage of modesty or injury to a student.

S. No.	Nature of Ragging	Punishment
1	Teasing, Embarrassing and Humiliating	Imprisonment Upto 6 Month or Fine Upto Rs 1000/- or Both.

2	Assaulting or using criminal Force or criminal intimidation	Imprisonment Upto 1 Year or Fine Upto Rs 2000/- or Both.
3	Wrongfully restraining or Confining or causing hurt	Imprisonment Upto 2 Years or Fine Upto Rs 5000/- or Both.
4	Causing grievous hurt kidnapping or raping or committing unnatural offence	Imprisonment Upto 5 Years or Fine Upto Rs 10000/- or Both
5	Causing death or abating Suicide	Imprisonment Upto 10 Years or fine Upto Rs. 50000/- or Both

Note:

1. A student convicted of any of the above offences, will be, dismissed from the college
2. A student imprisoned for more than six months for any of the above offences 'will not be admitted in any other College.
3. A student against whom there is prima facie evidence of ragging in any form will be suspended from the college immediately.

Prohibition of Ragging

1. Ragging is prohibited as per act 26 of AP. Legislative assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the college.
4. Outsiders are prohibited from entering the college premises without permission.
5. All students must carry their identity cards and show them when demanded.
6. The principal and staff will visit and inspect the rooms at any time.
7. Suspended students are debarred from entering the campus except when required to attend enquiry and to submit an explanation

6. ACADEMIC REGULATIONS R15 FOR B.TECH. (REGULAR)

(Applicable for the students of B.Tech (Regular) from the Academic Year 2017-2018 onwards)

6.1. AWARD OF B.TECH. DEGREE

A Student will be declared eligible for the award of the B.Tech. Degree if he fulfills the following academic regulations:

i) The candidate shall pursue a course of study for not less than four academic years and not more than eight years

ii) After eight academic years of course of study, the candidate is permitted to write the examinations for two more years

iii) The candidate shall register for 176 credits and secured 176 credits with compulsory subjects as listed in Table-1

Table-1: Compulsory Subjects

S.No.	Subject Particulars
1.	All practical subjects
2.	Industry oriented mini project
3.	Comprehensive Viva-Voce
4.	Seminar
5.	Project work

6.2 The students, who fail to fulfill all the academic requirements for the award of the degree within ten academic years from the year of their admission, shall forfeit their seats in B. Tech. course.

6.3 COURSES OF STUDY

The following courses of study are offered at present as specializations for the B.Tech courses

Branch Code	Branch
01	Civil Engineering
02	Electrical and Electronics Engineering
03	Mechanical Engineering
04	Electronics and Communication Engineering
05	Computer Science Engineering
08	Chemical Engineering
10	Electronics and Instrumentation Engineering
12	Information Technology

14	Mechanical Engineering(Mechatronics)
17	Electronics and Telematics Engineering
18	Metallurgy and Material Engineering
19	Electronics and Computer Engineering
20	Mechanical Engineering(Productions)
21	Aeronautical Engineering
22	Insrumentation and Control Engineering

23	Biotechnology
24	Automobile Engineering
25	Mining Engineering
26	Mining Machinery
27	Petroleum Engineering
28	Civil and Environmental Engineering
29	Mechanical Engineering(Nano Technology)
30	Agricultural Engineering
31	Computer Science & Technology

6.4 CREDITS

	I Year		Semester	
	Periods / Week	Credits	Periods / Week	Credits
Theory	03+1/03	06	04	03
	02	04	---	---
Practical	03	04	03	02
Drawing	02+03	06	03 06	02 03
Mini Project	---	----	---	02
Comprehensive	---	--	---	02

Viva Voce				
Seminar	---	---	06	02
Project	---	---	15	10

6.5 DISTRIBUTION AND WEIGHT AGE OF MARKS:

i. The performance of a student in each semester / I year shall be evaluated subject – wise with a maximum of 100 marks for theory and 75 marks for practical subject. In addition, Industry oriented mini-project, seminar and project work shall be evaluated for 50, 50 and 200 marks respectively.

ii. For theory subjects the distribution shall be 25 marks for Internal Evaluation and 75 marks for the End-Examination.

iii. For theory subjects, during a semester there shall be 2 mid-term examinations. Each mid-term examination consists of one objective paper, one essay paper and one assignment. The objective paper and the essay paper shall be for 10 marks each with a total duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for essay paper). The Objective paper is set with 20 bits of multiple choice, fill in the blanks and matching type of questions for a total of 10 marks.

Pattern of the question paper is as follows:

PART–A

Consists of ***one compulsory question*** with five sub questions each carrying one mark. For the I-Mid examinations the sub question would be from first 2 ½ units and for the II-Mid examination the sub

question would be from the remaining 2 ½ units.

PART-B

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

The mid-essay paper shall contain 3 sections, each sections consist of two questions from each unit third section consist of two questions from half unit covered in the syllabus out of which student has to answer 1 question from each section, carrying 4+4+2 marks.

The first mid-term examination shall be conducted on 1 to 2.5 units of the syllabus, the second mid-term examination shall be conducted on 2.5 to 5 units. 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-examination, and the second Assignment should be submitted before the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each candidate.

The external paper consists of two sections

Part A: compulsory questions carrying 25 marks

Part B: Totally 10 questions are given from all five units carrying 50 marks. Two questions from each unit will be given & one has to be answered each of 10 marks.

The details of the Question Paper pattern without deviating from the R15 regulations as notified in the website is as follows:

- ***The End semesters Examination will be conducted for 75 marks which consists of two parts viz. i). Part-A for 25 marks, ii). Part –B for 50 marks.***

- ***Part-A is compulsory question which consists of ten sub-questions. The first five subquestions are from each unit and carries 2 marks each. The next five sub-questions are one from each unit and carries 3 marks each.***

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

iv. For practical subjects there shall be a continuous evaluation during a semester for 25 sessional marks and 50 end semester examination marks. Out of the 25 marks for internal evaluation, day-to-day work in the laboratory shall be evaluated for 15 marks and internal practical examination shall be evaluated for 10 marks conducted by the laboratory teacher concerned. The end semester examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the clusters of colleges which are decided by the examination branch of the University.

v. There shall be an industry-oriented Mini-Project, in collaboration with an industry of their specialization, to be taken up during the vacation after III year II Semester examination. However, the mini-project and its report shall be evaluated along with the project work in IV year II Semester. The industry oriented mini-project shall be submitted in a report form and presented before the committee. It shall be evaluated for 50 marks. The committee consists of an external examiner, head of the department, the supervisor of the mini-project and a senior faculty member of the department. There shall be no internal marks for industry-oriented mini-project.

vi. There shall be a seminar presentation in IV year II Semester. For the seminar, the student shall collect the information on a specialized topic and prepare a technical report, showing his understanding of the topic, and submit it to the department. It shall be evaluated by the departmental committee consisting of head of the department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for the seminar

vii. There shall be a Comprehensive Viva-Voce in IV year II semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and

two Senior Faculty members of the Department. The Comprehensive Viva-Voce is intended to assess the student's understanding of the subjects he studied during the B. Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce.

viii. Out of a total of 200 marks for the project work, 50 marks shall be allotted for Internal Evaluation and 150 marks for the End Semester Examination (Viva Voce). The End Semester Examination of the project work shall be conducted by the same committee as appointed for the industry-oriented mini-project. In addition, the project supervisor shall also be included in the committee. The topics for industry oriented mini project, seminar and project work shall be different from one another. The evaluation of project work shall be made at the end of the IV year. The Internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project.

ix. The Laboratory marks and the sessional marks awarded by the College are subject to scrutiny and scaling by the University wherever necessary. In such cases, the sessional and laboratory marks awarded by the College will be referred to a Committee. The Committee will arrive at a scaling factor and the marks will be scaled accordingly. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective institutions as per the University rules and produced before the Committees of the University as and when asked for.

6.6 ATTENDANCE REQUIREMENTS:

i. A student is eligible to write the University examinations only if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

ii. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester or I year may be granted by the College Academic Committee.

iii. Shortage of Attendance below 65% in aggregate shall not be condoned.

iv. A student who is short of attendance in semester / I year may seek re-admission into that semester/I year when offered within 4 weeks from the date of the commencement of class work.

v. Students whose shortage of attendance is not condoned in any semester/I year are not eligible to write their end semester examination of that class and their registration stands cancelled.

vi. A stipulated fee shall be payable towards condonation of shortage of attendance.

vii. A student will be promoted to the next semester if he satisfies the attendance requirement of the present semester/I year, as applicable, including the days of attendance in sports, games, NCC and NSS activities

viii. If any candidate fulfills the attendance requirement in the present semester or I year, the shall not be eligible for readmission into the same class.

6.7 MINIMUM ACADEMIC REQUIREMENTS

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.6

i. A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/project and secures not less than 35% of marks in the end semester exam, and minimum 40% of marks in the sum total of the mid-term and end semester exams.

ii. A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement.

iii. A student will not be promoted from II year to III year unless he fulfills the academic requirement of 44 credits up to II year I semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

iv. A student shall be promoted from III year to IV year only if he fulfills the academic

requirements of 56 credits up to III year I semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

v. A student shall register and put up minimum attendance in all 176 credits and earn 176 credits. Marks obtained in the best 176 credits shall be considered for the calculation of percentage of marks.

vi. Students who fail to earn 176 credits as indicated in the course structure within ten academic years (8 years of study + 2 years additionally for appearing for exams only) from the year of their admission, shall forfeit their seat in B.Tech course and their admission stands cancelled.

7. COURSE CALENDAR FOR THE YEAR

Commencement of class work

1st spell of Instructions (Weeks)

I mid term exams (week)

2nd spell of Instructions (weeks)

II mid term exams (week)

Preparations & Practical examinations	(week)
End examinations	(weeks)
Commencement of class work for A.Y.2018-19 I sem	

IV YEAR I SEMESTER COURSE STRUCTURE

Code	Subject	L	T/P/D	Credits
A70231	Switch Gear and Protection	4	-	4
A70232	Utilization of Electrical Energy	4	-	4
A70421	Digital Signal Processing	4	-	4
A70230	Power System Operation and Control	4	-	4
A70228	**Elective-I** High Voltage Engineering VLSI Design Digital Control Systems Data Structures	4	-	4
A70226	**Elective-II** Optimization Techniques Electrical Distribution Systems Electrical Estimation and Costing	4	-	4
A70498	Microprocessors and Interfacing Devices Lab	-	3	2
A70293	Electrical Measurements Lab	-	3	2
	Total	**24**	**6**	**28**

Note: All End Examinations (Theory and Practical) are of three hours duration.

T-Tutorial **L – Lecture** **P- Practical** **C – Credits**

SWITCHGEAR AND PROTECTION

PROGRAMME: B.Tech ECE AC:YEAR: **2018-2019**	DEGREE: **B.TECH IV YEAR**
COURSE: **SWITCHGEAR AND PROTECTION**	SEMESTER: **I** CREDITS: 4 COURSE COORDINATOR: Mr.P.V.S.ADITYA
COURSE CODE: A70231 REGULATION:**R15**	COURSE TYPE: **core**
COURSE AREA/DOMAIN: EEE	CONTACT HOURS: 4 hours/Week.
CORRESPONDING LAB COURSE CODE : NILL	LAB COURSE NAME: NILL

BRIEF NOTE ON THE IMPORTANTANCE OF THE COURSE AND HOW IT FITS IN TO THE CURRICULAM

Switchgear and Protection(SGP) is concerned with the Secuirity, Protection and oppose over voltages in electrical power system. After half a century advances, SGP has become an important field, and has penetrated a wide range of applications in outside world, such as generation,Transmission and Distribution lines.

Protection of over voltages is a topic including SGP as a special case. This course will introduce the basic concepts and real time applications of different types of protecting devices. By the end of this course, the students should be able to understand the most important principles and removal of faults in SGP. The course emphasizes understanding and implementations of theoretical concepts, methods and Diagrams.

PREREQUISITES, IF ANY

- Power systems-I
- Power systems-II
- Computer methods in power systems
- Electrical machines

MARKS DISTRIBUTION:

Session Marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each Mid-term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part- B. Where part consists of short answer questions carrying total marks of 25	75	100

and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.awarded considering the average of two assignments in each course		

EVALUATION SCHEME:

S.No	Component	Total Duration	Marks
1.	I Mid Examination	90 Minutes	20
2.	I Assignment	----	05
3.	II Mid Examination	90 Minutes	20
4.	II Assignment	------	05
5.	External Examination	3 hours	75

Course Objectives:

This course introduce all varieties of circuit brekers and relays for protection of generators, transformers and feeder bus bars from over voltages and other hazards. It emphasis on neutral grounding for overall protection,

Course Outcomes:

1.Understand the operation, ratings & specifications of different types of Circuit Breakers & Auto closures.

2.Understand the necessity, construction & operation of unalike relays with applications.

3.Acquire the knowledge of protection of the Generator, Transformer, Bus bar & Feeder from distinct faults by various protection schemes

4.Capable to know the adverse effects of ungrounded systems, necessity of grounding & methods of grounding systems.

5.Understand the causes for over voltages & protection against over voltages using various devices with specifications

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

Course Code:A70231 SWITCH GEAR AND PROTECTION

UNIT-I Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages.- Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB ratings and Specifications : Types and Numerical Problems. – Auto reclosures.

Description and Operation of following types of circuit breakers: Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers.

UNIT – II Electromagnetic and Static Relays

Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays.

Relays Classification: Instantaneous, DMT and IDMT types.

Application of relays: Over current/ Under voltage relays, Direction relays, Differential Relays and Percentage Differential Relays.

Universal torque equation, Distance relays: Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison.

Static Relays: Static Relays verses Electromagnetic Relays.

UNIT – III Generator Protection

Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on % Winding Unprotected.

Transformer Protection

Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CT s Ratio, Buchholtz relay Protection.

UNIT –IV Feeder and Bus-Bar Protection

Protection of Lines: Over Current, Carrier Current and Three-zone distance relay protection using Impedance relays. Translay Relay.

Protection of Bus bars – Differential protection.

Neutral Grounding

Grounded and Ungrounded Neutral Systems.- Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance - Arcing Grounds and Grounding Practices.

UNIT – V Protection against over voltages

Generation of Over Voltages in Power Systems.-Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination -BIL, Impulse Ratio, Standard Impulse Test Wave, Volt-Time Characteristics.

TEXT BOOKS:

1.Switchgear and Protection – by Sunil S Rao, Khanna Publlishers

2.Power System Protection and Switchgear by Badari Ram , D.N Viswakarma, TMH Publications

REFERENCE BOOKS:

1.Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.

2.Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.

COURSE PLAN:

S. No	Unit No	Topic	No of sessions planned	Mode of teaching BB/PPT/OHP/MM	Reference *	Remarks
1	I	Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage Recovery voltages	3	BB	A1,B1	

2		RRRV,NUMERICAL PROBLEMS	1	BB	A1,B1	
3		Current Chopping and Resistance Switching.	1	BB	A1,B1	
4		CB ratings and Specifications	2	BB	A1,B1	
5		Numerical Problems. – Auto reclosures	1	BB	A1,B1	
6		Operation of Minimum Oil Circuit breakers.	1	BB	A1,B1	
7		Operation of Air Blast Circuit Breakers.	1	BB	A1,B1	
8		Operation of Vacuum Breakers .	1	BB	A1,B1	
9	II	Principle of Operation and Construction of Attracted armature, Balanced Beam,	2	**PPT**	A1,B1	
10		induction Disc and Induction Cup relays.	1	BB	A1,B1	
11		Relays Classification: Instantaneous, DMT and IDMT types.	1	BB	A1,B1	
12		Application of relays: Over current/ Under voltage relays, Direction relays, Differential Relays	2	BB	A1,B1	
13		Percentage Differential Relays.	1	**PPT**	A1,B1	
14		Universal torque equation, Distance relays: Impedance, Reactance	2	**PPT**	A1,B1	
15		Mho and Off-Set Mho relays.	1	**PPT**	A1,B1	
16		Characteristics of Distance Relays and Comparison.	1	**PPT**	A1,B1	
		Principle of Operation and Construction of Attracted armature, Balanced Beam,	2			
17		Static Relays verses Electro- magnetic Relays.	1	BB	A1,C1	
18	III	Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions.	3	BB	A1,C1	
19		Restricted Earth fault and Inter-turn fault Protection.	2	BB	A1,C1	
20		Numerical Problems on % Winding Unprotected	3	**PPT**	A1,C1	
21		Protection of transformers: Percentage Differential Protection.	4	**PPT**	A1,C1	

22		Numerical Problem on Design of CT s Ratio.	2	**PPT**	A1,C1	
23		Buchholtz relay Protection.	2	BB	A1,C1	
24		Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions.	3	BB	A1,C1	
25	IV	Over Current, Carrier Current and Three-zone distance relay protection	4	BB	A1,C1	
26		Translay Relay.	2	BB	A1,C1	
27		Protection of Bus bars – Differential protection.	4	BB	A1,C1	
28		Grounded and Ungrounded Neutral Systems.- Effects of Ungrounded Neutral on system performance.	2	BB	A1,C1	
29		Methods of Neutral Grounding: Solid, Resistance, Reactance - Arcing Grounds.	2	BB	A1	
30		Grounding Practices.	2	BB	A1	
31		Over Current, Carrier Current and Three-zone distance relay protection	4	BB	A1	
32	V	Generation of Over Voltages in Power Systems.-Protection against Lightning Over Voltages	2	BB	A1	
33		Valve type and Zinc-Oxide Lighting Arresters	2	BB	A1	
34		Insulation Coordination - BIL, Impulse Ratio, Standard Impulse Test Wave	2	BB	A1	
		Volt-Time Characteristics.	2			
35		Generation of Over Voltages in Power Systems.-Protection against Lightning Over Voltages	2	BB	A1	
36		Valve type and Zinc-Oxide Lighting Arresters	2	BB	A1	
37		Insulation Coordination - BIL, Impulse Ratio, Standard Impulse Test Wave	2	BB	A1	

TEXT BOOKS:A1.Switchgear and Protection – by Sunil S Rao, Khanna Publlishers

B1.Power System Protection and Switchgear by Badari Ram , D.N Viswakarma, TMH Publications.

C1.Electrical Power Systems by C.L.Wadwa

REFERENCE BOOKS:

1.Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.

2.Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.

MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objective	Course Outcomes				
	a	b	c	d	e
I	S				
II	S	S			
III			H		
IV				H	S
V					S

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
a	S													
b	S	S									S		S	S
c	S	S												
d		S					S				S		H	S
e	S		S		S		S				S		S	

1) What should be the value of fusing factor?

a. Equal to zero
b. Equal to one
c. Less than one
d. More than one

Answer -----

ANSWER: Less than one

-----:
----

2) What is the relation between the fusing current and the diameter of the wire?

a. $I = k\ d^3$
b. $I = k\ d^{3/2}$
c. $I = k\ d^2$
d. $I = k\ d^{2/3}$

Answer -----

ANSWER: $I = k\ d^{3/2}$

3) Circuit breakers usually operate under

a. Steady short circuit current
b. Sub transient state of short circuit current
c. Transient state of short circuit current
d. None of these

Answer -----

ANSWER: Sub transient state of short circuit current

-----:
----

4) The making and breaking currents of a 3 phase ac circuit breakers in power systems are respectively in ________form.

a. rms value, rms value
b. instantaneous value, rms value
c. rms value, instantaneous value
d. instantaneous value, instantaneous value

Answer -----

ANSWER: instantaneous value, instantaneous value

-----:
----

5) SF_6 is which type of gas?

a. Electro positive
b. Electro negative
c. Both (a) and (b)
d. None of these

Answer -----

ANSWER: Both (a) and (b)

-----:
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6) Why is an isolator installed?

a. To isolate one portion of the circuit from another
b. As an substitute for the circuit breaker
c. It used on either sides of the circuit breaker
d. Both (a) and (c)
e. None of these

Answer -----

ANSWER: To isolate one portion of the circuit from another

-----:
----

7) Assertion (A): In comparison to making capacity of a circuit breaker its breaking capacity is normally higher.
Reason (R): The breaking capacity of a CB is expressed as $\sqrt{3} * VI * 10^{-6}$ MVA

a. Both A and R are true and R is the correct ----- of A
b. Both A and R are true and R is not the ----- of A
c. A is true but R is false
d. A is false but R is true.

Answer -----

ANSWER: A is false but R is true.

-----:
----

8) What is the cut off current in the fuse?

a. Maximum value actually reached.

b. Rms value actually reached.
c. Average value actually reached.
d. None of the above

Answer -----

ANSWER: Maximum value actually reached.

-----:
----

9) Which circuit breaker is preferred to be installed in extra high voltage AC system?

a. Bulk oil type circuit breaker
b. Air blast circuit breaker
c. SF_6 circuit breaker
d. Vacuum circuit breaker

Answer -----

10) A three phase circuit breaker is rated 2000 MVA, 33 kV. What will be its making current?

a. 35 kA
b. 49 kA
c. 70 kA
d. 89 kA

Answer -----

ANSWER: 89 kA

-----:
----

11) A fuse wire of circular cross section has a radius of 0.8mm. The wire blows off at a current of 9A. What will be the radius of the wire that will blow off at a current of 1A?

a. 0.2 mm
b. 0.18 mm
c. 0.28 mm
d. 0.3 mm

Answer -----

ANSWER: 0.18 mm

-----:

----

12) Which among these tests are performed to check the nation or international standards?

a. Type test.

b. Production tests.
c. Site checks.
d. All of the above.

Answer -----

ANSWER: Type test.

-----:

----

13) A three phase, 33 kV oil circuit breaker is rated 1200 A, 2000 MVA, 3s. What is its symmetrical breaking current?

a. 1200 A
b. 3600 A
c. 35 kA
d. 104.8 kA

Answer -----

ANSWER: 35 kA

-----:

----

14) Refer to the following facts to answer the question

A 50 Hz, 11 kV, 3 phase alternator with earthed neutral having a reactance of 3 ohms per phase and is connected to a bus bar through a circuit breaker, if the distributed capacitance upto CB between the phase and neutral is 0.01 µ F.

What is the frequency of oscillations?

a. 10000 Hz
b. 12500 Hz
c. 12628 Hz
d. 13265 Hz

Answer -----

ANSWER: 12628 Hz

-----:

----

15) What is switchgear?

a. An apparatus used for switching, controlling and protecting the electrical circuits and equipments.

b. It detects the faults only.
c. It corrects the faults only.
d. All of the above.

Answer -----

ANSWER: All of the above.

-----:

----

16) What is the actuating quantity for the relays?

a. Magnitude
b. Frequency
c. Phase angle
d. All of these

Answer -----

ANSWER: All of these

-----:

----

17) What is / are the main disadvantage / s of using oil as the quenching medium in the circuit breakers?

a. Need periodical replacement.
b. Risk of formation of explosive mixture with air.
c. Possibility of causing fire hazards.
d. All of the above.

Answer -----

ANSWER: All of the above.

-----:

----

18) Which of the following circuit breakers has the lowest operating voltage?

a. SF6 circuit breaker
b. Air break
c. Air blast
d. Minimum oil circuit breaker

Answer -----

ANSWER: Air break

-----:

----

19) The most efficient torque producing actuating structure for the induction type relays is

a. Shaded pole structure
b. Watt hour meter structure
c. Induction cup structure
d. Single induction loop structure

Answer -----

ANSWER: Induction cup structure

-----:

----

20) Plug setting of a electromagnetic relay can be altered by varying

a. Number of ampere turns
b. Air gap of magnetic path
c. Adjustable back stop
d. None of these

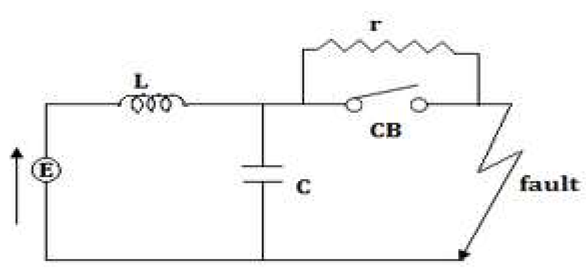
Answer -----

ANSWER: Number of ampere turns

-----:

----

21) In the following figure, the tripping circuit is__________.



a. AC
b. DC
c. Either AC or DC
d. None of these

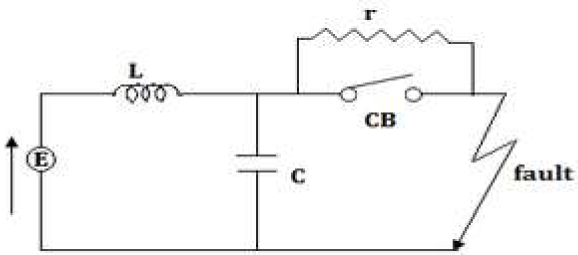
Answer -----

ANSWER: Either AC or DC

-----:

----

22) In the following figure, which component ensures the safety of the line from damage?



a. Relay
b. Circuit breaker
c. Bus bar
d. Current transformer

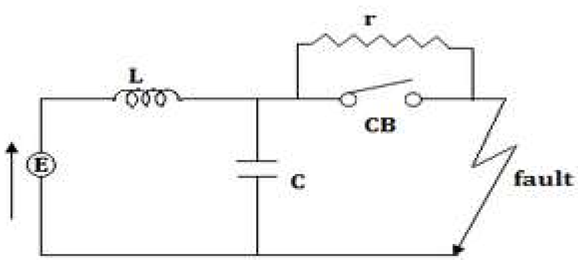
[Answer](#) [-----](#)

ANSWER: Relay

-----:

----

23) In the following figure, the relay circuit is divided into three parts. What does the third part consist of?



a. Primary winding of a current CT which is connected in series with the line to be protected.
b. Secondary of the CT and the operating coil.
c. Tripping circuit.
d. None of these

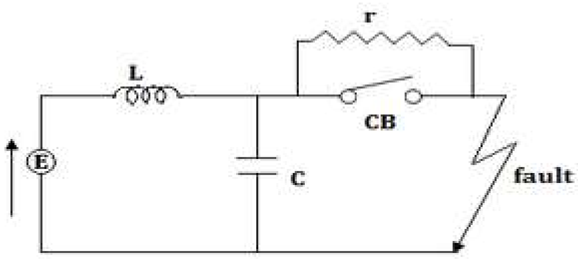
[Answer](#) [-----](#)

ANSWER: Tripping circuit.

-----:

----

24) In the following figure, the relay circuit is divided into three parts. What does the first part consist of?



a. Primary winding of a current CT which is connected in series with the line to be protected.
b. Secondary of the CT and the operating coil.
c. Tripping circuit.
d. None of these

Answer -----

ANSWER: Primary winding of a current CT which is connected in series with the line to be protected.

-----:

----

25) On what factor does the operating speed of the relay depend?

a. Rate of flux built up
b. Armature core air gap
c. Spring tension
d. All of these

Answer -----

ANSWER: All of these

-----:

----

26) Protective relays can be designed to respond to ___________.

a. Light intensity, impedance
b. Temperature, resistance, reactance
c. Voltage and current
d. All of these

Answer -----

27) What is the purpose of back up protection?

a. To increase the speed
b. To increase the reach
c. To leave no blind spot

d. To guard against failure of primary

Answer -----

ANSWER: To guard against failure of primary

-----:

----

28) What is the major cause of the failure of the circuit breaker?

a. Trip circuit open
b. Trip latch defective
c. Spring defective
d. All of these

Answer -----

ANSWER: All of these

-----:

----

29) Why are the isolators used?

a. Break abnormal current
b. Making under fault conditions
c. Breaking the circuit under no load condition
d. None of the above

Answer -----

ANSWER: Breaking the circuit under no load condition

-----:

----

30) The isolators used in the transmission lines are capable of breaking

a. Fault current
b. No current
c. Charging current
d. Load current

Answer -----

ANSWER: Charging current

-----:

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31) For which among the following the current ratings are not required?

a. Circuit breakers
b. Relays
c. Isolators
d. Load break switch

Answer -----

ANSWER: Isolators

-----:

----

32) What is the making to breaking current ratio for an extra high voltage circuit breaker?

a. More than 1
b. Equal to 1
c. Less than 1
d. A negative value

Answer -----

ANSWER: More than 1

-----:

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33) The breaking capacity of a three phase circuit breaker is given by

a. Service line voltage * rated symmetrical current in amperes * 10-6 MVA
b. √3 * Service line voltage * rated symmetrical current in amperes * 10-6 MVA
c. 1.1* Service line voltage * rated symmetrical current in amperes * 10-6 MVA
d. √2 * Service line voltage * rated symmetrical current in amperes * 10-6 MVA

Answer -----

ANSWER: √3 * Service line voltage * rated symmetrical current in amperes * 10^{-6} MVA

-----:

----

34) What is the making capacity of the circuit breaker?

a. Less than the asymmetrical breaking capacity of the breaker
b. Greater than the asymmetrical breaking capacity of the breaker
c. Equal to the asymmetrical breaking capacity of the breaker

d. Equal to the symmetrical breaking capacity of the breaker

Answer -----

ANSWER: Greater than the asymmetrical breaking capacity of the breaker

-----:

----

35) Which of the following circuit breaker is highly reliable and has a least maintenance?

a. Oil circuit breakers
b. Air blast
c. Vacuum circuit breakers
d. SF6 circuit breakers

Answer -----

ANSWER: SF_6 circuit breakers

-----:

----

36) The rating of the circuit breaker is usually determined on the basis of ____________ fault.

a. Symmetrical
b. Line to line
c. Single line to ground
d. Double line to ground

Answer -----

ANSWER: Symmetrical

-----:

----

37) Which among these circuit breakers produce the least arc energy?

a. Plain oil
b. Minimum oil
c. Air blast
d. Air break

Answer -----

ANSWER: Air blast

-----:

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38) Which of the following circuit breakers is used for the railway electrification?

a. Air blast circuit breaker
b. SF6 circuit breaker
c. Bulk oil circuit breaker
d. Minimum oil circuit breaker

Answer -----

ANSWER: Air blast circuit breaker

-----:

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39) A thermal protection switch provides protection against what?

a. Overload
b. Temperature
c. Short circuit
d. Over voltage

Answer -----

ANSWER: Overload

-----:

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40) What does protective relay provide?

a. Provide additional safety to the circuit breaker in its operation.
b. Close the contacts when the actuating quantity attains a certain predetermined value.
c. Limit the arcing current during the circuit breaker operation.
d. Earth or ground any stray voltage.

Answer -----

ANSWER: Close the contacts when the actuating quantity attains a certain predetermined value.

-----:

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41) What is the main purpose of oil in oil circuit breakers?

a. Provide insulation
b. Quenching arc.
c. Provide cooling of contacts.

d. None of the above

Answer -----

ANSWER: Quenching arc.

-----:

----

42) What is the advantage of using oil as the arc quenching medium?

a. Good cooling properties.
b. High dielectric strength.
c. Acts as an insulator.
d. All of these.

Answer -----

ANSWER: All of these.

-----:

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43) When does the arc interruption in oil circuit breaker take place?

a. Contacts apart.
b. Voltages becomes zero
c. Current goes through zero
d. All of the above

Answer -----

ANSWER: Current goes through zero

-----:

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44) For rural electrification in India, which circuit breaker is generally used?

a. Oil
b. SF6
c. Vacuum
d. Air blast

Answer -----

ANSWER: Vacuum

-----:

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45) Keeping in view the cost and the overall effectiveness, which of the following circuit breaker is best suited for capacitor bank switching?

a. Vacuum circuit breaker
b. Air blast CB
c. SF6
d. Oil CB

Answer -----

ANSWER: Vacuum circuit breaker

-----:

----

46) To limit current chopping in vacuum circuit breakers, the contact material employed should have the properties of

a. Low conductivity and high vapour pressure.
b. Low conductivity and low vapour pressure.
c. High conductivity and high vapour pressure.
d. High conductivity and low vapour pressure.

Answer -----

ANSWER: Low conductivity and high vapour pressure.

-----:

----

47) SF6 gas is imported in _____________.

a. Air cylinders
b. Gas cylinders
c. Liquid form in cylinders
d. Solid form.

Answer -----

ANSWER: Liquid form in cylinders

-----:

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48) During arc extinction SF6 gas gets converted to which among these?

a. Gets decomposed to SF4 and SF2
b. Gets decomposed to S and F

c. Gets reduced to SF6
d. Gets oxidized

Answer -----

ANSWER: Gets decomposed to SF_4 and SF_2

-----:

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49) What is the most important property which makes the SF6 very efficient medium for circuit breaking?

a. Is non toxic and non inflammable.
b. Has a high dielectric constant.
c. Has a high breakdown strength
d. Is highly electronegative gas

Answer -----

ANSWER: Is highly electronegative gas

-----:

----

50) What is the normal pressure at which the SF6 gas is maintained in the closed position of the breaker?

a. 2 kg / cm2
b. 2.5 kg /cm2
c. 2.8 kg / cm2
d. 3 kg / cm2

Answer -----

ANSWER: 2.8 kg / cm^2

-----:

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51) What is the major drawback of using SF6 circuit breakers?

a. Sealing problems of the gas.
b. Ingress of moisture in the gas system – dangerous.
c. Deterioration of SF6 gas with time.
d. Both (a) and (b)
e. None of these

Answer -----

ANSWER: Both (a) and (b)

-----:

----

52) Why do the SF6 gases have an excellent heat transfer property?

a. Low gaseous viscosity.
b. High dielectric strength.
c. Higher molecular weight.
d. Both (a) and (c)
e. None of these

Answer -----

ANSWER: Both (a) and (c)

-----:

----

53) What is the breaking capacity of the air blast circuit breaker?

a. 5000 MVA
b. 6000 MVA
c. 7000 MVA
d. 10000 MVA

Answer -----

ANSWER: 7000 MVA

-----:

----

54) In axial blast type of CB, expansion of air takes place from _______________.

a. High pressure to low pressure.
b. Low pressure to high pressure.
c. Always in high pressure.
d. Always in low pressure.

Answer -----

ANSWER: High pressure to low pressure.

-----:

----

55) The air blast circuit breakers for 400 kV systems are designed to operate in how much time?

a. 0.1 s
b. 0.5 s

c. 50 ms
d. 100µs

Answer -----

ANSWER: 50 ms

-----:

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56) What is the type of air blast in cross blast type CB?

a. The blast of air is along the arc.
b. The blast of air cuts across the arc.
c. Both (a) and (b)
d. None of the above.

Answer -----

ANSWER: The blast of air cuts across the arc.

-----:

----

57) Why is the resistance switching used in a air blast circuit breaker?

a. Reduce the magnitude of fault current.
b. Control the CB operating time.
c. Damp out the fast transient.
d. Change the fault current power factor.

Answer -----

ANSWER: Damp out the fast transient.

-----:

----

58) When using air blast circuit breaker, current chopping is a phenomenon observed when

a. A long overhead line is switched off.
b. A bank of capacitors is switched off.
c. A transformer on no load is switched off.
d. A heavy load is switched off.

Answer -----

ANSWER: A transformer on no load is switched off.

-----:

----

59) Which type of air is used in air blast circuit breaker?

a. Ionised air
b. Air free from moisture
c. Air should have least CO_2
d. Air must have oil mist.

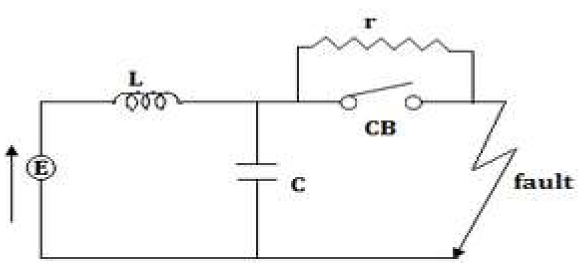
Answer -----

ANSWER: Air free from moisture

-----:

----

60) For the following figure shows a CB circuit with L - C introducing a damping circuit. For the critical damping what is the value of r?



a. √(LC)
b. 0.5*√(C/L)
c. 0.5*√(L/C)
d. 2π*√(L/C)

Answer -----

ANSWER: 0.5*√(L/C)

61) A 50 Hz 3 phase synchronous generator has inductance per phase of 15mH. The capacitance of generator and the circuit breaker is 0.002µ F. What is the natural frequency of oscillation?

a. 29 kHz

b. 2.9 kHz

c. 290 kHz

d. 29 MHz

Answer -----

ANSWER: 29 kHz

-----:

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62) What is the average rate of rise of restriking voltage upto the first peak?

a. $525 * 10^3$kV / sec
b. $453 * 10^3$kV / sec
c. $582 * 10^3$ kV / sec
d. $467 * 10^3$ kV / sec

Answer -----

ANSWER: $453 * 10^3$kV / sec

-----:

----

63) Refer to the following facts to answer the question

A 50 Hz, 11 kV, 3 phase alternator with earthed neutral having a reactance of 3 ohms per phase and is connected to a bus bar through a circuit breaker, if the distributed capacitance upto CB between the phase and neutral is 0.01 µ F.

What is the peak re striking voltage?

a. 18.36 kV
b. 17.96 kV
c. 15.96 kV
d. 12.65 kV

Answer -----

ANSWER: 17.96 kV

-----:

----

64) In a short circuit test on a circuit breaker, the following readings were obtained on single frequency transients

a. Time to reach the peak re striking voltage - 50µ sec
b. The peak re striking voltage, 100 kV

what will be the frequency of oscillations?

a. 100 Hz
b. 1,000 Hz
c. 10,000 Hz
d. 10 Hz

Answer -----

65) In a short circuit test on a circuit breaker, the following readings were obtained on single frequency transients

a. Time to reach the peak re striking voltage - 50μ sec
b. The peak re striking voltage, 100 kV

What is its average RRRV?

a. $2*10^6$kV/sec
b. $3*10^5$kV/sec
c. $2*10^5$kV/sec
d. $3*10^6$kV/sec

Answer -----

ANSWER: $2*10^6$kV/sec

-----:
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66) How is the restriking voltage measured?

a. RMS value
b. Peak value
c. Instantaneous value
d. Average value

Answer -----

ANSWER: Peak value

-----:
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67) What is the interrupting medium in the contactor?

a. Air at atmospheric pressure.

b. SF_6 gas

c. Oil

d. All of the above.

Answer -----

ANSWER: All of the above.

-----:

----

68) Recovery voltage is the value of rms voltage that reappears across the poles of a circuit breaker before_______________

a. Restriking voltage

b. Final arc extinction

c. Rise of voltage

d. All of the above

Answer -----

ANSWER: Final arc extinction

-----:

----

69) Why is it difficult to interrupt a capacitive circuit?

a. The current has a leading power factor.

b. The restriking voltage can be high.

c. Current magnitude is very small.

d. Stored energy in the capacitor is very high.

Answer -----

ANSWER: The restriking voltage can be high.

70. In order that current should flow without causing excessive heating or voltage drop, the relay contacts should

(A) Have low contact resistance

(B) Be clean and smooth

(C) Be of sufficient size and proper shape

(D) Have all above properties

Correct Answer

---

71. A transmission line is protected by

(A) Inrush protection

(B) Distance protection

(C) Time graded and current graded over current protection

(D) Both (B) and (C)

Correct Answer

---

72. The arc voltage produced in A.C. circuit breaker is always

(A) In phase with the arc current

(B) Lagging the arc current by 90°

(C) Leading the arc current by 90°

(D) None of the above

Correct Answer

---

73. To protect most of the electrical equipment handling low power, the types of relays used are

(A) Thermocouple

(B) Electronic and bimetallic

(C) Both (A) and (B)

(D) None of the above

Correct Answer

---

74. A.C. network analyzer is used to solve problems of

(A) Load flow

(B) Load flow and short-circuit

(C) Load flow and stability

(D) Load flow, short-circuit and stability

Correct Answer

---

75. ________ relay is preferred for phase fault on short transmission line.

(A) Induction type

(B) Reactance

(C) Impedance

(D) None of the above

Correct Answer

---

76. Which of the following parameter can be neglected for a short line?

(A) Inductance

(B) Capacitance

(C) Resistance

(D) Reactance

Correct Answer

---

77. Air blast circuit breakers for 400 kV power system are designed to operate in

(A) 100 microsecond

(B) 50 millisecond

(C) 0.5 sec

(D) 0.1 sec

Correct Answer

---

78. The steady state stability of the power system can be increased by

(A) Connecting lines in parallel

(B) Connecting lines in series

(C) Using machines of high impedance

(D) Reducing the excitation of machines

Correct Answer

---

79. On which of the following effects of electric current a fuse operates?

(A) Photoelectric effect

(B) Electrostatic effect

(C) Heating effect

(D) Magnetic effect

Correct Answer

View All Answers

01. Answer: Option D 02. Answer: Option D 03. Answer: Option A 04. Answer: Option C 05. Answer: Option D 06. Answer: Option B 07. Answer: Option B 08. Answer: Option B 09. Answer: Option A 10. Answer: Option C

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80. A fuse in a motor circuit provides protection against

(A) Overload

(B) Short-circuit and overload

(C) Open circuit, short-circuit and overload

(D) None of the above

Correct Answer

---

81. A short-circuit is identified by

(A) No current flow

(B) Heavy current flow

(C) Voltage drop

(D) Voltage rise

Correct Answer

---

82. In a single bus-bar system there will be complete shut down when

(A) Fault occurs on the bus itself

(B) Fault occurs on neutral line

(C) Two or more faults occur simultaneously

(D) Fault occurs with respect to earthing

Correct Answer

---

83. The inductive interference between power and communication line can be minimized by

(A) Transposition of the power line

(B) Transposition of the communication line

(C) Both (A) and (B)

(D) Increasing the distance between the conductors

Correct Answer

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84. Over voltage protection is recommended for

(A) Hydroelectric generators

(B) Steam turbine generators

(C) Gas turbine generators

(D) All of the above

Correct Answer

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85. Series reactors should have

(A) Low resistance

(B) High resistance

(C) Low impedance

(D) High impedance

Correct Answer

---

86. _________ relays are used for phase faults on long line.

(A) Impedance

(B) Reactance

(C) Either of the above

(D) None of the above

Correct Answer

---

87. Induction cup relay is operated due to changes in

(A) Current

(B) Voltage

(C) Impedance

(D) All of the above

Correct Answer

---

88. For the protection of power station buildings against direct strokes the requirements are

(A) Interception

(B) Interception and conduction

(C) Interception, conduction and dissipation

(D) Interception, conduction, dissipation and reflection

Correct Answer

---

89. The time of closing the cycle, in modern circuit breakers is

(A) 0.003 sec

(B) 0.001 sec

(C) 0.01 sec

(D) 0.10 sec

Correct Answer

View All Answers

01. Answer: Option B 02. Answer: Option B 03. Answer: Option A 04. Answer: Option C 05. Answer: Option D 06. Answer: Option A 07. Answer: Option A 08. Answer: Option D 09. Answer: Option C 10. Answer: Option A

90. Protective relays are devices that detect abnormal conditions in electrical circuits by measuring

(A) Current during abnormal condition

(B) Voltage during abnormal condition

(C) Constantly the electrical quantities which differ during normal and abnormal conditions

(D) None of the above

Correct Answer

---

91. Overheating of relay contacts or contact born out is due to

(A) Slow making and breaking of load circuit contacts

(B) Foreign matter on the contact surface

(C) Too low contact pressure

(D) All of the above

Correct Answer

---

92. An efficient and a well designed protective relaying should have

(A) Good selectivity and reliability

(B) Economy and simplicity

(C) High speed and selectivity

(D) All of the above

Correct Answer

---

93. D.C. shunt relays are made of

(A) Few turns of thin wire

(B) Few turns of thick wire

(C) Many turns of thin wire

(D) Many turns of thick wire

Correct Answer

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94. Arc in a circuit behaves as

(A) A capacitive reactance

(B) An inductive reactance

(C) A resistance increasing with voltage rise across the arc

(D) A resistance decreasing with voltage rise across the arc

Correct Answer

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95. The main function of a fuse is to

(A) Protect the line

(B) Open the circuit

(C) Protect the appliance

(D) Prevent excessive currents

Correct Answer

---

96. The current zero interruption, in oil and air blast circuit breakers, is achieved by

(A) Lengthening of the gap

(B) Cooling and blast effect

(C) Both (A) and (B)

(D) Deionising the oil with forced air

Correct Answer

---

97. Ionization in circuit breaker is facilitated by

(A) High temperature

(B) Increase of mean free path

(C) Increasing field strength

(D) All of the above

Correct Answer

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98. The delay fuses are used for the protection of ________.

(A) Motors

(B) Power outlet circuits

(C) Fluorescent lamps

(D) Light circuits

Correct Answer

100.When a wave propagates on a transmission line, it suffers reflection several times at

(A) Tapping

(B) Load end

(C) Sending end

(D) Sending and other end

Correct Answer

View All Answers

01. Answer: Option C 02. Answer: Option D 03. Answer: Option D 04. Answer: Option C 05. Answer: Option D 06. Answer: Option D 07. Answer: Option C 08. Answer: Option D 09. Answer: Option A 10. Answer: Option D

S.No	QUESTION	BLOOMS TAXONOMY LEVEL	COURSE OUTCOME
UNIT-I **CIRCUIT BREAKER-1**			
1	What is a circuit breaker ? Explain its functions.	Evaluate	1
2	Discuss the arc phenomenon in a circuit breaker	Apply	1
3	Define the following terms as applied to circuit breakers : (i) Arc voltage (ii) Re striking voltage (iii) Recovery voltage	Apply	1
4	Why are circuit breakers designed to have a short-time rating ?	Evaluate	1
5	Explain the phenomenon of current chopping	Understand	1
6	Explain the term RRRV	Evaluate	1
7	What is resistance switching?	Analyze	1
8	What is the function of Auto re closures	Analyze	1
9	What are the major duties that a circuit breaker is required to perform	Analyze	2
10	What is switchgear?	Analyze	2
11	Discuss the advantages and disadvantages of oil circuit breakers	Remember	2
12	Explain the difference between bulk oil circuit breakers and low-oil circuit breakers	Apply	2
13	Explain the terms (i) symmetrical breaking current (ii) Asymmetrical breaking current(iii) making current	Apply	2

14	What are the types of air blast circuit breaker?	Analyze	2
15	What are the advantages of SF6 circuit breaker?	Evaluate	2
16	What are the disadvantages of an Air blast circuit breaker?	Understan d	2
17	Give the advantage of SF6 circuit breaker over Air blast circuit breaker	Remember	2
18	What are the application of air blast circuit breaker	Remember	2
19	What are the disadvantage the plain break oil circuit breaker	Evaluate	2
20	What are the application of vacuum circuit breaker	Remember	
UNIT-II **ELECTROMAGNETIC AND STATIC RELAYS**			
1	What is the difference between a fuse and a relay ?	understand	3
2	What is the difference between an over current relay and current differential relay ?	understand	2
3	Why are differential relays more sensitive than over current relays?	Evaluate	3
4	What is the difference between a balanced voltage relay and a Tran slay relay?	Analyze	3
5	What is protective relay?	Apply	1
6	Define the following terms as applied to protective relaying : (*i*) Pick-up value(*ii*) Current setting	Remember	1
7	Define the following terms as applied to protective relaying *(i)* Plug-setting multiplier (ii) Time-setting multiplier	Remember	1
8	State the various applications of differential protection.	Remember	1
9	What are the essential qualities of a relay?	Analyze	1
10	How the relays are basically classified	Analyze	1
UNIT-III **GENERATOR PROTECTION**			
1	Why is overload protection not necessary for alternators?	Evaluate	5
2	What are the types of stator winding faults in alternator?	Understan d	5
3	Mention the most commonly used protection scheme for alternators	analyze	5
4	What are the rotor faults in alternator	Evaluate	5
5	What is field suppression?	Evaluate	5
6	Discuss the protection employed against loss of excitation of an alternator.	Apply	5
7	(a) What do you understand by field suppression of an alternator? (b) How is it achieved?	Apply	5
8	What type of relays are required for back-up protection of alternator	analyze	5
9	Which type of relays are used in merz-price protection system for alternator	Remember	5
10	Explain biased differential	Remember	5

TRANSFORMER PROTECTION			
1	How many faults develop in a power transformer?	Analyze	6
2	Discuss the different transformer faults	Analyze	6
3	What are the various protections usually recommended for power transformers?	Apply	6
4	What are incipient faults?	Apply	6
5	What is through fault	Remember	6
6	Name the two basic requirements that are to be fulfilled by differential relay	Evaluate	6
7	What is magnetic inrush current?	Apply	6
8	What is magnetizing current	Analyze	6
9	What is the principle of harmonic restraint relay	Evaluate	6
10	What are the advantages of differential protection scheme	Apply	6
UNIT-IV **FEEDER AND BUS-BAR PROTECTION**			
1	How earth fault protection is achieved in case of feeder?	Analyze	5
2	What are the protection scheme for the protection parallel feeder	Analyze	6
3	Explain a scheme of protection for a ring mains	Apply	6
4	What is the Merz-Price voltage protection scheme	Apply	5
5	What are the advantages of distance protection over other types of protection	Remember	6
6	What is the importance of bus-bar protection?	Evaluate	6
7	What is backup protection of bus bars?	Apply	5
8	What is differential protection of bus bars	Analyze	6
9	How does linear coupler differ from ordinary CTs?	Evaluate	6
10	What is the necessity of bus-bar protection?	Apply	6
11	What do you mean by grounding or earthling?	Analyze	6
12	What do you mean by equipment grounding?	Analyze	6
13	What is neutral grounding?	Apply	7
14	What are the advantages of neutral grounding?	Apply	6
15	What is solid grounding?	Remember	6
16	What is resistance grounding?	Evaluate	7
17	What is resonant grounding?	Apply	6
18	Where do we use grounding transformer?	Analyze	6
19	In an overhead system, most of the faults are single line to ground. Why?	Evaluate	6
20	What are the factors causing arching grounds?	Apply	7

UNIT-V PROTECTION AGAINST OVER VOLTAGES			
1	What is a voltage surge?	Analyze	6
2	What are the causes of over voltages	Analyze	6
3	What is lightning?	Apply	7
4	What are the harmful effects of lightning?	Apply	6
5	What is a surge diverter?	Remembe r	6
6	What is a surge absorber?	Evaluate	6
7	Where will you use a surge absorber?	Apply	7
8	Why is lightning accompanied by a thunder?	Analyze	6
9	What is the principle of a valve type arrester	Evaluate	7
10	What are the types of lightning stroke	Apply	6

GROUP-II (LONG ANSWER QUESTIONS)

UNIT-I CIRCUIT BREAKER-1			
S.No	**QUESTION**	**BLOOMS TAXONOMY LEVEL**	**COURSE OUTCOME**
1	What is a circuit breaker? Describe its operating principle	analyze	1
2	Explain the various methods of arc extinction in a circuit breaker	analyze	1
3	Explain the following terms as applied to circuit breakers : (i) Arc voltage (ii) Re striking voltage (iii) Recovery voltage	Evaluate	1
4	Write a short note on the rate of re-striking voltage indicating its importance in the arc extinction	Evaluate	1
5	Discuss the phenomenon of (*i*) Current chopping (*ii*) Capacitive current breaking	Analyze	1
6	Write short notes on the following (i) resistance switching (ii) circuit breaker ratings (iii) circuit interruption problems	Evaluate	1
7	(a) What is resistance switching? (b) Derive the expression for critical resistance	Evaluate	1
8	Derive an expression for restriking voltage in terms of system capacitance and inductance	Analyze	1
9	Derive the expression for recovery voltage	Apply	1
10	What are the major duties that a circuit breaker is required to perform? Explain them clearly.	Evaluate	1

11	Describe briefly the action of an oil circuit breaker. How does oil help in arc extinction?	Evaluate	2
12	Discuss the constructional details and operation of a typical low-oil circuit breaker? What are its relative merits and demerits?	Evaluate	2
13	Discuss the principle of operation of an air-blast circuit breaker. What are the advantages and disadvantages of using air as the arc quenching medium?	Analyze	3
14	Explain briefly the following types of air-blast circuit breakers : (*i*) Axial-blast type (*ii*) Cross-blast type	Apply	3
15	With neat sketch, describe the working principle of an axial air blast type circuit breaker	Evaluate	3
16	Discuss the operating principle of SF6 circuit breaker.	Apply	3
17	What are its advantages over other types of circuit breakers?	Analyze	3
18	Describe construction, operating principle and application of vacuum circuit breaker. For what voltage range is it recommended?	Evaluate	3
19	What are the different methods of testing of circuit breakers? Discuss their merits and demerits	Evaluate	3
20	Compare the performance of sf6 gas with air when used for circuit breaking	Evaluate	3
UNIT-II ELECTROMAGNETIC AND STATIC RELAYS			
1	With the help of neat sketch explain the principle of operation of Differential relays	Evaluate	2
2	Distinguish between Over current relays, Directional relays and Differential relays.	Evaluate	1
3	Define the following terms and explain their significance in distance protection (a) Reach of a distance relay. (b) Under reach	Understand	1
4	. Explain the „Differential protection'. State the various applications of differential protection.	Analyze	1
5	What are the different types of electromagnetic relays? Discuss their field of applications.	Evaluate	2
6	What are the various types of over current relays? Discuss their area of application.	Evaluate	2
7	Describe the operating principle, constructional features and area of applications of reverse power or directional relay	Evaluate	1
8	Describe the construction and principle of operation of an induction type directional over current relay.	Remember &Evaluate	1
9	Explain the working principle of distance relays	Apply	2
10	Write a detailed note on differential relays	Understand	1
UNIT-III GENERATOR PROTECTION			

1	Explain with a neat diagram the application of Merz-Price circulating current principle for the protection of alternator	Understan d	5
2	Describe with a neat diagram the balanced earth protection for small-size generators	understan d	5
3	How will you protect an alternator from turn-to-turn fault on the same phase winding?	analyze	5
4	Discuss the important faults on an alternator	understan d	5
5	What type of a protective device is used for the protection of an alternator against overheating of its (i) stator (ii) rotor? Discuss them in brief	understan d	5
6	What type of a protective scheme is employed for the protection of the field winding of the alternator against ground faults?	understan d	5
7	Draw the schematic of a Merz-price circulating method of protecting an alternator .Explain the operating principle	Understan d	5
8	Discuss suitable protection schemes for internal and external fault protection of an alternator protection of an alternator	analyze	5
9	Write short notes on the following (i) Generator faults (ii)protection of alternator(iii)over-load protection of alternator(iv)self balanced protection	analyze	5
10	Describe protection scheme of an alternator against inter-turn fault	understan d	5
	TRANSFORMER PROTECTION		
1	What factors cause difficulty in applying circulating current principle to a power transformer ?	Apply	6
2	Describe the construction and working of a Buchholz relay	Evaluate	6
3	Describe the Merz-Price circulating current system for the protection of transformers	Evaluate	6
4	Write short notes on the following (i) combined leakage and overload protection for transformers (ii) Earth fault protection for transformer	Evaluate	6
5	Describe the protection scheme for internal faults in a three phase delta/star connected power transformer. Draw a neat sketch and explain clearly why the CTs are to be connected in a particular fashion only	Apply	6
6	What protective devices other than differential protection are used for the protection of a large transformer? Briefly describe them	Analyze	6
7	Explain with a neat circuit diagram the differential protection scheme used to protect star/delta transformers.	Apply	6
8	Describe with a neat sketch the operation of Buchholz relay	Apply	6
9	Discuss the different transformer faults .What are the various protection schemes available for transformers?	Analyze	7
10	What is the principle of harmonic restraint relay? Explain its applications	Apply	7
	UNIT-IV **FEEDER AND BUS-BAR PROTECTION**		
1	Discuss the time-graded over current protection for (*i*) Radial feeders (*ii*) Parallel feeders (*iii*) Ring main system	Apply	6
2	Describe the differential pilot wire method of protection of feeders	Evaluate	

			6
3	Explain the Translay protection scheme for feeders	Evaluate	6
4	Describe distance protection scheme for the protection of feeders	Evaluate	6
5	Write short-notes on the following : (i) Fault-bus protection (ii) Merz-Price voltage balance system for protection of feeders (iii) Translay scheme	Apply	6
6	Discuss and compare briefly various bus-bar arrangement in a power system	Analyze	6
7	What are the different bus-bar arrangements possible in a substation? Discuss them briefly with application areas	Apply	6
8	What is the necessity of bus-bar protection? How bus-bar protection scheme is stabilized?	Apply	6
9	Describe with neat line diagram the principle of operation of duplicate bus- bar system in a substation	Analyze	7
10	Write short notes on the following (i) Necessity of bus-bar protection (ii) bus bar arrangement (iii) differential protection of bus bar	Apply	7
	NEUTRAL GROUNDING		
1	What is resistance grounding? What are its advantages and disadvantages?	Apply	6
2	Describe ungrounded or isolated neutral system. What are its disadvantages?	Evaluate	6
3	What do you mean by grounding or earthling? Explain it with an example	Evaluate	6
4	What is solid grounding? What are its advantages and disadvantages?	Evaluate	6
5	Describe Arc suppression coil grounding	Apply	6
6	What is the importance of arc suppression coil grounding?	Analyze	6
7	What are the various methods of neutral grounding? Compare their performance with respect to (i) protective relaying (ii) fault levels (iii) stability (iv) voltage level of power systems	Apply	6
8	Explain the phenomenon of 'Arcing grounds' and suggest the method to minimize the effect of this phenomenon	Apply	6
9	Discuss the advantages of (i) Grounding the neutral of the system (ii)keeping the neutral isolated	Analyze	7
10	The H.V. line of a single phase transformer accidently falls on L.V. line. There may be massive flash-over in a home or factory. Why?	Apply	7
	UNIT-V **PROTECTION AGAINST OVER VOLTAGES**		
1	What is a voltage surge? Draw a typical lightning voltage surge	Apply	6
2	Discuss the causes of over voltages	Evaluate	6
3	What is lightning? Describe the mechanism of lightning discharge	Evaluate	6
4	Describe the various types of lightning stroke	Evaluate	6

5	How do earthling screen and ground wires provide protection against direct lightning strokes?	Apply	6
6	What is a surge diverter? What is the basic principle of operation of a surge diverter?	Analyze	6
7	Write short notes on the following surge diverters (i) Rod gap diverter (ii) Horn gap diverter	Apply	6
8	Write short notes on the following surge diverters (i) Expulsion type diverter (ii) Multigap type diverter	Apply	6
9	Discuss the construction, principle and working of a valve type arrester	Analyze	7
10	What is a surge absorber? Write a short note on Ferranti surge absorber.	Apply	7

GROUP-III (ANALYTICAL QUESTIONS)

S.No	QUESTIONS	BLOOMS TAXONOMY LEVEL	PROGRAMOUTCOME
	UNIT-I CIRCUIT BREAKER-1		
1	An air-blast circuit breaker is designed to interrupt a transformer magnetizing current of 11 A (r.m.s.) chops the current at an instantaneous value of 7 A. If the values of L and C in the circuit are 35·2 H and 0·0023 μF, find the value of voltage that appears across the contacts of the breaker. Assume that all the inductive energy is transferred to the capacitance	Understand	1
2	A circuit breaker is rated as 1500 A, 1000 MVA, 33 kV, 3-second, 3-phase oil circuit breaker. Find (i) rated normal current (ii) breaking capacity (iii) rated symmetrical breaking current (iv) rated making current (v) short-time rating (vi) rated service voltage	Understand	2
3	In a short circuit test on a circuit breaker, the following readings were obtained on single frequency transient : (i) time to reach the peak re-striking voltage, 50μsec (ii) the peak re-striking voltage, 100 kV Determine the average RRRV and frequency of oscillations	Understand	1
4	Differentiate between type tests and routine tests. What different tests are carried out to prove the ability of circuit breaker	Understand	2
5	Ina power system the r.m.s voltage is 38.1kv, L is 10mH and C is 0.02μF. determine a) restriking voltage across the circuit breaker b) frequency of restriking voltage transient c) average rate of restriking voltage up to peak restriking voltage and d) maximum RRRV	Remember	2
6	(a) Explain briefly about various Switch gear components. (b) Give the importance of ratings and specifications of Circuit Breaker	Evaluate	1
7	Explain the terms Recovery voltage, Restriking voltage and RRRV. Derive an expression for the restriking voltage in terms of system capacitance and inductance	Apply	2
8	Explain Slepian's theory of arc interruption and discuss its limitations. How does energy balance theory, explain the process of arc interruption?	Analyze	1

9	Discuss the recovery rate theory and energy balance theory of arc interruption in a circuit breaker	Apply	1
10	Write the differences between high resistance and low resistance methods	Apply	4
1	A circuit breaker is rated at 1500 A, 2000 MVA, 33 kV, 3 sec, 3-phase oil circuit breaker. Determine (*i*)the rated normal current (*ii*) breaking current (*iii*) making current (*iv*) short time rating current	Remembe r	4
2	Describe the construction, principle of operation and application of sf6 circuit breaker. How does this breaker essentially differed from an air blast breaker	Understan d	4
3	Explain the properties of vacuum, arc phenomenon, and constructional details, working principle, merits and applications of vacuum circuit breakers.	Remembe r	4
4	With a neat diagram, discuss the constructional details and operational features of a typical minimum oil circuit breaker. Also state its advantages and disadvantages over others	Understan d	4
5	A 50 Hz, 3 phase alternator has rated voltage 12 kV, connected to circuit breaker, inductive reactance 5 ohms/phase, C= 3µF. Determine maximum RRRv, peak restriking voltage and frequency of oscillations.	Apply	4
6	With a neat block diagram, explain the construction, operating principles and merits of air blast circuit breaker.	Remembe r	4
7	Write brief note on (i) Vacuum circuit breaker (ii) Testing of circuit breaker.	Apply	4
8	Discuss how breaking capacity and making capacity of a circuit breaker are tested in a laboratory type testing stations.	Remembe r	4
9	Discuss the selection of circuit breakers for different ranges of system voltages	Apply	4
10	Enumerate the breaking capacity of circuit breaker How do you classify circuit breaker	Apply	4
	UNIT-II **ELECTROMAGNETIC AND STATIC RELAYS**		
1	Determine the time of operation of a 5-ampere, 3-second over current relay having a current setting of 125% and a time setting multiplier of 0· 6 connected to supply circuit through a 400/5 current transformer when the circuit carries a fault current of 4000 A.	Understand	4
2	What are the different inverse time characteristics of over current relays? Mention how characteristics can be achieved in practice for an electromagnetic relay.	Evaluate	4
3	Writes short notes on the following : (*i*) Percentage differential relays (*ii*) Definite distance relays (*iii*) Time-distance relays	Evaluate	4
4	Describe the construction and principle of operation of an induction type directional over current relay.	Evaluate	4
5	Explain with the help of neat diagram the construction and working of : *(i)* Non-directional induction type over current relay *(ii)* Induction type directional power relay	Analyze	4

6	Define and explain the following terms as applied to protective relaying : (*i*) Pick-up value(*ii*) Current setting (*iii*) Plug-setting multiplier (*iv*) Time-setting multiplier	Apply	4
7	(a)Derive the equation for torque developed in an induction relay. (b) Explain the working principle of distance relays	Apply	4
8	(a) Draw the characteristics of a directional impedance relay and mho relay on an R-X diagram (b) Compare Static and Electromagnetic relay	Understand	4
9	A relay is connected to 400/5 ratio current transformer with current setting of 150%. Calculate the Plug Setting Multiplier when circuit carries a fault current of 4000A	Apply	4
10	Describe the operating principle, constructional features and area of applications of directional relay. How do you implement directional feature in the over current relay?	Apply	4
	UNIT-III GENERATOR PROTECTION		
1	A star-connected, 3-phase, 10-MVA, 6·6 kV alternator has a per phase reactance of 10%. It is protected by Merz-Price circulating-current principle which is set to operate for fault currents not less than 175 A. Calculate the value of earthling resistance to be provided in order to ensure that only 10% of the alternator winding remains unprotected	Understa n d	5
2	A star-connected, 3-phase, 10 MVA, 6·6 kV alternator is protected by Merz-Price circulating-current principle using 1000/5 amperes current transformers. The star point of the alternator is earthed through a resistance of 7·5 Ω . If the minimum operating current for the relay is 0·5 A, calculate the percentage of each phase of the stator winding which is unprotected against earth-faults when the machine is operating at normal voltage	Apply	8
3	A star-connected, 3-phase, 10 MVA, 6·6 kV alternator is protected by circulating current protection, the star point being earthed via a resistance r. Estimate the value of earthling resistor if 85% of the stator winding is protected against earth faults. Assume an earth fault setting of 20%. Neglect the impedance of the alternator winding.	Apply	8
4	A 10 MVA, 11 kV, 3-phase star-connected alternator is protected by the Merz- Price balance-current system, which operates when the out-of-balance current exceeds 20% of full-load current. Determine what portion of the alternating winding is unprotected if the star point is earthed through a resistance of 9 Ω . The reactance of the alternator is 2 Ω	Rememb e r	8
5	A 3-phase, 20 MVA, 11kV star connected alternator is protected by Merz-Price circulating current system. The star point is earthed through a resistance of 5 ohms. If the CTs have a ratio of 1000/5 and the relay is set to operate when there is an out of balance current of 1·5 A, calculate : (i) the percentage of each phase of the stator winding which is unprotected (ii) the minimum value of earthling resistance to protect 90% of the winding	Creating	8
6	The neutral point of 25 MVA, 11 kV alternator is grounded through a resistance of 5 Ω , the relay is set to operate when there is an out of balance current of 2A. The CTs used have a ratio of 1000/5. Calculate (neglect reactance of alternator) : (i) the percentage of stator winding protected against an earth fault	remembe r	8

	(ii) the minimum value of earthling resistance to protect 95% of the winding		
7	A 10 MVA, 6·6 kV, 3-phase star-connected alternator is protected by Merz-Price circulating current system. If the ratio of the current transformers is 1000/5, the minimum operating current for the relay is 0·75 A and the neutral point earthling resistance is 6 Ω calculate :	remembe r	8

	(i) The percentage of each of the stator windings which is unprotected against earth faults when the machine is operating at normal voltage. (ii) the minimum resistance to provide protection for 90% of the stator winding		
8	Describe with a neat sketch the percentage differential protection of a modern alternator	remembe r	8
9	Make a list of faults , which may occur on a alternator .State the protections to be used for each of such faults	remembe r	8
10	Discuss suitable protection scheme which are used for (i) rotor earth fault (ii)rotor open-circuit of a synchronous generator	apply	8
1	A 3-phase transformer of 220/11,000 line volts is connected in star/delta. The protective transformers on 220 V side have a current ratio of 600/5. What should be the CT ratio on 11,000 V side?	creating	8
2	A 3-phase transformer having line-voltage ratio of 0·4 kV/11kV is connected in star-delta and protective transformers on the 400 V side have a current ratio of 500/5. What must be the ratio of the protective transformers on the 11 kV side?	Remember	8
3	A 3-phase, 33/6·6 kV, star/delta connected transformer is protected by Merz- Price circulating current system. If the CTs on the low-voltage side have a ratio of 300/5, determine the ratio of CTs on the high voltage side	Remember	8
4	A 3-phase, 200 kVA, 11/0·4 kV transformer is connected as delta/star. The protective transformers on the 0·4 kV side have turn ratio of 500/5. What will be the C.T. ratios on the high voltage side ?	Remember	8
5	A 3-phase transformer of 220/11,000 line volts is connected in star-delta. The protective transformers on 220v side have a current ratio of 600/5. What should CT ratio 11,000v side?	apply	8
6	A 3-phase transformer rated for 33/6.6kv is star/delta connected and the protection current transformers on the low voltage side have a ratio of 400/5A.Determine the ratios of CTs on the ht side	Remember	8
7	A 3-phase transformer having a line voltage ratio of 400/33,000V is star-delta connected. The CTs on the 400v side have a ratio of 800/5A.What must be the ratio of CTs on 33,000V side?	Apply	8
8	A 3-phase Delta-wye connected 30MVA; 33/11kv transformer is protected by a simple differential relaying scheme. The CT ratio on the primary side is 500:5 and that on the secondary side is 2000:5. Sketch the CT connection diagram for the relaying scheme. Also calculate the relay current setting for fault drawing up to 200% of rated current.	Evaluate	8
9	Write short notes on the following : (a) Combined leakage and over load protection (b) Biased differential protection (c) Restricted earth- fault protection for power transformer	Understand	8

10	Explain the protective scheme for the transformer that takes care of magnetizing inrush current without effecting the sensitivity	Apply	8
UNIT-IV **FEEDER AND BUS-BAR PROTECTION**			
1	Write short notes on the following : (i)Time graded protection of feeders (ii) protection of parallel feeders	Apply	6
2	How earth fault protection is achieved in case of feeders. How is the protection system graded with respect to the time of operation of relays for a radial feeder	Evaluate	6
3	Describe in detail the protection of parallel feeder and ring mains	Evaluate	6

4	What is Merz –Price voltage protection scheme? how does it protects feeder Explain with neat diagram	Evaluate	6
5	Write short notes on the following: (i) Distance protection scheme (ii) Translay protection to a 3-phase feeder	Apply	6
6	Describe the following systems of bus-bar protection : (i) Differential protection (ii) Fault-bus protection	Analyze	6
7	Describe the principle of bus bar protection based on voltage differential systems. How does it respond to saturation of CTs for external and internal faults?	Apply	6
8	Describe earth fault protection of sectionalized bus bar	Apply	6
9	Discuss why duplicate bus-bar system is used? With a neat sketch develop the duplicate bus-bar system	Analyze	7
10	Explain the following: (i) What is back up protection of bus bar (ii) Bus bar protection needs special attention why? (iii) What is differential protection of bus bar	Apply	7
NEUTRAL GROUNDING			
1	State the difference between equipment earthling and neutral earthling	Apply	6
2	What are the merits and demerits of reactance earthling compared to solid earthling?	Evaluate	6
3	Explain the phenomenon of “arcing grounds” on overhead transmission lines. How does neutral earthling oppose arcing ground currents?	Evaluate	6
4	Explain with diagrams : the phase to earth voltage rise in un faulted lines during a single phase to earth fault in a 3-phase system without (a) neutral earthling, (b)	Evaluate	6

	the situation with neutral earthling		
5	A transmission line has capacitance of 0.1µf per phase. Determine the inductance of Peterson coil to neutralize the effect of capacitance of (i) complete length of line (ii) 97%of the line (iii) 90% length of line .The supply frequency is 50HZ	Apply	6
6	A 132kv,50hz,3-phase, 100km long transmission line has a capacitance of 0.012µf per km per phase. Determine the inductive reactance and KVA rating of the arc suppression coil suitable for the line to eliminating arcing ground phenomenon.	Analyze	6
7	A 132 kv ,3-phse ,50hz overhead line of 100km length has a capacitance to earth of each line of 0.01µf per km. Determine inductance and KVA rating of the arc suppression suitable for this line the arc suppression suitable for this line	Apply	6
8	A 230 kV, 3-phase, 50 Hz, 200 km transmission line has a capacitance to earth phase. Calculate the inductance and kVA rating of the Peterson coil used for system.	Apply	6
9	A 50 Hz overhead line has line to earth capacitance of 1.2 µF. It is desired to use *earth fault neutralizer. Determine the reactance to neutralize the capacitance of (i) 100% of the length of the line (ii) 90% of the length of the line and (iii) 80% of the length of the line	Analyze	6
10	A 132 kV, 3-phase, 50 Hz transmission line 200 km long consists of three conductors of effective diameter 20 mm arranged in a vertical plane with 4 m spacing and regularly transposed. Find the inductance and kVA rating of the arc suppression coil in the system	Apply	7

UNIT-V PROTECTION AGAINST OVER VOLTAGES			
1	What are the causes of over-voltages arising on a power system? Why is it necessary to protect the lines and other equipment of power system against over voltages?	Apply	6
2	How can the magnitude of over voltages due to direct and indirect lightning strokes on overhead lines be calculated?	Evaluate	6
3	What is a ground wire? What are the requirements to be satisfied by ground wires to provide efficient protection to lines against direct lightening strokes? How do ground wires protect the overhead lines against direct lightening strokes?	Evaluate	6
4	Explain the term over voltage factor, protective ratio, protective angle, protective zone and coupling factor?	Evaluate	6

5	Discuss the phenomenon of lightning stroke. How can wave set up by such a stroke be represented	Apply	6
6	What is a horn-gap arrester? Explain how its works. what is the purpose of inserting a resistance between horn gap arrester and the line	Analyze	6
7	What is the function of a surge absorber? In what way is it different from lightning arrester	Apply	6
8	Explain clearly why lightening arresters are used. Name other types of lightening arresters used now-a-days in protecting equipment and overhead line	Apply	6
9	Write short notes on the following (i)Causes of over voltages (ii) switching surges (iii)Lightening phenomenon	Analyze	6
10	Explain how a substation and the equipment in the substation are protected from lightening strokes	Apply	7

DIGITAL SIGNAL PROCESSING

PROGRAMME: B.Tech ECE AC:YEAR: **2018-2019**	DEGREE: **B.TECH IV YEAR**
COURSE: **DIGITAL SIGNAL PROCESSING**	SEMESTER: **I** CREDITS: 4 COURSE COORDINATOR: Mrs. D.Padmashri
COURSE CODE: **A70421** REGULATION:**R15**	COURSE TYPE: **core**
COURSE AREA/DOMAIN: ECE	CONTACT HOURS: 4 hours/Week.
CORRESPONDING LAB COURSE CODE : NILL	LAB COURSE NAME: NILL

BRIEF NOTE ON THE IMPORTANTANCE OF THE COURSE AND HOW IT FITS IN TO THE CURRICULAM

Digital Signal Processing (DSP) is concerned with the representation, transformation and manipulation of signals on a computer. After half a century advances, DSP has become an important field, and has penetrated a wide range of application systems, such as consumer electronics, digital communications, medical imaging and so on. With the dramatic increase of the processing capability of signal processing microprocessors, it is the expectation that the importance and role of DSP is to accelerate and expand.

Discrete-Time Signal Processing is a general term including DSP as a special case. This course will introduce the basic concepts and techniques for processing discrete-time signal. By the end of this course, the students should be able to understand the most important principles in DSP. The course emphasizes understanding and implementations of theoretical concepts, methods and algorithms.

PREREQUISITES, IF ANY

- Fourier Transforms
- Signals and systems

MARKS DISTRIBUTION:

Session Marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each Mid-term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25.	75	100

The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part- B. Where part consists of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.awarded considering the average of two assignments in each course		

EVALUATION SCHEME:

S.No	Component	Total Duration	Marks
1.	I Mid Examination	90 Minutes	20
2.	I Assignment	----	05
3.	II Mid Examination	90 Minutes	20
4.	II Assignment	------	05
5.	External Examination	3 hours	75

Course Objectives:

I. To provide background and fundamental material for the analysis and processing of digital Signals.
II. To familiarize the relationships between continuous-time and discrete-time signals and Systems
III. To familiarize the relationships between continuous-time and discrete-time signals relationships of these analytic methods.
IV. To study the designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given specific
V. To introduce a few real-world signal processing applications.
VI. To acquaint in FFT algorithm, multi-rate signal processing techniques and finite word length effects

Course Outcomes:

On completion of this subject, the student should be able to

1. Perform time, frequency and Z-transform analysis on signals and LTI system and study the Properties like stability, causality, time variance, recursive and etc..
2. Understand the inter-relationship between DFT, FFT and Various transforms.
3. Design of infinite impulse response filters for a given specifications.
4. Design of finite impulse response filters for a given specifications.
5. Understand the tradeoffs between normal and multi rate DSP techniques and finite length word effects.
6. Understand the significance of various filter structures and effects of round off errors

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

	L	T/P/D	C
III Year B.Tech. ECE-II Sem	**4**	**-/-/-**	**4**

DIGITAL SIGNAL PROCESSING

UNIT-I

Introduction to Digital Signal Processing: Discrete time signals & sequences, Linear shift invariant systems, Stability and causality, Linear Constant Coefficient Difference Equations, Frequency domain representation of discrete time signals and systems

Realization of Digital Filters: Applications of Z-Transforms, Solution of difference equations of digital filters., System function, System function, Frequency Response of stable Systems, Realization of Digital Filters-Direct, Canonic, Cascade and Parallel forms

UNIT-II

Discrete Fourier series: DFS representation of periodic sequences, Properties of discrete

Fourier series, Discrete Fourier transforms: Properties of DFT, Linear convolution of sequences using DFT, Computation of DFT: Over-lap Add method and Over-lap Save method, Relation between DTFT, DFS, DFT and Z-Transform

Fast Fourier transforms: Fast Fourier transforms (FFT) - Radix-2 Decimation in Time and Decimation in Frequency FFT Algorithms, Inverse FFT, and FFT with general Radix-N

UNIT-III

IIR Digital Filters: Analog filter approximations -Butterworth& Chebyshev, Design of IIR digital filters from analog filters, Step and Impulse invariant techniques, Bilinear Transformation Method, Spectra Transformations

UNIT-IV

FIR Digital Filters: Characteristics of FIR Digital Filters, Frequency response, Design of FIR: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling technique, Comparison of IIR & FIR filters.

UNIT-V

Multirate Digital signal Processing: Introduction**,** Down sampling Decimation and Up sampling, Interpolation, Sampling rate conversion,

Finite Word Length Effects: Limit cycles, Overflow oscillations, Round-off noise in IIR filters, Computational output round off noise, Methods to prevent overflow, Tradeoff between round off and overflow noise, Dead band effects

TEXT BOOKS:

- Digital Signal Processing, Principles, Algorithms, and Applications: John G.Proakis, Dimitris G.Manolakis, Pearson Education /PHI, 2007**.**
- Discrete Time Signal Processing – A.V.Oppenheim and R.W.Schaffer,PHI, 2009
- Fundamentals of Digital Signal Processing – Loney Ludeman, John Wiley, 2009

REFERENCE BOOKS:

1. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008
2. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
3. Digital Signal Processing - S.Salivahanan, A.Vallavaraj and C.Gnanapriya, TMH, 2009
4. Discrete Systems and Digital Signal Processing with MATLAB – Taan S. ElAli, CRC press, 2009

5. Digital Signal Processing – A Practical approach, Emmanuel C.Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education, 2009

6. Digital Signal Processing – Nagoor Khani, TMG, 2012

COURSE PLAN:

S. No	Unit No	Topic	No of sessions planned	Mode of teaching BB/PPT/ OHP/MM	Reference *	Remarks
1	I	Introduction to Digital Signal Processing	1	BB	A1,B1	
2		Discrete time signals & sequences	1	BB	A1,B1	
3		Linear shift invariant systems	2	BB	A1,B1	
4		Stability and causality	1	BB	A1,B1	
5		Linear Constant Coefficient Difference Equations	2	BB	A1,B1	
6		Frequency domain representation of discrete time signals	1	BB	A1,B1	
7		Frequency domain representation of discrete time systems	2	BB	A1,B1	
8		Introduction of Realization of	1	BB	A1,B1	

		Digital Filters				
9		Applications of Z-Transforms	2	**PPT**	A1,B1	
10		Solution of difference equations of digital filters	1	BB	A1,B1	
11		System function,Stability Criterion	1	BB	A1,B1	
12		Frequency Response of stable Systems	1	BB	A1,B1	
13		Realization of Digital Filters-Direct form	1	**PPT**	A1,B1	
14		Realization of Digital Filters-Direct form-2, Canonic Form	1	**PPT**	A1,B1	
15		Realization of Digital Filters - Cascade and Parallel forms	1	**PPT**	A1,B1	
16		Differenc between Direct form -I and Direct form –II	1	**PPT**	A1,B1	
		Tutorial				
17	II	DFS representation of periodic sequences	1	BB	A1,C1	
18		Properties of discrete Fourier series	1	BB	A1,C1	
19		Properties of DFT	1	BB	A1,C1	
20		Linear convolution of sequences using DFT	2	**PPT**	A1,C1	
21		Computation of DFT: Over-lap Add method	2	**PPT**	A1,C1	
22		Computation of DFT:Over-lap Save method	2	**PPT**	A1,C1	
23		Relation between DTFT, DFS, DFT and Z-Transform	1	BB	A1,C1	
24		Introduction Fast Fourier transforms (FFT)	1	BB	A1,C1	
25		Radix-2 Decimation in Time	2	BB	A1,C1	
26		Decimation in Frequency FFT Algorithms	2	BB	A1,C1	

27		Inverse FFT	2	BB	A1,C1	
28		FFT with general Radix-N	1	BB	A1,C1	
29	III	Analog filter approximations – Butterwort	1	BB	A1	
30		Analog filter approximations Chebyshev	1	BB	A1	
31		Design of IIR digital filters from analog filters	2	BB	A1	
32		Step and Impulse invariant techniques	2	BB	A1	
33		Bilinear Transformation Method	2	BB	A1	
34		Spectra Transformations	1	BB	A1	
		Tutorial Test				
35	IV	Characteristics of FIR Digital Filters	1	BB	A1	
36		Frequency response	1	BB	A1	
37		Design of FIR Digital Filters using Window Techniques,	2	BB	A1	
38		Frequency Sampling technique,	2	BB	A1	
39		Comparison of IIR & FIR filters.	1	BB	A1	
40		Review.	1	BB	A1	
		Tutorial Test	1			
41	V	Introduction, Downsampling and Upsampling	1	BB	A1	
42		Interpolation and Decimation	2	BB	A1	
43		Sampling rate conversion,	1	BB	A1	
		Tutorial Test				
		Introduction of Finite word Length Effect				
44		Limit cycles, Overflow oscillations	1	BB	A1	
45		Round-off noise in IIR filters	1	BB	A1	

46		Computational output round off noise	1	BB	A1	
47		Methods to prevent overflow	1	BB	A1	
48		Trade off between round off and overflow noise	1	BB	A1	
49		Measurement of coefficient quantization effects through pole-zero movement , Dead band effects	1	BB	A1	
49		Dead band effects	1	BB	A1	
50		Tutorial Test	1			
51		Revision Classes				

Text Books

A1	A1. Digital Signal Processing, Principles, Algorithms, and Applications: John G.Proakis Dimitris G.Manolakis, Pearson Education /PHI, 2007.
B1	Discrete Time Signal Processing – A.V.Oppenheim and R.W.Schaffer,PHI, 2009
C1	Digital Signal Processing – Nagoor Khani, TMG, 2012

MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objective	**Course Outcomes**				
	a	**b**	**c**	**d**	**e**
I	S				
II	S	S			
III			H		
IV				H	S
V					S

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes													
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**
a	S													
b	S	S									S		S	S
c	S	S												
d		S					S				S		H	S
e	S		S		S		S				S		S	

QUESTION BANK

OBJECTIVES:

UNIT I : INTRODUCTION OF DSP

1. y (n) = x (2n) [ ]
   a) Causal b) Non-Causal c) Time invariant d) none

2. x(-n + 2) is obtained using following operation [ ]
   a) x (-n) is delayed by two samples b) x (-n) is advanced by two samples

   c) x (n) is shifted left by two samples d) none

3. The output of anti causal LTI system is [ ]
   a) y (n) = $\sum_{K=0}^{\infty} h(k)x(n-k)$ b) y (n) = $\sum_{K=0}^{n} h(k)x(n-k)$

   c) y (n) = $\sum_{-\infty}^{-1} h(k)x(n-k)$ d) y (n) = $\sum_{-\infty}^{\infty} h(k)x(n-k)$

4. δ(n-k) * x (n-k) is equal to [ ]
   a) x(n-2k) b) x(n-k) c) x(k) d) none

5. Given x(n) the y(n) = x(2n – 6) is [ ]
   a) x(n) is Compressed by 2 and shifted by 6 b) x(n) is Compressed by 2 and shifted by 3
   c) x(n) is Expanded by 2 and shifted by 3 d) none
6. Decimation by a factor N is equivalent to [ ]
   a) Sampling x(t) at intervals t_s / N b) Sampling x(t) at intervals t_sN
   c) N fold increase in sampling rate d) none
7. In fractional delay, x(n-M/N), specify the order of operation. [ ]
   a) Decimation by N, shift by M, Interpolation by N
   b) Shift by M, Decimation by N and Interpolation by N
   c) Interpolation by N, Shift by M and Decimation by N
   d) All are correct
8. Given g(n) $=\{1,\underset{\uparrow}{2},3\}$, find x(n) = g (n / 2), using linear interpolation [ ]

   a) 1, 0, 2, 0, 3 b) 1, 1, 2, 2, 3, 3 c) 1, 3/2, 2, 5/2, 3 d) none
9. The h(n) is periodic with period N, x(n) is non periodic with M samples, the output y(n) is
   a) Periodic with period N b) Periodic with period N+M [ ]

   c) Periodic with period M d) none

10.Determine the non causal system [ ]

a) $y(n) = x(n^2)$ b) $y(n) = \sum_{k=-\infty}^{n} x(k)$

c) $y(n) = x(n) - x(n-1)$ d) $y(n) = nx(n)$

11.Two signals $x_1(n)$={1,2,3,4} and $x_2(n)$={4,3,2,1}, then $x_1(n) + x_2(n)$= [ ]

a) {2,2,2,2} b) {3,2,4,1} c) {1,1,1,1} d) {5,5,5,5}

12.Identify the dynamic system [ ]

a) y(n) = $ax^2(n)$ b) y(n) = ax(n) c) y(n) = $ax^2(n)$ + x(n)d) y(n) = x(n)+x(n-1)

13.Find the ROC of signal x(n)=u(n-2) [ ]

a) $|z| < 1$ b) $|z| > 10$ c) $|z| < 0$ d) $|z| > 1$

14.What is the speed improvement factor in calculating 64 – point DFT of a sequence using direct computation and FFT algorithm [ ]

a) 40.33 b) 30.33 c) 10.33 d) 21.33

15.Find the linear convolution of two sequences $x_1(n)=\{1,2\}$ and $x_2(n)=\{3,4\}$ [ ]

a) {3,10} b) {10,3,8} c) {3,10,8} d) {3,8,10}

16.Number of complex additions required to calculate Radix – 2 FFT is [ ]

a) $N-1$ b) $\frac{N}{2}log_2N$ c) $Nlog_2N$ d) N

17 In the design a IIR Digital filter for the conversion of analog filter in to Digital domain the desirable property is [ ]

a. The axis in the s - plane should map outside the unit circle in the z - Plane

b. The Left Half Plane(LHP) of the s - plane should map in to the unit circle in the Z - Plane

c. The Left Half Plane(LHP) of the s-plane should map outside the unit circle in the z-Plane

d. The Right Half Plane(RHP) of the s-plane should map in to the unit circle in the Z - Plane

18 The I I R filter design method that overcomes the limitation of applicability to only Lowpass filter and a limited class of bandpass filters is [ ]

a. Approximation of derivatives b. Impulse Invariance

c. Bilinear Transformation d. Frequency sampling

19 In the Frequency Transformations of the analog domain the transformation is [ ]

a. Low Pass to Lowpass b.Lowpass to Highpass

c. Lowpass to Bandpass d.Lowpass to Bandreject

20 In the Frequency Transformations of the analog domain the transformation is [ ]

a. Low Pass to Lowpass b. Lowpass to Highpass

c. Lowpass to Bandpass d. Lowpass to Bandreject

REALIZATION OF DIGITAL FILTERS:

1. In direct –form II realization the number of memory locations required is more than that of direct form –I realization [ ]

2. An LTI system having system function H(z) is stable if and only if all poles of H(z) are out side the unit circle. [ ]

3. Relation ship between x(n) and x(z) is ………………..

4. The inverse Z – transform of z/z-a is a^n u(n) [ ]

5. Digital filters are not realizable for ideal case [ ]

6.The z-transform of a discrete time signal x(n) is defined as………

7.Relation ship between x(n) and x(z) is ………………..

8.z-transform and roc of the anticausal sequence x(n)={-3,-2,-1,0,1} is ……………

9.A LTI system with the BIBO stable if and only if ROC contains the…………

10.The ROC cannot contain any …………

11.If x(n) is a finite duration ,two sided sequence the ROC is entire Z-plane except at ……….&…………

12.parsevals relation is……….

13.relation between s-plane and z-plane is………..

14……………. Method is used for evaluation of the inverse Z-transform

15.caushy residue theorem is stated as………

16. ROC of a causal signal is the …………. Of a circle of same radius r

17.The ROC must be a ……….region

18.multiplication property of Z-transform is…………..

19 .Application of z-transform are ………..

20.Inverse of x(z)= z/(z-a)^3 is …………….

UNIT II: DISCRETE FOURIER SERIES:

1. Power signal is

a) Periodic b) aperiodic c) Continuous d) none [ ]

2. W_N^{nK} *is*

a) $e^{\frac{-j2\Pi K}{N}}$ b) $e^{-j2\Pi nK}$ c) $e^{\frac{-j2\Pi Kn}{N}}$ d) $e^{\frac{2\Pi Kn}{N}}$ [ ]

3. When the sequence is circularly shifted in time domain by 'm' samples i.e. $x((n-m))_N$ then on applying DFT, it is equivalent multiply sequence in frequency domain by

a) $e^{\frac{j2\Pi Km}{N}}$ b) $e^{\frac{-j2\Pi Km}{N}}$ c) $e^{-j2\Pi Km}$ d) $e^{\frac{-2\Pi Km}{N}}$ [ ]

4. Multiplication of sequence in time domain, on apply DFT, it corresponds to circular convolution in frequency domain and is given as
[ ]

a) $x_1(n)\ x_2(n) \xleftrightarrow{DFT} X_1(K) \quad X_2(K)$ b) $x_1(n)\ x_2(n) \xleftrightarrow{DFT} X_1(K)X_2(K)$

c) $x_1(n) * x_2(n) \xleftrightarrow{DFT} X_1(K) \quad X_2(K)$ d) $x_1(n)\ x_2(n) \xleftrightarrow{DFT} \sum_{K=0}^{N-1} X_1(K)X_2(K)$

5. Linear convolution of two sequences N_1 and N_2 produces an output sequence of length

a) $N_1 - N_2 + 1$ b) $N_1 + N_2 - 1$ c) $N_1 + N_2 + 1$ d) $2N_1 - N_2 + 1$[ ]

6. The basic signal flow graph for butterfly computation of DIT-FFT is ……

7. The Fourier transform of discrete time signal is called ………

8. FFT's are based on the ……………… of an N-point DFT into successively smaller DFT's.

9. The Fourier transform of x(n)*h(n) is equal to ………………

10. Appending zeros to a sequence in order to increase the size or length of the sequence is called ……………

11. In N-point DFT using radix 2 FFT, the decimation is performed …………… times.

12. In 8-point DFT by radix 2 FFT, there are …………… stages of computations with ……………… butterflies per stage.

13. If DFT of x(n) is X(K), then DFT of $W_N^{\ln}$ x(n) is …………………….

14. If xp(n) is periodic sequence with period N and DFS[xp(n)]=xp(k) then DFS[xp(n-m)]

Is …………

15.The magnitude and phase angle of is ……………….. & ………

16.In linearity property DFT[ax1(n)+bx2(n)]= …………….

17.fourier transform gives …………… for an A periodic signal

18.Aperiodic sequence xp(n) with fundamental period N can be represented in Fourier transform as ……………..

19…………………. & ……………… are methods used for circular convolution

20.If X(k) is DFT of a sequence x(n),then DFT of imaginary part of x(n) is …………

FAST FOURIER TRANSFORMS:

1. ROC of a causal signal is the exterior of a circle of some radius r. [ ]
2. ROC of a anti causal signal is the exterior of a circle of some radius r. [ ]
3. ROC of a two sided finite duration frequency is entire Z-plane. [ ]
4. Direct form I required less no.of memory elements as compared to Canonic form.

   [ ]
5. A linear time invariant system with a system function H(Z) is BIBO stable if and only if the ROC for H(Z) contains unit circle. [ ]

6. The DFT of sequence can be evaluated as…………

7. In DFT radix-2 FFT … is the name of domain to be decimated

8. DFS is used to find out the spectrum of …………Signals

9. Number of complex multiplication required to calculate Radix-2 FFT is………..

10…………….. is a natural signal

11.A first order LTI system is behaved as…………

12.X(n)*[h(n1)+h(n2)]=………

13.Determine step response of the causal system described by difference equation y(n)=y(n-1)+x(n) is ……….

14.Idft of x(k)=(1,0,1,0) is ………

15………….. is the system function described by the difference equation y[n]=x(n)+2x(n-1)-4x(n-2)+x(n-3)

16. FFT reduces the computation time required to compute ……………

17. For DIT, the input is ………… while the output is in natural order

18………..&……… Are the applications of FFT algorithm

19.The Twiddle factor exponents are a function of the stage index m and is given by …

20.The number of sets or sections of butterflies in each stage is given by …………

UNIT III: IIR DIGITAL FILTERS:

1. The magnitude response of the following filter decreases monotonically as frequency increases [ ]

   a)Butterworth Filter b.)Chebyshev type – 1 c.)Chebyshev type – 2 d) FIR Filter

2. The transition band is more in [ ]

   a)Butterworth Filter b) Chebyshev type - 1 c) Chebyshev type - 2 d) FIR Filter

3. The poles of Butterworth filter lies on [ ]

   a)sphere b) circle c)ellipse d)parabola

4. I I R digital filters are of the following nature [ ]

   a)Recursive b)Non Recursive c)Reversive d)Non Reversive

5. In I I R digital filter the present output depends on [ ]

   a)Present and previous Inputs only b)Present input and previous outputs only

   c)Present input only d) Present Input, Previous input and output

6. Which of the following is best suited for I I R filter when compared with the FIR filter

   a)Lower sidelobes in stopband b)Higher Sidelobes in stopband [ ]

   c)Lower sidelobes in Passband d)No sidelobes in stopband

7. In the case of I I R filter which of the following is true if the phase distortion is tolerable

   a)More parameters for design b) More memory requirement [ ]

   c)Lower computational Complexity d)Higher computational complexity

8. A causal and stable I I R filter has [ ]

   a)Linear phase b)No Linear phase c)Linear amplitude d) No Amplitude

9. Neither the Impulse response nor the phase response of the analog filter is Preserved in the digital filter in the following method
[ ]

a)The method of mapping of differentials b)Impulse invariant method

c)Bilinear transformation d)Matched Z - transformation technique

10. Out of the given I I R filters the following filter is the efficient one [ ]

a)Circular filter b)Elliptical filter c)Rectangular filter d)Chebyshev filter

11. What is the disadvantage of impulse invariant method [ ]

a)Aliasing b)one to one mapping c) anti aliasing d) warping

12. Which of the I I R Filter design method is antialiasing method? [ ]

a)The method of mapping of differentials b) Impulse invariant method

c) Bilinear transformation d) Matched Z - transformation technique

13. The nonlinear relation between the analog and digital frequencies is called [ ]

a) aliasing b) warping c) prewarping d) antialiasing

14. The most common technique for the design of I I R Digital filter is [ ]

a) Direct Method b) In direct method c) Recursive method d) non recursive method

15. In the design a IIR Digital filter for the conversion of analog filter in to Digital domain the desirable property is
[ ]

a)The axis in the s - plane should map outside the unit circle in the z - Plane

b)The Left Half Plane(LHP) of the s - plane should map in to the unit circle in the Z - Plane

c.) The Left Half Plane(LHP) of the s-plane should map outside the unit circle in the z-Plane

d.) The Right Half Plane(RHP) of the s-plane should map in to the unit circle in the Z - Plane

16. The I I R filter design method that overcomes the limitation of applicability to only Lowpass filter and a limited class of bandpass filters is
[ ]

a) Approximation of derivatives b) Impulse Invariance

c) Bilinear Transformation d) Frequency sampling

17. In the Frequency Transformations of the analog domain the transformation is [ ]

a) Low Pass to Lowpass b) Lowpass to Highpass

c) Lowpass to Bandpass d) Lowpass to Bandreject

18. Frequency Transformations in the Analog domain and in the Digital domain will yield

    a) Same Results c) Different results for Bilinear Transformation [ ]

    b) Different Results d) Different Results except Bilinear Transformation

19. In the Impulse Invariance method the mapping from analog frequency Ω to the digital frequency ω is

    [ ]

    a) one to one b) one to many c) many to many d) many to one

20. A discrete impulse function is applied to the inputs of four different filters. The output sequences of these filters are listed below. Which one of these filters has a pole outside the unit circle?

    [ ]

    a) {1, 2, 3, 4, 5, 6, 0, 0, 0, ... } b) {1, - 1, 1, - 1, 1, - 1, ... }

    c) {1, 2, 4, 8, 16, ... } d) {1, 0.5, 0.25, 0.125, ... }

21. A discrete impulse function is applied to the inputs of four different filters. For each of the output sequences that follow, state whether the filter is nonrecursive.

    [ ]

    a) {1, 2, 3, 4, 5, 6, 0, 0, 0 ..... } b) {1, -1, 1, -1, 1, -1 ..... }

    c) {1, 2, 4, 8, 16 ..... } d) {1, 0.5, 0.25, 0.125, ... }

22. A filter has the difference equation: y(nt-2T)+x(nT)+x(nT-T). What traditional filter type best describes this filter? [

    ]

    a) Integrator b) differentiator c) subtractor d) multiplier

UNIT IV: FIR DIGITAL FILTERS :

1. The Linear Phase symmetric Impulse response having even number of samples cannot be used to design the following filter [

   ]

   a) Lowpass b) Highpass c) Bandpass d) Bandstop

2. The following filter is always stable [ ]

   a) Butterworth filter b) Chebyshev filter c) II R filter d) FIR filter

3. Which of the filter can be realized in both recursive and non recursive structure?
   a) Butterworth filter   b) Chebyshev filter   c) II R filter   d) FIR filter   [ ]
4. Which filter is free of Limit cycle oscillations when implemented on a finite word length digital system [ ]
   a) Butterworth filter   b) Chebyshev filter   c) II R filter   d) FIR filter
5. In which filter the memory requirement and execution time are very high [ ]
   a) Butterworth filter   b) Chebyshev filter   c) II R filter   d) FIR filter
6. Which of the following window is used instead of Hanning window for the same main lobe width [ ]
   a) Rectangular window   b) Triangular window
   c) Hamming window   d) Kaiser Window
7. The cascaded form of realization is used [ ]
   a) When complex poles with absolute magnitude less than one
   b) When complex poles with absolute magnitude greater than one
   c) When complex zeros with absolute magnitude less than one
   d) When complex zeros with absolute magnitude greater than one
8. In the following window the amplitude of the side lobes is unaffected by the length of the window [ ]
   a) Rectangular window   b) Triangular window
   c) Hamming window   d) Kaiser Window
9. In which of the following windows the transition region is more and stop-band attenuation is less [ ]
   a) Rectangular window   b) Triangular window
   c) Hamming window   d) Kaiser Window
10. The mainlobe width of the Hanning window is twice that of [ ]
    a) Rectangular window   b) Triangular window
    c) Hamming window   d) Kaiser window
11. The Gibbs oscillations are due to [ ]
    a) Abrupt truncation of the Fourier series   b) No truncation of the Fourier series
    c) Abrupt termination of the Fourier transform   d) Slow termination of the Fourier series

12. One of the desirable characteristic of the window is that the central lobe of the frequency response of the window should contain

[ ]

   a) Most of the energy and should be narrow
   b) Lowest energy and should be narrow
   c) Most of the energy and should be broad
   d) Lowest of the energy and should be broad

13. In a window the desirable characteristic is that the sidelobes of the frequency response should

   a) Increase in energy rapidly as ω tends to π [ ]
   b) Decrease in energy rapidly as ω tends to π
   c) Increase in frequency response
   d) Contain most of the energy and should be narrow

14. Which window has the advantage of flexibility of sidelobe level and N ? [ ]

   a) Rectangular window b) Triangular window
   c) Hamming window d) Kaiser window

15. In which filter closed form design equations exist [ ]

   a) FIR Filter b) II R Filter c) Butterworth d) Chebyshev

16. In which filter all the poles are located at origin [ ]

   a) FIR Filter b) II R Filter c) Butterworth d) Chebyshev

17. In which filter high selectivity can be achieved by using higher order [ ]

   a) FIR Filter b) II R Filter c) Butterworth d) Chebyshev

18. Which filter has less flexibility specially for obtaining non-standard frequency response?

   a) FIR Filter b) II R Filter c) Butterworth d) Chebyshev [ ]

19. Which filter design methods are iterative procedures that require powerful Computational facilities for Implementation

[ ]

   a) FIR Filter b) II R Filter c) Butterworth d) Chebyshev

20. Frequency sampling method is suitable for [ ]

   a) Broad band frequency selective filters b) Narrow band frequency selective filters
   b) Passband frequency selective filters d) Stopband frequency selective filters

21. The frequency sample method can be improved by [ ]

a) Introducing the stopband b) Introducing ripples

c) Introducing the transition samples d) Eliminating the transition samples

22. In the frequency sampling method the Peak sidelobe level can be reduced by

a) Increasing Transition width b) Decreasing Transition width [ ]

c) Increasing Ripples d) Decreasing Ripples

23. In which of the following filter the errors due to round off noise are more [ ]

a) FIR Filter b) II R Filter c) Butterworth d) Chebyshev

24. In which of the following filter the poles are placed any where inside the Unit circle and not always stable is [ ]

a) FIR Filter b) II R Filter c) Butterworth d) Chebyshev

UNIT V: MULTIRATE DIGITAL SIGNAL PROCESSING:

1. When the input rate F_X is greater than the output rate F_Y in the sampling rate Conversion the Lowpass filter acts as
a) anti - aliasing pre filter b) anti - imaging post filter
c) anti - aliasing post filter d) anti - imaging pre filter

2. When the input rate F_X is greater than the output rate F_Y in the sampling rate Conversion the Lowpass filter removes the spectral replicas at multiples of
a)F_X b) $I F_X$ c) F_Y d) $I F_Y$

3. An Increase in the sampling rate by an integer factor I can be accomplished by interpolating
a)I - 1 samples between successive values b) I - 1 samples between alternate values
c) I - 2 samples between successive values d) I - 2 samples between alternate values

4. For the sampling rate conversion process by a factor of the processes are
a) First Interpolation and then decimation
b) First Decimation and then Interpolation
c) First Extrapolation and then Decimation
d) First Decimation and then Extrapolation

5. In the Sampling rate conversion both the up sampling filter and down sampling filters can be replaced with a single
a) Highpass filter b) Bandpass filter c) Lowpass filter d) Bandstop

6. Sampling rate conversion by any rational factor can be obtained with
a) only decimation b) only interpolation
c) only extrapolation d) decimation and Interpolation

7. The Process of sampling rate conversion is
a) Only Resampling b) Only Reconstruction
c) Resampling after Reconstruction d) Reconstruction after Resampling

8. In the decimation process, the down sampling operation in combination with filtering on a linear time invariant system results in
a) linear time invariant b) Linear time variant
c) Non Linear time invariant d) Nonlinear time - invaraint

9. The Implementation of sampling rate conversion requires the use of the following Filter
a) Linear time - invariant filter b) Linear time - variant filter
c) Non Linear time - Invariant filter d) Non Linear time - variant filter

10. In the Down sampling process the frequency range of the input signal
a) stretches by a factor D b) compresses by a factor D
c) stretches by a factor 2D d) compresses by a factor 2D

11. Which of the following is not an application of multirate Digital signal processing?
a) Digital filter banks b) Subband coding
c) Broadband filters d) Transmultiplexers

12. The CIC filter structure is
a) Combinational Impulse Cascade b) Cascade Integrator Comb
c) Cascade Impulse Comb d) Combinational Integarted Impulse

13. For the development of Polyphase decimator which of the following is used
a) Commutator b) Decommutator c) Communicator d) Transmitter

14. For the efficient software Implementation of Rational sampling rate conversion the following filter is used
a) II R filter b) FIR filter c) Butterworth filter d) Chebyshev filter

15. When the output rate F_y is greater than the output rate F_x in the sampling rate Conversion the Lowpass filter removes the spectral replicas at multiples of
a) F_x b) $I F_x$ c) F_y d) $I F_y$

16. When the output rate F_y is greater than the output rate F_x in the sampling rate Conversion the Lowpass filter acts as
a) anti - aliasing prefilter b) anti - imaging postfilter
c) anti - aliasing postfilter d) anti - imaging prefilter

17. Polyphase filter Structures are used for
a) Up sampling b) Down sampling
c) Sampling Rate Conversion d) anti - aliasing

18. The Polyphase filter structures are suitable for
a) FIR Filters b) II R Filter c) FIR and II R filters d) analog filter

19. The order of the sampling rate converter and a linear time - invariant system can be interchanged by changing
    a) Upsampling rate b) Down sapling rate
    c) Filter system function d) Input function
20. Polyphase filter Structures are used for
    a) Up sampling b) Down sampling
    c) Sampling Rate Conversion d) anti - aliasing

FINITE WORD LENGTH EFFECTS:

1. Conversion of a continuous time signal into a digital value produces ……………..
2. Errors arising from quantization are …………. & ……………
3. In two's compliment numbers negative number is obtained by ………….. all the bits of the positive number and adding one to……………….
4. Common methods of quantization are ………….&…………..
5. From the assumptions of the effects of rounding in digital filter error sequence e(N) is ………….. signal
6. Quantization step size …………….
7. Three quantization errors in finite word length registers are………………….
8. …………… realization is less sensitive to process of quantization
9. Methods used to prevent over flow are………..

10.A/D converter output is sum of …………&……………

11.for two's complement truncation p(e)=…………

12.The quantization error is given by……………..

13.in one's compliment representation the error for truncation of positive values of the mantissa is…………

14.(11)2*11(2)=…………

15.the finite coefficients are computed to ……………….. in the theory

16.the quantization error leads to………..

17……………. Occurs as a result of the quantization effects in multiplication

18.The amplitudes of the outputs during limit cycles are confined to range of values called as…………

19.when a stable IIR digital filter is excited by a finite input sequence the output will ideally decay to…………..

20.Application of DFT in Dsp are…………

Important two Mark Questions with Answers

1. Define discrete time signal.

A discrete time signal x (n) is a function of an independent variable that is an integer.
A discrete time signal is not defined at instant between two successive samples.

2. Define discrete time system.

A discrete or an algorithm that performs some prescribed operation on a discrete time signal is called discrete time system.

 What are the elementary discrete time signals?

- Unit sample sequence (unit impulse)

(n)= 1when n=0
0otherwise

- Unit step signal

U (n) = 1 when n>=0

= 0 otherwise

- Unit ramp signal

  $Ur(n)= n \quad \text{when} \quad n>=0$

  $\quad = 0 \quad \text{otherwise}$

- Exponential signal
  $x(n)=a^n$ where a is real x(n)-Real signal

4. State the classification of discrete timesignals.
The types of discrete time signals are

- Energy and power signals
- Periodic and Aperiodic signals
- Symmetric(even) and Antisymmetric (odd) signals

5. Define energy and power signal.

$$E = \sum_{n=-\infty}^{\infty} |x(n)|^2$$

If E is finite i.e. $0<E<\infty$, then x (n) is called energy signal.

If P is finite in the expression $P = \lim_{N\to\infty} (1/2N+1)\, E_N$, the signal is called a power signal.

6. Define periodic and aperiodic signal.

A signal x (n) is periodic in period N, if x (n+N) =x (n) for all n. If a signal does not satisfy this equation, the signal is called aperiodic signal.

7. Define symmetric and antisymmetric signal.

A real value signal x (n) is called symmetric (even) if x (-n) = x (n). On the other hand the signal is called antisymmetric (odd) if x (-n) = - x (n).

& **State the classification of systems.**

Static and dynamic system.

Time invariant and time variant system.
Causal and anticausal system.
Linear and Non-linear system.
Stable and Unstable system.

& **Define dynamic and static system.**

A discrete time system is called static or memory less if its output at any instant n depends almost on the input sample at the same time but not on past and future samples of the input. e.g. y(n) =a x (n)

In any other case the system is said to be dynamic and to have memory.

e.g. (n) = x (n)+3 x(n-1)

10. Define time variant and time invariant system.

A system is called time invariant if its output, input characteristics does not change with time.

e.g. y(n) = x(n)+x(n-1)

A system is called time variant if its input, output characteristics changes with time.

e.g. y(n) = x(-n).

11. Define linear and non-linear system.

Linear system is one which satisfies superposition principle.

Superposition principle:

The response of a system to a weighted sum of signals be equal to the corresponding weighted sum of responses of system to each of individual input signal.

i.e.,

$T [a_1x_1(n)+a_2x_2(n)]=a_1T[x_1(n)]+a_2T[x_2(n)]$

e.g. y(n) = nx(n)

A system which does not satisfy superposition principle is known as non-linear system.
e.g. $y(n) = x_2(n)$

12. Define causal and anticausal system.

The system is said to be causal if the output of the system at any time ‘n’ depends only on present and past inputs but does not depend on the future inputs.

e.g. $y(n) = x(n) - x(n-1)$

A system is said to be non-causal if a system does not satisfy the above definition.

13. Define stable and unable system.

A system is said to be stable if we get bounded output for bounded input.

- **What are the steps involved in calculating convolution sum?**

The steps involved in calculating sum are

- Folding
- Shifting
- Multiplication
- Summation

15. Define causal LTI system.

The LTI system is said to be causal if

$h(n) = 0$ for $n < 0$.

16. Define stable LTI system.

The LTI system is said to be stable if its impulse response is absolutely summable.

$$\text{i.e. } |y(n)| = \sum_{k=-\infty}^{\infty} |h(k)| < \infty$$

17. What are the properties of convolution sum

The properties of convolution sum are

- Commutative property.
- Associative law.
- Distributive law.

18. State associative law

The associative law can be expressed as

$[x(n)*h_1(n)]*h_2(n)=x(n)[h_1(n)*h_2(n)]$

Where x(n) is input

$h_1(n)$ & $h_2(n)$ are impulse responses.

19. State commutative law

The commutative law can be expressed as

$x(n)*h(n)=h(n)*x(n)$

20. State distributive law

The distributive law can be expressed as

$x(n)*[h_1(n)+h_2(n)]=x(n)*h_1(n)+x(n)*h_2(n)$

21. Define Z-transform

Z- transform can be defined as

$$X(z) = \sum_{n=-\infty}^{n=\infty} x(n) z^{-n}$$

22. Define Region of convergence

The region of convergence (ROC) of X(Z) the set of all values of Z for which X(Z) attain final value.

23. State properties of ROC.

- The ROC does not contain any poles.
- When x(n) is of finite duration then ROC is entire Z-plane except Z=0 and/or Z=∞.
- If X(Z) is causal, then ROC includes Z=∞.
- If X(Z) is anticasual, then ROC includes Z=0.

- **State the properties of Z-transform**.

i) linearity:-

if $x1(n) \overset{z}{\leftrightarrow} X1(Z)$ and $x2(n) \overset{z}{\leftrightarrow} X2(Z)$

then

$a1x1(n)+a2x2(n) \overset{z}{\leftrightarrow} a1X1(Z)+a2X2(Z)$

ii)Time shifting

if $x(n) \overset{z}{\leftrightarrow} X(Z)$

then

$x(n-k) \xleftrightarrow{z} Z-KX(Z)$

iii) Scaling in Z-domain

if $x(n) \xleftrightarrow{z} X(Z)$

then $a^n x(n) \xleftrightarrow{z} X(a^{-1}Z)$

iv)Time reversal

if $x(n) \xleftrightarrow{z} X(Z)$

then $x(-n) \xleftrightarrow{z} X(Z^{-1})$

v) Differtiation in Z domain

$nx(n) \xleftrightarrow{z} - z\, D\{ X(Z)\}$

vi) Convolution of two sequences

if $x_1(n) \xleftrightarrow{z} X_1(Z)$ and $x_2(n) \xleftrightarrow{z} X_2(Z)$

then $x_1(n)*x_2(n) \xleftrightarrow{z} X(Z)=X_1(Z).X_2(Z)$

vii) correlation

if $x_1(n) \xleftrightarrow{z} X_1(Z)$ and $x_2(n) \xleftrightarrow{z} X_2(Z)$

then ∞ z

$$r_{x1x2}(l)=\sum_{n=-\infty}^{\infty} x_1(n)\, x_2(nl) \overset{z}{\leftrightarrow} R_{x1x2}(Z)=X_1(Z)\, .X_2(Z-1)$$

State the methods for evaluating inverse Z-transform.

Direct valuation by contour integration.

Expansion into series of terms in the variable Z and Z-1.

Partial fraction expansion and look up table.

Define DFT and IDFT (or) What are the analysis and synthesis equations of DFT?

DFT Analysis Equation)

$$X(k)= \sum_{n=0}^{N-1} x(n)\, W_N^{nk} \text{ , } W_N = e\text{-}j2\prod/N$$

IDFT (Synthesis Equation)

$$x(n)= 1/N \sum_{k=0}^{N-1} X(k)\, W_N^{-nk} \text{ , } W_N = e\text{-}j2\prod/N$$

27. State the properties of DFT.

1) Periodicity

2) Linearity and symmetry

3) Multiplication of two DFTs

4) Circular convolution

5) Time reversal

6) Circular time shift and frequency shift

7) Complex conjugate

8) Circular correlation

28. Define circular convolution.

Let $x_1(n)$ and $x_2(n)$ are finite duration sequences both of length N with DFTs $X_1(K)$ and $X_2(k)$

If $X_3(k)=X_1(k)X_2(k)$ then the sequence $x_3(n)$ can be obtained by circular convolution defined as

$$x_3(n)=\sum_{m=0}^{N-1} X_1(m)X_2((n-m))_N$$

29. How to obtain the output sequence of linear convolution through circular convolution?

Consider two finite duration sequences x(n) and h(n) of duration L samples and M samples. The linear convolution of these two sequences produces an output sequence of duration L+M-1 samples, where as , the circular convolution of x(n) and h(n) give N samples where N=max(L,M).In order to obtain the number of samples in circular convolution equal to L+M-1, both x(n) and h(n) must be appended with appropriate number of zero valued samples. In other words by increasing the length of the sequences x(n) and h(n) to L+M-1 points and then circularly convolving the resulting sequences we obtain the same result as that of linear convolution.

30. What is zero padding? What are its uses?

Let the sequence x(n) has a length L. If we want to find the N-point DFT (N>L) of the sequence x(n), we have to add (N-L) zeros to the sequence x(n). This is known as zero padding.

The uses of zero padding are

We can get better display of the frequency spectrum.
With zero padding the DFT can be used in linear filtering.

 Define sectional convolution.

If the data sequence x(n) is of long duration it is very difficult to obtain the output sequence y(n) due to limited memory of a digital computer. Therefore, the data sequence is divided up into smaller sections. These sections are processed separately one at a time and controlled later to get the output.

 What are the two methods used for the sectional convolution?

The two methods used for the sectional convolution are

Overlap-add method and 2) Overlap-save method.

 What is overlap-add method?

In this method the size of the input data block xi(n) is L. To each data block we append M-1 zeros and perform N point circular convolution of xi(n) and h(n). Since each data block is terminated with M-1 zeros the last M-1 points from each output block must be overlapped and added to first M-1 points of the succeeding blocks. This method is called overlap-add method.

34. What is overlap-save method?

In this method the data sequence is divided into N point sections xi(n).Each section contains the last M-1 data points of the previous section followed by L new data points to form a data sequence of length N=L+M-1.In circular convolution of xi(n) with h(n) the first M-1 points will not agree with the linear convolution of xi(n) and h(n) because of aliasing, the remaining points will agree with linear convolution. Hence we discard the first (M-1) points of filtered section xi(n) N h(n). This process is repeated for all sections and the filtered sections are abutted together.

35. Why FFT is needed?

The direct evaluation DFT requires N2 complex multiplications and N2 –N complex additions. Thus for large values of N direct evaluation of the DFT is difficult. By using FFT algorithm the number of complex computations can be reduced. So we use FFT.

36. What is FFT?

The Fast Fourier Transform is an algorithm used to compute the DFT. It makes use of the symmetry and periodicity properties of twiddle factor to effectively reduce the DFT computation time. It is based on the fundamental principle of decomposing the computation of DFT of a sequence of length N into successively smaller DFTs.

- **How many multiplications and additions are required to compute N point DFT using redix-2 FFT?**

The number of multiplications and additions required to compute N point DFT using radix-2 FFT are $N \log_2 N$ and $(N/2) \log_2 N$ respectively,.

- **What is meant by radix-2 FFT?**

The FFT algorithm is most efficient in calculating N point DFT. If the number of output points N can be expressed as a power of 2 that is N=2M, where M is an integer, then this algorithm is known as radix-2 algorithm.

39. What is DIT algorithm?

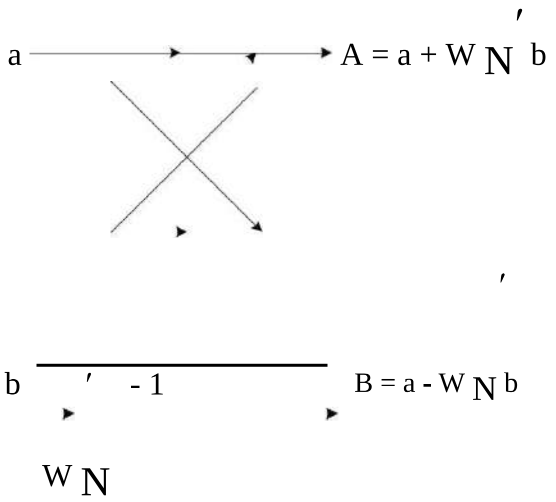
Decimation-In-Time algorithm is used to calculate the DFT of a N point sequence. The idea is to break the N point sequence into two sequences, the DFTs of which can be combined to give the DFT of the original N point sequence. This algorithm is called DIT because the sequence x(n) is often splitted into smaller sub-sequences.

40. What DIF algorithm?

It is a popular form of the FFT algorithm. In this the output sequence X(k) is divided into smaller and smaller sub-sequences , that is why the name Decimation In Frequency.

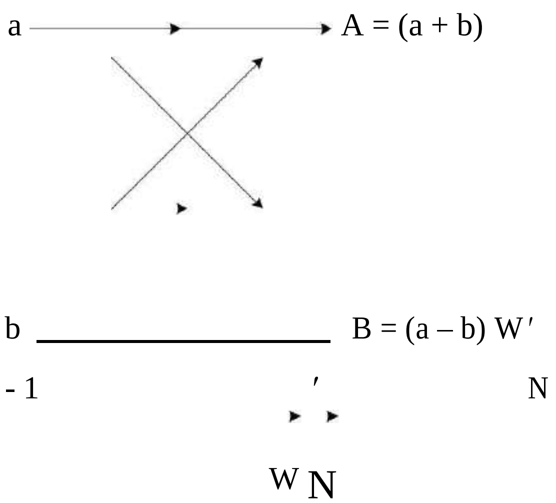
- **Draw the basic butterfly diagram of DIT algorithm.**

The basic butterfly diagram for DIT algorithm is



Where a and b are inputs and A and B are the outputs.

 Draw the basic butterfly diagram of DIF algorithm.
The basic butterfly diagram for DIF algorithm is



Where a and b are inputs and A and B are outputs.

 What are the applications of FFT algorithm?
The applications of FFT algorithm includes

1) Linear filtering

2) Correlation

3) Spectrum analysis

- **Why the computations in FFT algorithm is said to be in place?**

Once the butterfly operation is performed on a pair of complex numbers (a,b) to produce (A,B), there is no need to save the input pair. We can store the result (A,B) in the same locations as (a,b). Since the same storage locations are used troughout the computation we say that the computations are done in place.

45. Distinguish between linear convolution and circular convolution of two sequences.

Linear convolution

If x(n) is a sequence of L number of samples and h(n) with M number of samples, after convolution y(n) will have N=L+M-1 samples.

It can be used to find the response of a linear filter.

Zero padding is not necessary to find the response of a linear filter.

Circular convolution

If x(n) is a sequence of L number of samples and h(n) with M samples, after convolution y(n) will have N=max(L,M) samples.

It cannot be used to find the response of a filter.

Zero padding is necessary to find the response of a filter.

- **What are differences between overlap-save and overlap-add methods.**

<u>Overlap-save method</u>

In this method the size of the input data block is N=L+M-1.

Each data block consists of the last (M-1) data points of the previous data block followed by L new data points.

In each output block (M-1) points are corrupted due to aliasing as circular convolution is employed.

To form the output sequence the first (M-1) data points are discarded in each output block and the remaining data are fitted together.

<u>Overlap-add method</u>

In this method the size of the input data block is L.

Each data block is L points and we append (M-1) zeros to compute N point DFT.

In this no corruption due to aliasing as linear convolution is performed using circular convolution.

To form the output sequence the last (M-1) points from each output block is added to the first (M-1) points of the succeeding block.

- **What are the differences and similarities between DIF and DIT algorithms?**

Differences:

- The input is bit reversed while the output is in natural order for DIT, whereas for DIF the output is bit reversed while the input is in natural order.

- The DIF butterfly is slightly different from the DIT butterfly, the difference being that the complex multiplication takes place after the add-subtract operation in DIF.

Similarities:

Both algorithms require same number of operations to compute the DFT. Both algorithms can be done in place and both need to perform bit reversal at some place during the computation.

- **What are the different types of filters based on impulse response?**

Based on impulse response the filters are of two types

 IIR filter
 FIR filter

The IIR filters are of recursive type, whereby the present output sample depends on the present input, past input samples and output samples.

The FIR filters are of non recursive type, whereby the present output sample depends on the present input sample and previous input samples.

1. What are the different types of filters based on frequency response?

| Lowpass filter
| Highpass filter
| Bandpass filter
| Bandreject filter

51. Distinguish between FIR filters and IIR filters.

<u>FIR filter</u>

1. These filters can be easily designed to have perfectly linear phase.
2. FIR filters can be realized recursively and non-recursively
3. Greater flexibility to control the shape of their magnitude response.
4. Errors due to round off noise are less severe in FIR filters, mainly because feedback is not used.

<u>IIR filter</u>

1. These filters do not have linear phase.
2. IIR filters are easily realized recursively.
3. Less flexibility, usually limited to specific kind of filters.
4. The round off noise in IIR filters is more.

52. What are the design techniques of designing FIR filters?

There are three well known methods for designing FIR filters with linear phase .They are

(1) Window method

(2) Frequency sampling method

(3) Optimal or minimax design.

1. What is Gibb's phenomenon?

One possible way of finding an FIR filter that approximates H(w) would be to truncate the infinite Fourier series at n=±(N-1/2). Direct truncation of the series will lead to fixed percentage overshoots and undershoots before and after an approximated discontinuity in the frequency response.

54. List the steps involved in the design of FIR filters using windows.

1. For the desired frequency response $H_d(w)$, find the impulse response $h_d(n)$ using Equation

$$h_d(n)=1/2\pi\int_{-\pi}^{\pi} H_d(w)\, e^{jwn}\, dw$$

2. Multiply the infinite impulse response with a chosen window sequence w(n) of length N to obtain filter coefficients h(n),i.e.,

$$h(n) = h_d(n)w(n) \text{ for } |n|\leq(N-1)/2$$

$$= 0 \text{ otherwise}$$

3. Find the transfer function of the realizable filter (N-1)/2

$$H(z)=z-(N-1)/2\ [h(0)+\sum_{n=0} h(n)(zn+z-n)]$$

a. What are the desirable characteristics of the window function?

The desirable characteristics of the window are

1. The central lobe of the frequency response of the window should contain most of the energy and should be narrow.
2. The highest side lobe level of the frequency response should be small.
3. The side lobes of the frequency response should decrease in energy rapidly as ω tends to п.

1. Give the equations specifying the following windows.

Rectangular window
Hamming window
Hanning window
Bartlett window
Kaiser window

a. Rectangular window:

The equation for Rectangular window is given by $W(n) = 1$ for $0 \le n \le M-1$

$= 0$ otherwise

b. Hamming window:

The equation for Hamming window is given by

$W_H(n) = 0.54 - 0.46 \cos(2\pi n/M-1)$ for $0 \le n \le M-1$

$= 0$ otherwise

c. Hanning window:

[redacted]

The equation for Hanning window is given by

$W_{Hn}(n) = 0.5[1 - \cos(2\pi n/M-1]$ for $0 \le n \le M-1$

$= 0$ otherwise

1. Bartlett window:

The equation for Bartlett window is given by

$WT(n) = 1 - \{2|n-(M-1)/2|\}/(M-1)$ for $0 \le n \le M-1$

$= 0$ otherwise

e. Blackman window:

[redacted]

The equation for Blackman window is given by

$W_H(n) = 0.42 - 0.5 \cos(2\pi n/M-1) + 0.08 \cos(4\pi n/M-1)$ for $0 \le n \le M-1$

$= 0$ otherwise

1. What is the necessary and sufficient condition for linear phase characteristic in FIR filter?

The necessary and sufficient condition for linear phase characteristic in FIR filter is, the impulse response h(n) of the system should have the symmetry property i.e., h(n) = h(N-1-n) where N is the duration of the sequence.

2. What are the advantages of Kaiser window?

1. It provides flexibility for the designer to select the side lobe level and N

2. It has the attractive property that the side lobe level can be varied continuously from the low value in the Blackman window to the high value in the rectangular window

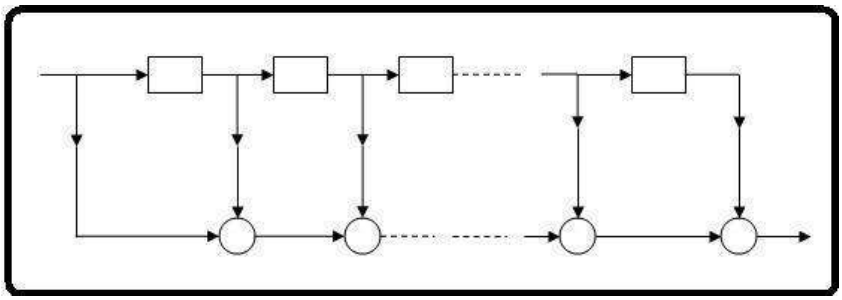
59. What is the principle of designing FIR filter using frequency sampling method?

In frequency sampling method the desired magnitude response is sampled and a linear phase response is specified .The samples of desired frequency response are identified as DFT coefficients. The filter coefficients are then determined as the IDFT of this set of samples.

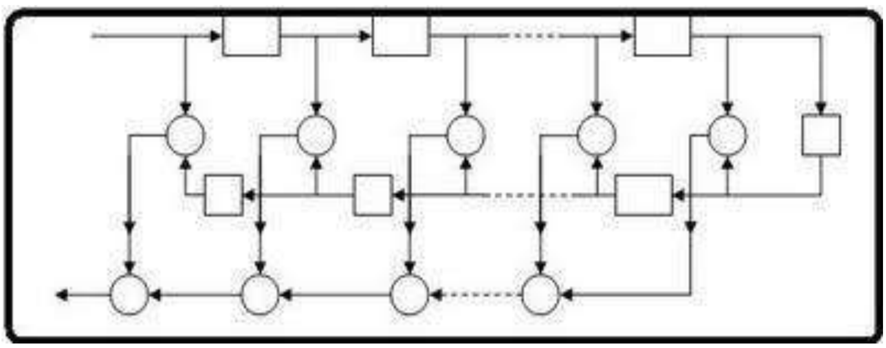
60. For what type of filters frequency sampling method is suitable?

Frequency sampling method is attractive for narrow band frequency selective filters where only a few of the samples of the frequency response are non zero.

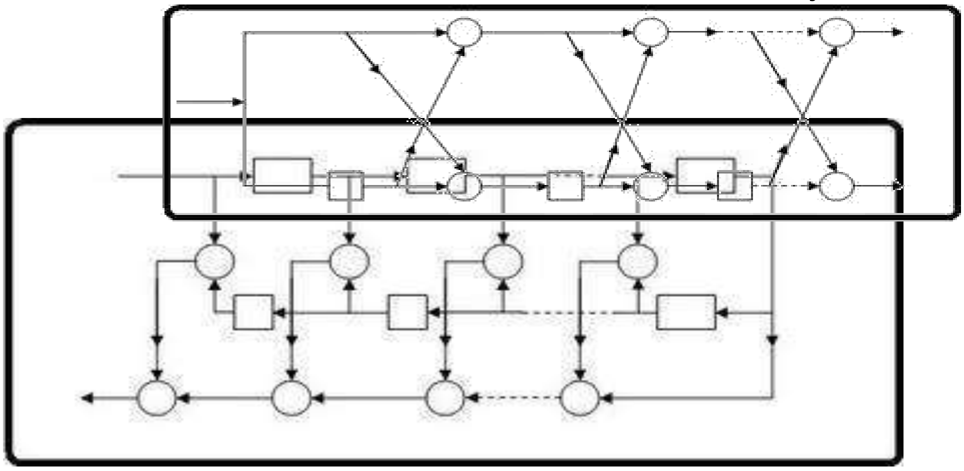
61. Draw the direct form realization of FIR system.



62. Draw the direct form realization of a linear Phase FIR system for N even.



63. Draw the direct form realization of a linear Phase FIR system for N odd.



64. When cascade form realization is preferred in FIR filters?

The cascade form realization is preferred when complex zeros with absolute magnitude is less than one.

65. Draw the M stage lattice filter.

66. State the equations used to convert the lattice filter coefficients to direct form FIR Filter coefficient.

αm(0) = 1
αm(m) = km

αm(k) = αm-1(k) + αm(m) • αm-1(m-k)

67. State the equations used to convert the FIR filter coefficients to the lattice filter Coefficient.

For an M_stage filter , αm-1(0) =1 and km = αm(m)

αm-1(k) = αm(k) - αm(m) • αm(m-k) , 1≤k≤m-1

1-αm2 (m)

67. State the structure of IIR filter?

IIR filters are of recursive type whereby the present o/p sample depends on present i/p, past i/p samples and o/p samples. The design of IIR filter is realizable and stable.

The impulse response h(n) for a realizable filter is
h(n)=0 for n≤0

68. State the advantage of direct form II structure over direct form I structure.

In direct form II structure, the number of memory locations required is less than that of direct form I structure.

69. How one can design digital filters from analog filters?

1 Map the desired digital filter specifications into those for an equivalent analog filter.

2 Derive the analog transfer function for the analog prototype.

3 Transform the transfer function of the analog prototype into an equivalent digital filter transfer function.

4. Mention the procedures for digitizing the transfer function of an analog filter.
The two important procedures for digitizing the transfer function of an analog filter are

• Impulse invariance method.

• Bilinear transformation method.

5. What do you understand by backward difference?

One of the simplest method for converting an analog filter into a digital filter is to approximate the differential equation by an equivalent difference equation.

d/dt y(t)=y(nT)-y(nT-T)/T

The above equation is called backward difference equation.

5. What is the mapping procedure between S-plane & Z-plane in the method of mapping differentials? What are its characteristics?

The mapping procedure between S-plane & Z-plane in the method of mapping of differentials is given by

$$1\,(z) = H(s)\big|_{S=1-Tz^{-1}}$$

The above mapping has the following characteristics

8. The left half of S-plane maps inside a circle of radius ½ centered at Z= ½ in the Z-plane.
9. The right half of S-plane maps into the region outside the circle of radius ½ in the Z-plane.
10. The j Ω-axis maps onto the perimeter of the circle of radius ½ in the Z-plane.

73. What is meant by impulse invariant method of designing IIR filter?

In this method of digitizing an analog filter, the impulse response of resulting digital filter is a sampled version of the impulse response of the analog filter. The transfer function of analog filter in partial fraction form,

74. Give the bilinear transform equation between S-plane & Z-plane.

$$H(z) = H(s)\Big|_{s=\frac{2(1-z^{-1})}{T(1+z^{-1})}}$$

75. What is bilinear transformation?

The bilinear transformation is a mapping that transforms the left half of S-plane into the unit circle in the Z-plane only once, thus avoiding aliasing of frequency components. The mapping from the S-plane to the Z-plane is in bilinear transformation is

$$s = \frac{2}{T}\frac{(1 - z^{-1})}{(1 + z^{-1})}$$

76. What are the properties of bilinear transformation?

1 The mapping for the bilinear transformation is a one-to-one mapping that is for every point Z, there is exactly one corresponding point S, and vice-versa.

2 The j Ω-axis maps on to the unit circle |z|=1,the left half of the s-plane maps to the interior of the unit circle |z|=1 and the half of the s-plane maps on to the exterior of the unit circle |z|=1.

77. Write a short note on pre-warping.

The effect of the non-linear compression at high frequencies can be compensated. When the desired magnitude response is piece-wise constant over frequency, this compression can be compensated by introducing a suitable pre-scaling, or pre-warping the critical frequencies by using the formula.

78. What are the advantages & disadvantages of bilinear transformation?

<u>Advantages</u>:

18. The bilinear transformation provides one-to-one mapping.
19. Stable continuous systems can be mapped into realizable, stable digital systems.
20. There is no aliasing.

Disadvantage:

1. The mapping is highly non-linear producing frequency, compression at high frequencies.

2. Neither the impulse response nor the phase response of the analog filter is preserved in a digital filter obtained by bilinear transformation.

79. What is the advantage of cascade realization?

Quantization errors can be minimized if we realize an LTI system in cascade form.

80. Define signal flow graph.

A signal flow graph is a graphical representation of the relationships between the variables of a set of linear difference equations.

1. What is transposition theorem & transposed structure?

The transpose of a structure is defined by the following operations.

• Reverse the directions of all branches in the signal flow graph

• Interchange the input and outputs.

• Reverse the roles of all nodes in the flow graph.

• Summing points become branching points.

• Branching points become summing points.

According to transposition theorem if we reverse the directions of all branch transmittance and interchange the input and output in the flow-graph, the system function remains unchanged.

2. What are the different types of arithmetic in digital systems?

There are three types of arithmetic used in digital systems. They are fixed point arithmetic, floating point, block floating point arithmetic.

83. What is meant by fixed point number?

In fixed point number the position of a binary point is fixed. The bit to the right represent the fractional part and those to the left is integer part.

84. What are the different types of fixed point arithmetic?

Depending on the negative numbers are represented there are three forms of fixed point arithmetic. They are sign magnitude, 1's complement, 2's complement.

85. What is meant by sign magnitude representation?

For sign magnitude representation the leading binary digit is used to represent the sign.

If it is equal to 1 the number is negative, otherwise it is positive.

86. What is meant by 1's complement form?

In 1,s complement form the positive number is represented as in the sign magnitude form. To obtain the negative of the positive number, complement all the bits of the positive number.

87. What is meant by 2's complement form?

In 2's complement form the positive number is represented as in the sign magnitude form. To obtain the negative of the positive number, complement all the bits of the positive number and add 1 to the LSB.

88. What is meant by floating pint representation?

In floating point form the positive number is represented as F =2CM, where is mantissa, is a

Fraction such that $1/2<M<1$ and C the exponent can be either positive or negative.

89. What are the advantages of floating pint representation?

1. Large dynamic range 2.Overflow is unlikely.

90. What are the quantization errors due to finite word length registers in digital filters?

Input quantization errors 2. Coefficient quantization errors 3.Product quantization errors

1. What is input quantization error?

The filter coefficients are computed to infinite precision in theory. But in digital computation the filter coefficients are represented in binary and are stored in registers. If a b bit register is used the filter coefficients must be rounded or truncated to b bits, which produces an error.

92. What is product quantization error?

The product quantization errors arise at the out put of the multiplier. Multiplication of a b bit data with a b bit coefficient results a product having 2b bits. Since a b bit register is used the multiplier output will be rounded or truncated to b bits which produce the error.

93. What is input quantization error?

The input quantization errors arise due to A/D conversion.

94. What are the different quantization methods?

Truncation and Rounding.

95. What is truncation?

Truncation is a process of discarding all bits less significant than LSB that is retained

96. What is Rounding?

Rounding a number to b bits is accomplished by choosing a rounded result as the b bit number closest number being unrounded.

1. **What are the two types of limit cycle behavior of DSP?**
   1. Zero limit cycle behavior 2.Over flow limit cycle behavior

2. **What are the methods to prevent overflow?**

1. Saturation arithmetic and 2. Scaling

99. State some applications of DSP?

Speech processing, Communication, Biomedical signal processing, Image processing, Radar signal processing, Sonar signal processing etc.

1. **What are the advances of DSP?**
   i. The programs can be modified easily for better performance.
   ii. Better accuracy can be achieved.
   iii. The digital signal can be easily stored and transported.
   iv. The digital systems are cheaper than analog equivalent

Digital Signal Processing

Important Long Answers Questions

UNIT -I

INTRODUCTION TO DIGITAL SIGNAL PROCESSING

1. What is signal Processing and list the advantages, Limitation of Digital Signal Processing. List out some applications of it.
2. Derive the necessary and sufficient condition for the system to be a stable and discuss the importance of Stable system
3. Determine the impulse and impulse response of the described by the following difference equation
   $$y(n) = 0.6y(n-1) - 0.08y(n-2) + x(n)$$
4. Determine the impulse response h(n) for he system described by the second order difference equation
   $$y(n) - 4y(n-1) + 4y(n-2) = x(n-1)$$
5. Test the following systems for Linearity, Time Variance, Causality and stability $y(n)=\sin(2nf\Pi/F)x(n)$.

Realization of Digital Filters:

Structures of IIR systems:

1. Obtain the cascade and parallel form realizations for the following systems

   $$Y (n) = -0.1(n-1) + 0.2\ y (n-2) + 3x (n) +3.6\ x (n-1) +0.6\ x (n-2)$$

2. Obtain the Direct form II

   $$y (n) = -0.1(n-1) + 0.72\ y(n-2) + 0.7x(n) -0.252\ x(n-2)$$

3. Find the direct form II

   $$H (z) =8Z-2+5Z^{--1}+1 / 7Z^{-3}+8Z^{-2}+1$$

4. Obtain the i) Direct forms ii) cascade iii) parallel form realizations for the following systems

   $$y (n) = 3/4(n-1) – 1/8\ y(n-2) + x(n) +1/3\ x(n-1)$$

5. Find the direct form –I, cascade and parallel form for

   $$H(Z) = Z^{-1} -1 / 1 – 0.5\ Z^{-1}+0.06\ Z^{-2}$$

6. Obtain the cascade and parallel form realizations for the following systems

   $$Y (n) = -0.1(n-1) + 0.2\ y (n-2) + 3x (n) +3.6\ x (n-1) +0.6\ x (n-2)$$

7. Obtain the Direct form II

   $$y (n) = -0.1(n-1) + 0.72\ y(n-2) + 0.7x(n) -0.252\ x(n-2)$$

8. Find the direct form II

   $$H (z) =8Z^{-2}+5Z^{-1}+1 / 7Z^{-1}+8Z^{-2}+1$$

9. Obtain the i) Direct forms ii) cascade iii) parallel form realizations for the following systems

   $$y (n) = 3/4(n-1) – 1/8\ y(n-2) + x(n) +1/3\ x(n-1)$$

10. Find the direct form –I, cascade and parallel form for

   $$H(Z) = Z^{-1} -1 / 1 – 0.5\ Z^{-1}+0.06\ Z^{-2}$$

FIR structures:

1. Determine the direct form of following system

   $H(z) = 1+2Z^{-1} - 3Z^{-2} + 4Z^{-3} - 5Z^{-4}$

2. Obtain the cascade form realizations of FIR systems

   $H(z) = 1+5/2\, Z^{-1} + 2Z^{-2} + 2\, Z^{-3}$

UNIT-II

Discrete Fourier series:

1. Define DFT and IDFT and State all Properties of DFT.
2. Determine the response of the whose input x(n) and impulse response h(n) are given by x(n)={1,2} and h(n)={1,2} using DFT and IDFT.
3. State and Prove circular convolution property of DFT
4. Explain all properties of DTFT.
5. Perform Linear convolution of two sequences x(n) = {1,-1,2,-2,3,-3,4,-4} and h(n) = {-1,1} using over-lap add method.
6. Perform Linear convolution of two sequences x(n) = {1,-1,2,-2,3,-3,4,-4} and h(n) = {-1,1} using over-lap save method.
7. Find the IDFT of the sequence X(K) = {2, 2-3j, 4, 2+3j}
8. Compute the circular convolution of the sequences

   $x_1(n)$= {1,2,0,1} and

   $x_2(n)$ ={2,2,1,1} using DFT

FFT:

1. Determine the Discrete Fourier transform x (n) = (1, 1, 1, 1) and Proof x(n)*h(n) =X(z)
2. Derive and draw the 8 point FFT-DIT butterfly structure.
3. Derive and draw the 8 point FFT-DIF butterfly structure.
4. Compute the DFT for the sequence.(0.5,0.5,0.5,0.5,0,0,0,0)
5. Compute the DFT for the sequence.(1,1,1,1,1,1,0,0)
6. Find the DFT of a sequence x(n)=(1,1,0,0) and find IDFT of Y(k) =(1,0,1,0)

7. If x (n) = sin (nΠ/2), n=0, 1, 2, 3
   h (n) = 2 n , n=0,1,2,3.Find IDFT and sketch it.

8. Find 4 point DFT using DIF of x(n) =(0,1,2,3)
9. a)Discuss the properties of DFT.
   b).Discuss the use of FFT algorithm in linear filtering.

UNIT III

IIR FILTER DESIGN:

1. Explain the method of design of IIR filters using bilinear transform method.
2. a)Derive bilinear transformation for an analog filter with system function

   H(s) = b/ s + a

3. For the analog transfer function H(s) = 2 / (s+1) (s+3) .
4. Determine H (z) using bilinear transformation. With T=0.1 sec
5. Convert the analog filter H(s) = 0.5 (s+4) / (s+1)(s+2) using impulse invariant transformation T=0.31416s
6. Design a single pole low pass digital IIR filter with -3db bandwidth of 0.2Π by using bilinear transformation.
7. For the constraints $0.8 \le |H(e^{jw})| \le 1, 0 \le \omega \le 0.2\pi$

| $H(e^{jw})| \le 0.2, 0.6\pi \le \omega \le \pi$ with T= 1 sec .Determine system function H(z) for a Butterworth filter using Bilinear transformation.

8. Design a digital Butterworth filter satisfying the following specifications

   $0.7 \le |H(e^{jw})| \le 1, 0 \le \omega \le 0.2\pi$

   $|H(e^{jw})| \le 0.2, 0.6\pi \le \omega \le \pi$ with T= 1 sec .Determine system function H (z) for a Butterworth filter using impulse invariant transformation.

9. Design a digital Chebyshev low pass filter satisfying the following specifications $0.707 \le |H(e^{jw})| \le 1, 0 \le \omega \le 0.2\pi$
   $|H(e\ jw)| \le 0.1\ 0.5 \le \omega \le \pi$ with T= 1 sec using for bilinear transformation.

10. Design a digital Butterworth High pass filter satisfying the following specifications $0.9 \le |H(e^{jw})| \le 1$, $0 \le \omega \le \pi/2$

    | $H(e^{jw})| \le 0.2$, $3\pi/4 \le \omega \le \pi$ with T= 1 sec. using impulse invariant transformation

11. Design a realize a digital filter using bilinear transformation for the following specifications
    i. Monotonic pass band and stop band
    ii. -3.01 db cut off at 0.5π rad
    iii. Magnitude down at least 15 db at $\omega = 0.75\pi$ rad.

UNIT IV

FIR FILTER

1. Prove that an FIR filter has linear phase if the unit sample response satisfies the condition $h(n)= \pm h(M-1-n)$, $n = 0,1,\ldots M-1$. Also discuss symmetric and anti Symmetric cases of FIR filter.
2. Explain the need for the use of window sequence in the design of FIR filter. Describe the window sequence generally used and compare the properties.
3. Design a HPF of length 7 with cut off frequency of 2 rad/sec using Hamming window. Plot the magnitude and phase response.
4. Explain the principle and procedure for designing FIR filter using rectangular window
5. Design a filter with

   $H_d(e^{j\omega}) = e^{-3j\omega}$, $\pi/4 \le \omega \le \pi/4$

   0. $\pi/4 \le \omega \le \pi$ using a Hamming window with N=7.

6. $H(w) = 1$ for $|\omega| \le \pi/3$ and $|\omega| \ge 2\pi/3$

   0 otherwise for N=11. and find the response.

7. Design a FIR filter whose frequency response

H (e jώ) = 1 π/4 ≤ ω ≤ 3π/4

0. | ω | ≤3 π/4. Calculate the value of h(n) for N=11 and hence find H(z).

8. 21.Design an ideal differentiator with frequency response H (e jώ) = jw -π ≤ ω ≤ π using hamming window for N=8 and find the frequency response.
9. Design an ideal Hilbert transformer having frequency response

   H (e jώ) = j   -π ≤ ω ≤ 0

   - j   0 ≤ ω ≤ π for N=11 using rectangular window.

UNIT V

1) Explain the concept of Decimation by a factor D
2) Explain the concept of interpolation by factor I
3) Explain sampling rate conversion by a rational factor I/D
4) Discuss the effects due to finite word length effect
5) What is meant by overflow error and how it can be avoid
6) Define Limit cycle and discuss its types
7) Plot the signals and their corresponding spectra for rational sampling rate conversion by a) I/D = 5/3 and b) I/D = 3/5. Assume that the spectra ofinput signal x(n) occupies the entire range - $\Pi \leq W_x \leq \Pi$.

Tutorial Questions

Assignment Questions

1. Test the following systems for Linearity, Time Variance, Causality and stability y(n)=sin(2nfΠ/F)x(n).
2. Obtain the cascade and parallel form realizations for the following systems

$$Y(n) = -0.1(n-1) + 0.2\,y(n-2) + 3x(n) + 3.6\,x(n-1) + 0.6\,x(n-2)$$

3. Determine the direct form of following system

$$H(z) = 1+2Z^{-1} - 3Z^{-2} + 4Z^{-3} - 5Z^{-4}$$

4. Determine the response of the whose input x(n) and impulse response h(n) are given by x(n)={1,2} and h(n)={1,2} using DFT and IDFT.
5. Explain all properties of DTFT.
6. For the analog transfer function H(s) = 2 / (s+1) (s+3) .
7. Design a realize a digital filter using bilinear transformation for the following specifications
   - iv. Monotonic pass band and stop band
   - v. -3.01 db cut off at 0.5 π rad
   - vi. Magnitude down at least 15 db at $\omega = 0.75\,\pi$ rad.

8. Design an ideal Hilbert transformer having frequency response

$$H(e^{j\omega}) = j \quad -\pi \le \omega \le 0$$

$$-j \quad 0 \le \omega \le \pi$$ for N=11 using rectangular window.

9. Explain the concept of Decimation by a factor D
10. Define Limit cycle and discuss its types

POWER SYSTEM OPERATION AND CONTROL

PROGRAMME: B.Tech- EEE AC:YEAR: **2018-2019**	DEGREE: **B.TECH IV YEAR**
COURSE: **POWER SYSTEM OPERATION AND CONTROL**	SEMESTER: **I** CREDITS: 4 COURSE COORDINATOR: Dr.V.TAMILSELVAN
COURSE CODE: **A70230** REGULATION:**R15**	COURSE TYPE: **core**
COURSE AREA/DOMAIN: EEE	CONTACT HOURS: 5 hours/Week.
CORRESPONDING LAB COURSE CODE : NA	LAB COURSE NAME: NA

BRIEF NOTE ON THE IMPORTANTANCE OF THE COURSE AND HOW IT FITS IN TO THE CURRICULAM

Demand of electrical energy is increasing day by day due to improvement in the life style of the people in particular and development of the countries in general. On the other hand, conventional sources of power generation are limited. Under this scenario, the power system network operates in a stressed condition. Effective management of generation, transmission and distribution of electrical power is necessary for optimal system operation, for loss minimization and to avoid the unwanted power cuts. This subject deals with the fundamentals for effective operation and control of the power system.

PREREQUISITES, IF ANY

- Power system-I
- Power systems -II

MARKS DISTRIBUTION:

Session Marks	University End Exam Marks	Total Marks

There shall be two mid tem examinations. Each Mid-term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks.	75	100

The student is assessed by giving two assignments, one, after completion of 1to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part- B. Where part consists of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.awarded considering the average of two assignments in each course		

EVALUATION SCHEME:

S.No	Component	Total Duration	Marks
1.	I Mid Examination	90 Minutes	20
2.	I Assignment	----	05
3.	II Mid Examination	90 Minutes	20
4.	II Assignment	------	05
5.	External Examination	3 hours	75

Course Objectives:

1. To provide students the knowledge of optimization techniques used in the power system economics and Load Frequency Control (LFC).
2. To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models.
3. To provide the knowledge of Hydrothermal scheduling, reactive power control.

Course Outcomes:

1. Ability to understand the day-to-day operation of electric power system.
2. Ability to analyze the control actions to be implemented on the system to meet the minute-to-minute variation of system demand.
3. Ability to understand the significance of power system operation and control.
4. Ability to acquire knowledge on real power-frequency interaction.

5. Ability to understand the reactive power-voltage interaction.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. EEE-I Sem | **L** | **T/P/D** | **C**

	4	1**/-/-**	**4**

A70230 - POWER SYSTEM OPERATION AND CONTROL

UNIT—I

Economic Operation of Power Systems: Optimal operation of Generators in Thermal Power Stations, – heat rate Curve — Cost Curve — Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected. Optimum generation allocation including the effect of transmission line losses — Loss Coefficients, General transmission line loss formula.

UNIT—II

Hydrothermal Scheduling: Optimal scheduling of Hydrothermal System: Hydroelectric power plant models, scheduling problems-Short term hydrothermal scheduling problem.

UNIT—III

Modeling: Modeling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models.

Modeling of Governor: Mathematical Modeling of Speed Governing System — Derivation of small signal transfer function. Modeling of Excitation System: Fundamental Characteristics of an Excitation system, Transfer function, Block Diagram Representation of IEEE Type-1 Model.

UNIT- IV

Single Area & To•Area Load Frequency Control: Necessi of keeping frequency constant, Definitions of Control area Single area control Block dagra representation of an isolated power system — Steady state analysis Dynamic response — Uncontrolled case,

Load frequency control of area system: Uncontrolled case and controlled case, tie1ine bias control.

Load Frequency Controllers: Proportional plus Integral control of single area and its block diagram representation, steady state response — Load Frequency Control and Economic dispatch control.

UNIT—V

Reactive Power Control: Overview of Reactive Power control — Reactive Power compensation in transmission systems — advantages and disadvantages of different types of compensating equipment for transmission systems. Load compensation: Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation. (Qualitative treatment)

TEXT BOOKS

1. Power System Operation and Control, Dr. K. Uma Rao, Wiley India Pvt. Ltd.
2. Power Systems Analysis, operation and control, Abhijit Chakrabarti, Sunitha Halder, PHI.

REFERENCE BOOKS

1. Operation and Control in Power Systems, PSR Murthy, BS Publications.
2. Power systems stability and control, Prabha Kundur, The McGraw — Hill companies.
3. Power System Analysis, C.L.Wadhwa, Newage International.
4. Modern Power System Analysis, I.J.Nagrath & D.P.Kothari Tata McGraw — Hill Publishing Company Ltd.
5. Power System Analysis and Design, J.Duncan Glover and M.S.Sarma, Cengage Learning.
6. Power System Analysis, Grainger and Stevenson, Tata McGraw Hill.

COURSE PLAN:

S.No	Unit No	Topic	No of sessions planned	Mode of teaching BB/PPT/O HP/MM	Reference *	Remarks
1	I	Need for power system operation and control	1	BB	T1, T2 ,T3	
2		Optimal operation of Generators in Thermal Power Stations	1	BB	T1, T2 ,T3	
3		heat rate Curve ,Cost Curve, Incremental fuel and Production costs, input-output characteristics	1	PPT	T1, T2 ,T3	
4		Optimum generation allocation with line losses neglected.	1	BB	T1, T2 ,T3	
5		algorithm & flowchart for Optimum generation allocation with line losses neglected	1	BB	T1, T2 ,T3	
6		Numerical problems	1	BB	T1, T2 ,T3	
7		Numerical problems	1	BB	T1, T2 ,T3	
8		Optimum generation allocation including the effect of transmission line losses	1	BB	T1, T2 ,T3	
9		Optimum generation allocation including the effect of transmission line losses	1	BB	T1, T2 ,T3	
10		Loss Coefficients	1	BB	T1, T2 ,T3	
11		General transmission line loss formula.	1	BB	T1, T2 ,T3	
12		algorithm & flowchart for Optimum generation allocation including the effect of transmission line losses	1	BB	T1, T2 ,T3	
13		Numerical problems	1	BB	T1, T2 ,T3	
14		Numerical problems	1	BB	T1, T2 ,T3	
15	II	Optimal scheduling of Hydrothermal System	1	PPT	T1	
16		Optimal scheduling of Hydrothermal System-algorithm	1	BB	T1	
		Hydroelectric power plant models	1	BB	T1	
17		Scheduling problems	1	BB	T1	
18		Short term Hydrothermal scheduling problem	1	BB	T1	

19		Method of Lagrange Multipliers (losses neglected	1	BB	T1	
20		Lagrange Multipliers Method Transmission Losses Considered	1	BB	T1	
21		Scheduling problems using B-Coefficients for Transmission losses	1	BB	T1	
22		Numerical problems	1	BB	T1	
23		Numerical problems	1	BB	T1	
24		Revision of previous question papers	1	BB	T1, T2 ,T3	
25		Revision of previous question papers	1	BB	T1, T2 ,T3	
26	III	Modelling of Turbine	1	BB	T2 ,T3	
27		Speed Governing Mechanism	1	PPT	T2 ,T3	

28		Mathematical Modeling of Speed Governing System	1	BB	T2 ,T3	
29		Mathematical Modeling of Speed Governing System	1	BB	T2 ,T3	
30		Derivation of small signal transfer function.	1	BB	T2 ,T3	
31		Numerical problems	1	BB	T2 ,T3	
32		Numerical problems	1	BB	T2 ,T3	
33		Functional block diagram of Excitation System	1	PPT	T2 ,T3	
34		Mathematical Modeling of Excitation System	1	BB	T2 ,T3	
		Block Diagram Representation of IEEE Type-1Model	1	BB	T2 ,T3	
35		Numerical problems	1	BB	T2 ,T3	
36		Numerical problems	1	BB	T2 ,T3	
37	IV	Necessity of keeping frequency constant	1	PPT	T2 ,T3	
38		Definitions of Control area	1	BB	T2 ,T3	
39		Block diagram representation of an isolated power system	1	BB	T2 ,T3	
40		Steady state analysis	1	BB	T2 ,T3	
		Dynamic response - Uncontrolled case	1	BB	T2 ,T3	
41		Numerical problems	1	BB	T2 ,T3	
42		Numerical problems	1	BB	T2 ,T3	
43		Dynamic response ? Controlled case	1	BB	T2 ,T3	
		Numerical problems	1	BB	T2 ,T3	
		Load frequency control of 2-area system	1	BB	T2 ,T3	
44		Steady state & dynamic analysis for uncontrolled case	1	BB	T2 ,T3	
45		Steady state & dynamic analysis for uncontrolled case	1	BB	T2 ,T3	
46		tie-line bias control	1	BB	T2 ,T3	
47		Steady state & dynamic analysis for controlled case	1	BB	T2 ,T3	
48		Numerical problems	1	BB	T2 ,T3	
49		Numerical problems	1	BB	T2 ,T3	
49		Economic dispatch control	1	PPT	T2 ,T3	
50	V	Overview of Reactive Power control	1	PPT	T2 ,T3	
51		Reactive Power compensation in transmission systems	1	BB	T2 ,T3	
52		advantages and disadvantages of different types	1	BB	T2 ,T3	
53		load compensation ? Specifications of load compensator	1	PPT	T2 ,T3	
54		Uncompensated transmission lines	1	BB	T2 ,T3	

55		Compensated transmission lines	1	BB	T2 ,T3	
56		Shunt and series compensated	1	BB	T2 ,T3	
57		Shunt and series compensated	1	BB	T2 ,T3	
58		Revision of previous question papers	1	BB	T2 ,T3	
59		Revision of previous question papers	1	BB	T2 ,T3	

Text Books

1. Operation and Control in Power Systems, PSR Murthy, BSPublications.
2. Power System Analysis, C.L.Wadhwa, Newage International.
3. Modern Power System Analysis, I.J.Nagrath & D.P.Kothari Tata McGraw — Hill Publishing Company Ltd.

MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objective	Course Outcomes				
	a	b	c	d	e
I	S	H			
II	S		H	H	
III			S		H

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
a	S													
b	S	S									S		S	S
c	S	S												
d		S					S				S		H	S
e	S		S		S		S				S		S	

HOLY MARY INSTITUTE OF TECHNOLOGY & SCIENCE

(COLLEGE OF ENGINEERING)

Bogaram(V),Keesara(M),Medchal Dist - 501301

Department of Electrical and Electronics Engineering

SUBJECT: A70230 - POWER SYSTEMS OPERATION AND CONTROL

QUESTION BANK

Unit-I

ECONOMIC OPERATION OF POWER SYSTEMS

MULTIPLE-CHOICE QUESTIONS

1. In a thermal-electric generating plant, the overall efficiency is improved when:
   a. Boiler pressure is increased.
   b. The difference between initial pressure and temperature and exhaust pressure and temperature are held at a maximum.
   c. Load on the units is increased.
   d. Its operating time is increased.
2. When load on a thermal unit is increased, fuel input:
   a. Increases.
   b. Does not change.
   c. Decreases.
   d. None of these.
3. Incremental heat rate curves, for thermal generating units, are used to determine the:
   a. Fuel cost in rupees per hour.
   b. Values at which the units should be loaded to result in minimum fuel costs.
   c. Cost per unit of electrical output.
   d. Heat produced per hour.
4. When generating units are loaded to equal incremental costs, it results in:
   a. Minimum fuel costs.
   b. Fuel costs are at a maximum.
   c. Fuel costs are not affected.
   d. Maximum loading of generating units.
5. One advantage of computer control of generating units is that:
   a. Net output of the units is minimized.
   b. All units under the control of the computer will be loaded to the same load.
   c. Loading of the units will be frequently adjusted to maintain them at equal incremental costs.
   d. Both (b) and (c).
6. If the fuel cost of one unit, operating in parallel with other units, is increased and it is desired to maintain average fuel cost, the load on the unit will be:

a. Increased.
b. Held constant.
c. Decreased.
d. None of these.

7. In a power system using both hydro- and thermal-generation, the proportion of hydrogeneration can be increased by:
   a. Increasing the price (gamma) of water.
   b. Reducing the price of water.
   c. Increasing the field currents of the hydro-generators.
   d. None of these.
8. Economic operation of power system is:
   a. Unit commitment.
   b. Load scheduling.
   c. Controlling of voltage and its magnitude.
   d. Both (a) and (b).
9. Lagrangian multiplier method converts a non-linear constrained optimization problem into_______non-linear optimization problem.
   a. Gradient.
   b. Linear.
   c. Unconstrained.
   d. All of these.
10. Unit of heat rate curve is_____.
   a. Million kCal/hr.
   b. Rs.-hr.
   c. Rs./MWh.
   d. Rs./hr.
11. Power balance equation is_____constraint.
   a. Equality.
   b. Inequality.
   c. Security constraints.
   d. Branch transfer capacity constraint.
12. Optimization problems with only objective function and without constraints is a _____ function.
   a. Single-valued.
   b. Multi-valued.
   c. Both (a) and (b).
   d. Either (a) or (b).
13. Unit of λ is______.
   a. Rs./hr.
   b. Rs./MW.
   c. Rs./MWh.
   d. MW/Rs.
14. Which of the following has a negligible effect on the production cost?

   i. Generation of real power.
   ii. Real and reactive-power demands.
   iii. System voltage and angle.
   iv. Generation of reactive power.

a. (i) and (ii).

b. Except (iii).
c. (ii) and (iv).
d. All of these.

15. An analytical method of getting the solution to optimization problem, the following graph is to be drawn:
    a. Total real-power demand versus λ.
    b. Total real-power generation versus total real- power demand.
    c. Total real-power generation versus λ.
    d. Total real-power generation versus fuel input.
16. The control variables are:
    a. *P*D and *Q*D.
    b. PG and QG.
    c. *V* and *δ*
    d. *Q* and *δ*
17. *P*D and *Q*D are:
    a. Control variables.
    b. State variables.
    c. Disturbance variables.
    d. Constants.
18. *P*D and *Q*D are:
    a. Disturbance variables.
    b. Demand variables.
    c. Uncontrollable variables.
    d. All of these.
19. Cost curves can be obtained by:
    a. Multiply the fuel input with cost of fuel.
    b. Subtract the fuel input with cost of fuel.
    c. Add the fuel input with cost of fuel.
    d. None of these.
20. Cost curves are expressed as:
    a. Rs./million cal.
    b. Million cal/hr × Rs./million cal.
    c. Rs./hr.
    d. (b) and (c)
21. The curve obtained by considering the change in cost of generation to change in real power generation at various points is:
    a. Fuel cost curve.
    b. Input–output curve.
    c. Incremental cost curve.
    d. All of these.
22. Incremental fuel cost, *I*C is given by:
    i. Rs./MWh.
    ii. Slope of the fuel cost curve.

iii. Tan $\theta = \Delta C/\Delta PG$.

iv. $\Delta i/p/\Delta o/p$.
a. (i) and (ii).
b. (ii) and (iii).
c. All except (iv).
d. All of these.

23. Incremental production cost of a given unit is made up of:
a. *IC* - incremental cost of labor, supplies, maintenance, etc.
b. IC + incremental cost of labor, supplies, maintenance, etc.
c. IC × incremental cost of labor, supplies, maintenance, etc.
d. IC% incremental cost of labor, supplies, maintenance, etc.

24. The optimization problem is:
a. To allocate total load demand among various units such that the cost of generation is maintained constant.
b. To allocate total load demand among various units such that the cost of generation is minimized.
c. To allocate total load demand among various units such that the cost of generation is enormously increased.
d. To allocate total load demand among various units such that there is no effect with cost of generation.

25. The method adopted to get an optimal solution to optimal scheduling problem depends on:
i. The mathematical equation representing *I*C.
ii. No. of units.
iii. Need to represent any discontinuity in incremental cost curve.
iv. Change in location.
a. Only (i).
b. Only (ii).
c. All expect (iv).
d. All expect (ii).

26. In a digital computer method of getting the solution to an optimization problem,
i. The number of terms included in expression for depends on the degree of accuracy.
ii. α, β, γ coefficients are to be taken as output.
iii. α, β, γ coefficients are to be taken as input.
a. Both (i) and (ii).
b. Both (i) and (iii).
c. Only (i).
d. Only (iii).

27. If the real-power inequality constraints are violated for any generator, then:
a. It is tied to the corresponding limit and the rest of the load is economically distributed among the remaining units.
b. It is tied to the corresponding limit and the total load is economically distributed among all the units.
c. It is not considered and the total load is economically distributed among all the units.

d. Any of the above methods.

28. The method of getting the solution to an optimization problem with neglected transmission losses:

i. Does sense the changes in the loads.

ii. Does not sense the location of the changes in the load.

iii. Does sense the changes in the load and the location of changes in the loads.

iv. Does not sense both the location and the changes in the load.

a. (i) and (ii).

b. Either (iii) or (iv).

c. Only (iv).

d. Only (iii).

29. To get an optimal solution to an optimization problem, we will define an

a. $C^* = \sum_{i=1}^{n} C_i(P_{G_i})$.

b. $C^* = \sum_{i=1}^{n} C_i(P_{G_i} - \lambda)$.

c. $C^* = C - \lambda \left\{ \sum_{i=1}^{n} P_{G_i} - P_D \right\}$.

d. $C^* = \lambda - C \left\{ \sum_{i=1}^{n} P_{G_i} < P_D \right\}$.

objective function as:

30. The condition for optimality is:

a. $\partial C_1/\partial P_{G_1} = \partial C_2/\partial P_{G_2} = \cdots = \partial C_n/\partial P_{G_n} = \lambda$.

b. $\partial C_i/\partial P_{G_i} - \lambda = 0$.

c. $\partial C_i/\partial P_{G_i} + \lambda = 0$.

d. (d) Both (a) and (b).

31. Which of the following is the real indicator of the state of development of a country?

a. Population.

b. Facilities.

c. Politics.

d. Per capita consumption of electricity

32. Equality and inequality constraints are

a. $\sum_{i=1}^{n} P_{G_i} - P_D = 0$; $P_{G_i(\min)} < P_{G_i} < P_{G_i(\max)}$.

b. $\sum_{i=1}^{n} P_{G_i} + P_D = 0$; $P_{G_i(\min)} < P_{G_i} < P_{G_i(\max)}$.

c. $\sum_{i=1}^{n} P_{G_i} - P_D = 0$; $P_{G_i(\min)} > P_{G_i} > P_{G_i(\max)}$.

d. (d) None of the above.

33. In a mathematical determination, the optimization problem should be modified as:

a. Constrained optimization problem.

b. Normalized optimization problem.

c. Conditional optimization problem.

d. All the above

Answers

(1) a	(10) a	(19) a	(28) a
(2) a	(11) a	(20) d	(29) c
(3) b	(12) a	(21) c	(30) d
(4) a	(13) c	(22) d	(31) d
(5) c	(14) d	(23) b	(32) a
(6) d	(15) c	(24) b	(33) a
(7) d	(16) b	(25) c	
(8) d	(17) c	(26) b	

SHORT QUESTIONS AND ANSWERS

1. Justify the production cost being considered as a function of real-power generation. The production cost in the case of thermal and nuclear power stations is a function of fuel

input. The real-power generation is a function of fuel input. Hence, the production cost would be a function of real-power generation.

2. Give the expression for the objective function used for optimization of power system operation

$$C = \sum_{i=1}^{n} C_i(P_{G_i})$$

3. State the equality and inequality constraints on the optimization of product cost of a power station.

The equality constraint is the sum of real-power generation of all the various units that must always be equal to the total real-power demand on the system.

$$\text{i.e.,} \quad \sum_{i=1}^{n} P_{G_i} = P_D$$

The inequality constraint in each generating unit should not be operating above its rating
or below some minimum generation

$$\text{i.e., } P_{Gi(\min)} \le P_{Gi} \le P_{Gi\,(\max)},$$
$$\text{for } i = 1, 2, 3, \ldots, n$$

4. What is an incremental fuel cost and what are its units?

Incremental fuel cost is the cost of the rate of increase of fuel input with the increase in
power input. Its unit is Rs./MWh.

5. How is the inequality constraint considered in the determination of optimum allocation?

If one or several generators reach their limit values, the balance real-power demand, which is equal to the difference between the total demand and the sum of the limit value, is optimally distributed among the remaining units by applying the equal incremental fuel cost rule.

6. On what factors does the choice of a computation method depend on the determination of optimum distribution of load among the units?

The factors depend upon the following:

i. Number of generating units.

ii. The degree of polynomial representing the IC curve.

iii. The presence of discontinuities in the IC curves.

7. What does the production cost of a power plant correspond to?

The production cost of a power plant corresponds to the least of minimum or optimum production costs of various combinations of units, which can supply a given real-power demand on the station.

8. To get the solution to an optimization problem, what will we define an objective's function?

Minimize the cost of production, min $C' = \min C(P_{Gn})$

9. Write the condition for optimality in allocating the total load demand among the various units.

The condition for optimality is the incremental fuel cost

$$\frac{\partial C_i}{\partial P_{G_i}} = \lambda.$$

10. Write the separable objective function and why it is called so.

$$C = C_1(P_{G_1}) + C_2(P_{G_2}) + \cdots + C_n(P_{G_n})$$

$$\text{i.e., } C = \sum_{i=1}^{n} C_i(P_{G_i})$$

The above objective function consists of a summation of terms in which each term is a function of a separate independent variable. Hence, it is called separable objective function.

11. Minimize the overall cost of production, which is subjected to equality constraints and inequality constraints.

Equality constraint is: Inequality constraint is $P_{Gi(\min)} \leq P_{Gi} \leq P_{Gi(\max)}$

12. What is the reliable indicator of a country's or state's development? It is the per capita consumption of electrical energy.
13. State in words the condition for minimum fuel cost in a power system when losses are neglected.

The minimum fuel cost is obtained when the incremental fuel cost for all the stations is the same in the power system.

14. What is the need of system variables and what are the variables?

To analyze the power system network, there is a need of knowing the system variables.

They are:

Control variables—*P*G and *Q*G.

Disturbance variables—*P*D and *Q*D. State variables—V and δ.

15. Define the control variables.

The real and reactive-power generations are called control variables since they are used to control the state of the system.

16. Define the disturbance variables.

The real and reactive-power demands are called demand variables and they are beyond system control and are hence called uncontrolled or disturbance variables.

17. Define the state variables.

The bus voltage magnitude *V* and its phase angle δ dispatch the state of the system. They are dependent variables that are being controlled by the control variables.

18. What is the need of input–output characteristics of a steam unit?

It establishes the relationship between the energy input to the turbine and the energy output from the electrical generator.

19. Define the incremental fuel or heat rate curve.

It is defined as the ratio of a small change in the input to the corresponding small change in the output.

$$\text{Incremental fuel rate} = \frac{\Delta \text{ input}}{\Delta \text{ output}} = \frac{\Delta F}{\Delta P_G}$$

20. How do you get incremental cost curve?

The incremental cost curve is obtained by considering at various points, the change in cost of generation to the change in real-power generation, i.e., slope of the input–output curve.

21. How you get the heat rate characteristic?

The heat rate characteristic is obtained from the plot of net heat rate in kCal/kWh versus power output in kW.

22. Define the incremental efficiency.

It is defined as the reciprocal of incremental fuel rate and is given by

$$\text{Incremental efficiency} = \frac{\text{output}}{\text{input}} = \frac{dP_G}{dC}$$

23. What are hard-type constraints? Give examples.

Hard-type constraints are definite and specific in nature. No flexibility will be taken place
in violating these types of constraints.
E.g., The tapping range of an on-load tap-changing transformer.

24. What are soft-type constraints? Give examples.

Soft-type constraints have some flexibility with them in violating these type of constraints.
E.g., Magnitudes of node voltages and the phase angle between them.

25. What is the need of spare capacity constraints? These constraints are required to meet:
    a. Errors in load prediction.
    b. The unexpected and fast changes in load demand.
    c. Unplanned loss of scheduled generation, i.e., the forced outages of one or more alternators on the system.

DESCRIPTIVE QUESTIONS

1. A power plant has three units with the following cost characteristics:
   $C_1 = 0.05P_{G1}^2 + 23.5P_{G1} + 700$ Rs/hr

   $C_2 = 0.2P_{G2}^2 + 20P_{G2} + 850$ Rs/hr

   $C_3 = 0.09P_{G3}^2 + 18P_{G3} + 960$ Rs/hr where P_{Gi} ' s are in MW.

   Maximum and minimum loading allowable on each unit are: 150 MW and 40MW.Find optimal scheduling for a load of 275 MW.

2. For the incremental cost characteristics of two thermal plants as given by $dF_1/dP_{G1} = 60 + 0.2\,P_{G1}$ Rs./MWHr

$dF_2/dP_{G2} = 40 + 0.3\,P_{G2}$ Rs./MWHr

Calculate the sharing of a load of 200MW for most economic operation. If the plants are rated 150MW and 250MW, what will be the saving in cost Rs/Hr in comparison to loading in the same proportion to rating?

3. Derive the co ordination equation of economic dispatch with including transmission losses.
4. Three plants of total capacity 500MW are scheduled for operation to supply a total system load of 310MW. Evaluate the optimum load scheduling if the plants have

the following incremental cost characteristics and the limitations:

$dF_1/dP_{G1} = 30 + 0.12\ P_{G1}$ Rs./MWHr $30\ MW \leq P_{G1} \geq 150 MW$ $dF_2/dP_{G2} =$

$40 + 0.20\ P_{G2}$ Rs./MWHr $20\ MW \leq P_{G2} \geq 100\ MW$

$dF_3/dP_{G3} = 10 + 0.15\, P_{G3}$ Rs./MWHr 50 MW $\leq P_{G3} \geq 250$ MW

5. Obtain the priority list of unit commitment using full load average production cost for the given data:

$H_1 = 510 + 7.2\, P_{G1} + 0.00142 P_{G1}^2$

$H_2 = 310 + 7.85\, P_{G2} + 0.00194 P_{G2}^2$

$H_3 = 78 + 7.97\, P_{G3} + 0.00482 P_{G3}^2$

Unit	Minimum(MW)	Maximum(MW)	Fuel Cost(K)
1	150	600	1.1
2	100	400	1.0
3	50	200	1.2

6. Discuss the iterative algorithm for economic dispatch problem without loss.
7. Derive co ordination equation economic dispatch without loss. Also explain the steps involved to find economic dispatch problem.
8. A system consists of two generating plants with fuel costs of:

$C_1 = 0.03 P_{G1}^2 + 15\, P_{G1} + 1$ and $C_2 = 0.04 P_{G2}^2 + 21\, P_{G1} + 1.4$

The system operates on economical dispatch with 120 MW of power generation by each plant. The incremental transmission loss of plant2 is 0.15.Find the penalty factor of Plant1

9. Two units in a plant have the following cost curves:

$C_1 = 0.1 P_{G1}^2 + 40\, P_{G1} + 120$ and $C_2 = 0.125 P_{G2}^2 + 30\, P_{G1} + 100$

If the load is 220 MW, how is it shared?

10. Explain the incremental production cost of a thermal power station can be determined.
11. What are B-coefficients? Derive them.
12. Give the assumptions considered in deriving the transmission loss expression.
13. Derive the transmission loss formula and state the assumptions made in it.
14. Obtain the condition for optimum operation of a power system with '*n*' plants when losses are considered.
15. Briefly explain about the exact co-ordination equation and derive the penalty factor.
16. Explain economic dispatch of thermal plants co-ordinating the system transmission line losses. Derive relevant equations and state the significance and role of penalty factor.
17. Give a step-by-step procedure for computing economic allocation of power generation in a thermal system when transmission line losses are considered.

ASSIGNEMENT QUESTION

1. A power plant consists of two 200 MW units, whose input cost data is given by, $F1 = 0.004\, P1^2 + 2.0\, P1 + 80$ Rs/hr

$F2 = 0.006\ P2^2 + 1.5\ P2 + 100$ Rs/hr

For the total load of 250 MW, what should be the division of load between two units for most economic operation?

2. The fuel-cost functions for three thermal plants in \$/h are given by

   $F_1 = 0.004PG_1^2 + 5.3\ PG_1 + 500$

$F_2 = 0.006PG_2^2 + 5.5\ PG_2 + 400\ F_3 =$

$0.009\ PG_3^2 + 5.8\ PG_3 + 200$

Where PG_1, PG_2, PG_3 are in MW.

Find the optimal dispatch and the total cost when the total load is 925 MW with the following generator limits:

$100\ MW \leq PG_1 \leq 450\ MW$

$100\ MW \leq PG_2 \leq 350\ MW$

$100\ MW \leq PG_3 \leq 225\ MW$

3. The cost characteristics of three plants of a plant are:

   $C_1 = 0.05\ P_1^2 + 17.0\ P_1 + 160$ Rs/hr

$C_2 = 0.06\ P_2^2 + 14.4\ P_2 + 200$ Rs/hr $C_3 =$

$0.08\ P_3^2 + 90.0\ P_3 + 240$ Rs/hr

Where P_1, P_2 & P_3 are in MW.

The incremental transmission losses for the network with respect to plants 1,2and 3 are 0.05, 0.10 and 0.15MW per MW of generation. Find the optimal dispatch for a total load of 100MW and also its incremental cost of received power.

4. In a power system having two units, the loss coefficient are:

   $B_{11} = 0.0015\ MW^{-1}$, $B_{12} = -0.0006\ MW^{-1}$,

$B_{21} = -0.0006\ MW^{-1}$, $B_{22} = -0.0024\ MW^{-1}$, The incremental production costs of the units are:

$dF_1/dPG_1 = 0.08 + 20$ Rs/MWhr

$dF_2/dPG_2 = 0.09 + 16$ Rs/MWhr

Find the generation schedule for $\lambda = 20$ and 25. Find also the change intransmission losses between the two schedules.

5. Consider two steam power plants operating with incremental production costs

$$\frac{dC_1(P_1)}{dP_1} = (0.08P_1 + 16)\text{Rs/Mwhr} \quad \text{and}$$

$$\frac{dC_2(P_2)}{dP_2} = (0.08P_2 + 12)\text{Rs/Mwhr}$$

Given the loss coefficients

$$B_{11} = 0.001 \text{ per MW}$$
$$B_{12} = B_{21} = -0.0005 \text{ per MW}$$
$$B_{22} = 0.0024 \text{ per MW}$$

Find the economic schedule of generation for $\lambda = 20$Rs/MWhr

6. Consider the two bus system shown in fig. the incremental production cocts at the two generating stations are given by

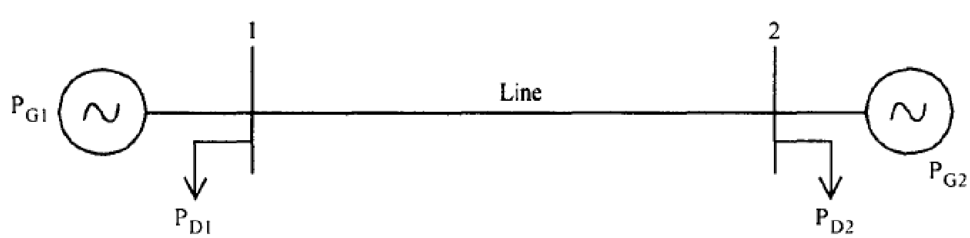
$$\frac{dC_1}{dP_1} = 0.005P_1 + 5 \text{ and}$$

$$\frac{dC_2}{dP_2} = 0.004P_2 + 7$$

The B coefficients are given in matrix form as

$$B = \begin{bmatrix} 0.0002 & -0.00005 \\ -0.00005 & 0.0003 \end{bmatrix}$$

Determine the penalty factors at both the buses and also the approximate penalty factors. Given $\lambda = 8$



Unit-2

**Hydro-thermal scheduling MULTIPLE-
CHOICE QUESTIONS**

1. When compared to a hydro-electric plant, the operating cost of the thermal plant is very _____________ and its capital cost is____.
   a. High, low.
   b. High, high.
   c. Low, low.
   d. Low, high.
2. When compared to a thermal plant, the operating cost and capital cost of a hydro- electric plant are:
   a. High and low.
   b. Low and high.
   c. Both high.
   d. Both low.
3. The optimal scheduling problem in the case of thermal plants is:
   a. Static optimization problem.
   b. Dynamic optimization problem.
   c. Static as well as dynamic optimization problem.
   d. Either static or dynamic optimization problem.
4. The operation of the system having hydro and thermal plants is more complex. In this case, the optimal scheduling problem is:
   a. Static optimization problem.
   b. Dynamic optimization problem.
   c. Static as well as dynamic optimization problem.
   d. Either static or dynamic optimization problem.
5. The optimal scheduling problem in the case of a thermal plant can be completely solved at any desired instant:
   a. With reference to the operation at other times.
   b. Without reference to the operation at other times.
   c. Case (a) or case (b) that depends on the size of the plant.
   d. None of these.
6. The time factor is considered in solving the optimization problem of_____.
   a. Hydro plants.
   b. Thermal plants.
   c. Hydro-thermal plants.
   d. None of these.
7. The objective function to the optimization problem in a hydro-thermal system becomes:
   a. Minimize the fuel cost of thermal plants.
   b. Minimize the time of operation.

c. Maximize the water availability for hydro-generation.

d. All of these.

8. The optimal scheduling problem of a hydro-thermal system is solved under the constraint of:
   a. Fuel cost of thermal plants for thermal generation.
   b. Time of operation of the entire system.
   c. Water availability for hydro-generation over a given period.
   d. Availability of coal for thermal generation over a given period.
9. To solve the optimization problem in a hydro-thermal system, which of the following variables are considered as control variables?
   a. PD thermal and PG hydro.
   b. QD thermal and QD hydro.
   c. PG thermal and PD hydro.
   d. PG thermal and PG hydro.
10. In which system is the generation scheduled generally such that the operating costs of thermal generation are minimized?
   a. Systems where there is a close balance between hydro and thermal generation.
   b. Systems where the hydro-capacity is only a fraction of the total capacity.
   c. Both (a) and (b).
   d. None of these.
11. Thermal plants are more suitable to operate as_____plants leaving hydro-plants to operate as______plants.
   a. Base load, base load.
   b. Peak load, peak load.
   c. Peak load, base load.
   d. Base load, peak load.
12. In hydro-thermal systems, the whole are part of the base load that can be supplied by:
   a. Run-off river-type hydro-plants.
   b. Reservoir-type hydro-plants.
   c. Thermal plants.
   d. Reservoir-type hydro-plants and thermal plants with proper co-ordination.
13. In a hydro-thermal system, the peak load can be met by:
   a. Run-off river-type hydro-plants.
   b. Reservoir-type hydro-plants.
   c. Thermal plants.
   d. Reservoir-type hydro-plants and thermal plants with proper co-ordination.
14. For an optimal scheduling problem, it is assumed, which parameter is known deterministically as a function of time?
   a. Water inflow to the reservoir.
   b. Power generation.
   c. Load demand.
   d. Both (a) and (c).
15. In a hydro-thermal system, the optimization problem is stated as determining ____ so as to minimize the cost of thermal generation.

a. Load demand (PD).

b. Water storage (X).
c. Water discharge rate ($q(t)$).
d. Water inflow rate ($J(t)$).

16. Which of the following equations is considered as a constraint to the optimization problem of a hydro-thermal system?
a. Real power balance equation.
b. Water availability equation.
c. Real power hydro-generation as a function of water storage.
d. All of these.

17. The water availability equation is:
a. $X'(T) - X'(0) - \int_0^T J(t)\,dt + \int_0^T q(t)\,dt = 0$.
b. $P_{GH}(t) + P_{GH}(t) - P_L(t) - P_D(t) = 0,\ t \in (0,T)$.
c. $P_{GH}(t) = f(X'(t), q(t))$.
d. None of these.

18. In the optimization problem of a hydro-thermal system, the constraint real power hydrogeneration is a function of:
i. Water inflow rate ($J(t)$).
ii. Water storage (X).
iii. Water discharge rate ($q(t)$)
a. (i) and (ii).
b. (ii) and (iii).
c. (i) and (iii).
d. None of these.

19. The optimization scheduling problem of a hydro-thermal system can be conveniently solved by_____principle.
a. Dependence.
b. Discretization.
c. Dividing.
d. None of these.

20. In the discretization principle, the real power hydro-generation at any sub-interval 'k' can

be expressed as:

21. In the optimization problem of a hydro-thermal system, which of the following are closed

as independent variables?

a. Water storages in all sub-intervals except one sub-interval.
b. Water inflows in all sub-intervals except one sub-interval.
c. Water discharges in all sub-intervals except one sub-interval.
d. Hydro and thermal generations, water storages at all sub-intervals, and water discharge at one sub-interval.

22. In the optimal scheduling problem of a hydro-thermal system, which of the following are

closed as dependent variables?

a. Water storages in all sub-intervals except one sub-interval.

b. Water inflows in all sub-intervals except one sub-interval.

c. Water discharges in all sub-intervals except one sub-interval.

d. Hydro and thermal generations, water storages at all sub-intervals, and water discharge at one sub-interval.

23. To obtain the solution to the optimization problem of a hydro-thermal system, which of the following technique is used?

a. Non-linear programming technique in conjunction with the first-order gradient method.

b. Linear programming technique in conjunction with the first-order gradient method.

c. Non-linear programming technique in conjunction with the multiple-order gradient method.

d. Linear programming technique in conjunction with the multiple-order gradient method.

24. In a hydro-thermal system for optimality, the condition is:

a. Gradient vector should be zero.

b. Gradient vector should be positive.

c. Gradient vector should be negative.

d. None of these.

25. For multihydro and multithermal plants, the optimization problem can be solved by a modified technique, which is known as:

a. Discretization technique.

b. Decomposition technique.

c. Decoupled technique.

d. None of these.

26. In Kirchmayer's method of solution of optimization problem in a hydro-thermal system,

the co-ordination equations are derived in terms of__________of both plants.

a. Power generations.

b. Power demands.

c. Penalty factors.

d. All of these.

27. γj is used as a constant, in an optimization problem of a hydro-thermal system, which converts:

a. Fuel cost of a thermal plant into an incremental fuel cost.

b. Incremental water rate of a hydro-plant into an incremental cost.

c. Incremental water inflow rate into an incremental discharge rate.

d. None of these.

28. The power generation of a hydro-plant PGH is directly proportional to:

a. Plant head.

b. Water discharge ωj.

c. Both (a) and (b).

d. None of these.

29. The main advantages of the operation of a hydro-thermal system are:
    i. Greater economy.
    ii. Security of supply and flexibility.
    iii. Better energy conservation.
    iv. Reduction in reserve capacity maintenance.
    Regarding the above statement, which is
    correct?
    a. (i) and (ii).
    b. (ii) and (iii).
    c. all except (iii).
    d. All of these.
30. The co-ordination equations used to obtain the optimal scheduling of a hydro-thermal system when considering transmission losses are:

a. $$\frac{dC_i}{dP_{GT_i}}\left(\frac{1}{1-\frac{\partial P_L}{\partial P_{GT_i}}}\right)=\lambda=\frac{d\omega_j}{dP_{GH_j}}\left(\frac{1}{1-\frac{\partial P_L}{\partial P_{GH_j}}}\right).$$

b. $$\frac{dC_i}{dP_{GH_i}}\left(\frac{1}{1-\frac{\partial P_L}{\partial P_{GH}}}\right)=\lambda=\gamma_j\frac{d\omega_j}{dP_{GT_j}}\left(\frac{1}{1-\frac{\partial P_L}{\partial P_{GT_j}}}\right).$$

c. $$\frac{dC_i}{dP_{GT_i}}\left(\frac{1}{1-\frac{\partial P_L}{\partial P_{GT_i}}}\right)=\lambda=\gamma_j\frac{d\omega_j}{dP_{GH_j}}\left(\frac{1}{1-\frac{\partial P_L}{\partial P_{GH_j}}}\right).$$

d. None of these.

31. As far as possible, hydro-plants are used for base-load operation since:
    a. Their capital cost is high.
    b. Their operation is easy.
    c. Their capital cost is low.
    d. Their efficiency is low.
32. A thermal plant gives minimum cost per unit of energy generated when used as a _____ plant.
    a. Peak load.
    b. Base-load plant.
    c. Simultaneously as base-load and peak load plant.
    d. None of these.
33. In the combined operation of steam plant and run-off river plants, the sites of hydro and steam plants can be found with the help of__________.

a. Demand curve.

b. Input–output curve.

c. Load curve.

d. Chronological load curve.

34. Long-term hydro-thermal co-ordination can be done by:

a. Plotting the basic rule curve.

b. Plotting no spill-rule curve.

c. Plotting the full reservoir storage curve.

d. All of these.

35. _____ hydro-thermal co-ordination is done for the available water and is to be used in a given period (24 hr).

a. Long-term.

b. Short-term.

c. Both (a) and (b).

d. None of these.

36. Hydro-thermal co-ordination is necessary only in countries with:

a. Ample coal resources.

b. Ample water resources.

c. Both (a) and (b).

d. None of these.

37. In short-term hydro-thermal co-ordination,

a. No spill-rule curve is used.

b. Spill-rule curve is used.

c. Here no rule curve is used due to constraints.

d. None of these.

38. The units of incremental water rate are:

a. m3/s-MW.

b. m3-s/MW.

c. m-s/MW.

d. m2-s/MW.

39. Hydro-generation is a function of:

a. Water head.

b. Water discharge.

c. Water inflow.

d. Both (a) and (b).

40. In the long-term hydro-thermal co-ordination,

a. Basic rule curve is plotted.

b. No spill curve.

c. No full reservoir storage curve.

d. All of these.

41. In the combined operation of a steam and a run-off river plant, the sizes of hydro and steam plants can be obtained with the help of:

a. Load curve.

b. Demand curve.

c. Chronological load curve.
d. None of these.

ANSWERS

(1) a	(12) a	(23) a	(34) d
(2) b	(13) d	(24) a	(35) b
(3) a	(14) d	(25) b	(36) b
(4) b	(15) c	(26) c	(37) a
(5) b	(16) d	(27) b	(38) a
(6) c	(17) a	(28) c	(39) d
(7) a	(18) b	(29) d	(40) d
(8) c	(19) b	(30) c	(41) c
(9) d	(20) c	(31) a	
(10) c	(21) c	(32) b	
(11) d	(22) d	(33) d	

SHORT QUESTIONS AND ANSWERS

1. Why is the optimal scheduling problem in the case of thermal plants referred to as a static

optimization problem?
Optimal scheduling problem can be completely solved at any desired instant without referring to the operation at other times.

2. The optimization problem in the case of a hydro-thermal system is referred to as a dynamic problem. Why is it so?

The operation of the system having hydro and thermal plants have negligible operation
costs but is required under the constraint of water availability for hydro-generation over a
given period of time.

3. What is the statement of optimization problem of hydro-thermal system?

Minimize the fuel cost of thermal plants under the constraint of water availability for hydro-generation over a given period of time.

4. In the optimal scheduling problem of a hydro-thermal system, which variables are considered as control variables?

Thermal and hydro-power generations (PGT and PGH).

5. Fast-changing loads can be effectively met by which type of plants? Hydro-plants.
6. Generally, which type of plants are more suitable to operate as base-load and peak load

plants?
Thermal plants are suited for base-load plants and hydro-plants are suited for peak load
plants.

7. Whole or part of the base load can be supplied by which type of hydro-

plants? Run-off river type.

8. The peak load or remaining base load is met by which type of plants?

A proper co-ordination of reservoir-type hydro-plants and thermal plants.

9. In the optimal scheduling problem of a hydro-thermal system, what parameters are assumed to be known as the function of time with certainty?

Water inflow to the reservoir and load demand.

10. What is the mathematical statement of the optimization problem in the hydro-thermal system?

Determine the water discharge rate $q(t)$ so as to minimize the cost of thermal generation.

11. Write the objective function expression of hydro-thermal scheduling problem.

$$\min C_T = \int_0^T C'\left(P_{GT}(t)\right) dt$$

12. Write the constraint equations of the hydro-thermal scheduling problem.

$P_{GT}(t) + P_{GH}(t) - P_L(t) - P_D(t) = 0$

for $t \in (O,T)$—Real power balance equation

$$X'(T) - X'(0) - \int_0^T J(t)\,dt + \int_0^T q(t)\,dt = 0$$

—$P_{GH}(t) = (X'''(t), q(t))$

13. By which principle can the optimal scheduling problem of a hydro-thermal system be solved?

Discretization principle.

14. Write the expression for real power hydro-generation in any sub-interval '*K*'?

$P^K_{GH} = h_o \{1 + 0.5e\,(X^K + X^{K-1})\}\,(q^K - \rho)$

15. Define the terms of the above real power hydro-generation.

$P^K_{GH} = h_o \{1 + 0.5e\,(X^K + X^{K-1})\}\,(q^K - \rho)$

where $h_0 = 9.81 \times 10^{-3}\, h_{01}$, h_{o1} is the basic water head that corresponds to dead storage, e the water-head correction factor to account for the variation in head with water storage, X^k the water storage at interval k, q^k the water discharge at interval k, and ρ the non-effective discharge.

16. In the optimal scheduling problem of a hydro-thermal system, which variables are used to

choose as independent variables?

Water discharges in all sub-intervals except one sub-interval:

i.e., $e^k{}_{k \neq 1}$, for $q^2, q^3 \cdots q^N$

where $k = 2, 3 \ldots N$ (k is sub-interval).

17. Which parameters are used as dependent variables?

Thermal, hydro-generations, water storages at all sub-intervals, and water discharge at

i.e., $P_{GT}{}^k$, $P_{GH}{}^k$ X^k, and q^1

excepted sub-intervals are used as dependent variables,

18. In solving the optimal scheduling problem of a hydro-thermal system, for 'N' sub-intervals (i.e., $k = 1, 2, \ldots, N$), $N-1$ number of water discharges q*'s* can be specified as

independent variables except one sub-interval. Write the expression for water discharge in the excepted sub-interval, which is taken as a dependant variable.

$$q' = X^0 - X^N + \sum_{k=1}^{N} J^k - \sum_{k=2}^{N} q^k$$

19. Which technique is used to obtain the solution to the optimization problem of the hydrothermal system?

A non-linear programming technique in conjunction with a first-order negative gradient
method is used to obtain the solution to the optimization problem.

20. Write the expression for a Lagrangian function obtained by augmenting the objective function with constraint equations in the case of a hydro-thermal scheduling problem.

$$\mathfrak{L} = \sum_{k=1}^{N} \begin{bmatrix} C(P_{GT}^k) - \lambda_1^k (P_{GT}^k + P_{GH}^k - P_L^k - P_D^k) + \\ \lambda_2^k (X^k - X^{k-1} - J^k + q^k) + \\ \lambda_3^k (P_{GH}^k - h_0 \left\{1 + 0.5e(X^k + X^{k-1})\right\} \end{bmatrix} (q^k - \rho)$$

21. What is the gradient vector?

The partial derivatives of the Lagrangian function with respect to independent variables
are

$$\text{i.e., } \left[\frac{\partial \mathfrak{L}}{\partial q^k}\right]_{\substack{k \neq 1 \\ k=2\cdots N}} = \lambda_2^k - \lambda_3^k h_0 \left\{ \begin{bmatrix} 1 + 0.5e \\ \begin{pmatrix} 2X^{k-1} + \\ J^k - 2q^k + \rho \end{pmatrix} \end{bmatrix} \right\}$$

22. What is the condition for optimality in the case of a hydro-thermal scheduling problem?

The gradient vector should be zero:

$$\text{i.e., } \left[\frac{\partial \mathfrak{L}}{\partial q^k}\right]_{\substack{k \neq 1 \\ k=2\ldots N}} = 0$$

23. The condition for optimality in a hydro-thermal scheduling problem is that the gradient

vector should be zero. If this condition is violated, how will we obtain the optimal solution?

Find the new values of control variables, which will optimize the objective function. This
can be achieved by moving in the negative direction of the gradient vector to a point where the value of the objective function is nearer to an optimal value.

24. For a system with a multihydro and a multithermal plant, the non-linear programming technique in conjunction with the first-order gradient method is also directly applied. However, what is the drawback?

It requires large memory since the independent and dependant variables, and gradients need to be stored simultaneously.

25. By which method can the drawback of the non-linear programming technique be overcome when applied to a multihydro and multithermal plant system and what is its procedure?

By the method of decomposition technique. In this technique, the optimization is carried

out over each sub-interval and a complete cycle of iteration is replaced, if the water availability equation does not check at the end of the cycle.

26. For short-range scheduling of a hydro-thermal plant, which method is useful? Kirchmayer's method or the penalty factor method is useful for short-range scheduling.
27. What is Kirchmayer's method of obtaining the optimum scheduling of a hydro- thermal

system?

In Kirchmayer's method or the penalty factor method, the co-ordination equations are derived in terms of penalty factors of both hydro and thermal plants.

28. What is the condition for optimality in a hydro-thermal scheduling problem when considering transmission losses?

$$\frac{\partial C_i}{\partial P_{GT_i}}\left(1\Big/1-\frac{\partial P_L}{\partial P_{GT_i}}\right)_{\text{for } i=1,2,\ldots,\alpha}=\gamma_j$$

$$\frac{\partial w_j}{\partial P_{GH_j}}\left(1\Big/1-\frac{\partial P_L}{\partial P_{GH_j}}\right)_{\text{for } j=\alpha+1,\alpha+2,\ldots,n}=\lambda$$

where *i* represents the thermal plant and *j* represents the hydro-plant.

29. What is short-term hydro-thermal co-ordination?

Short-term hydro-thermal co-ordination is done for a fixed quantity of water to be used in

a certain period (i.e., 24 hr).

30. What are the scheduling methods for short-term hydro-thermal co-ordination? Constant hydro-generation method.

Constant steam generation method.

Maximum hydro-efficiency method.

Equal incremental production costs and solution of co-ordination equations (Kirchmayer's method).

31. What is the significance of the co-efficient γj?

γj represents the incremental water rates into incremental costs which must be so selected

as to use the desired amount of water during the operating period.

DESCRIPTIVE QUESTIONS

1. Explain the hydro-thermal co-ordination and its importance.
2. Describe the types of hydro-thermal co-ordination.
3. What are the factors on which economic operation of a combined hydro-thermal system

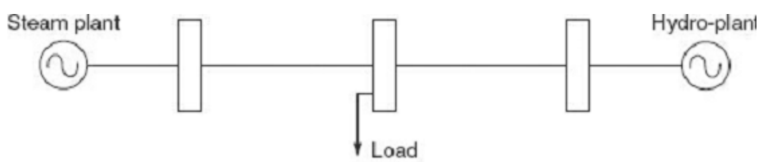
depends?

4. The system shown in Fig. (a) is to supply a load shown in Fig. (b). The data of the system are as follows:

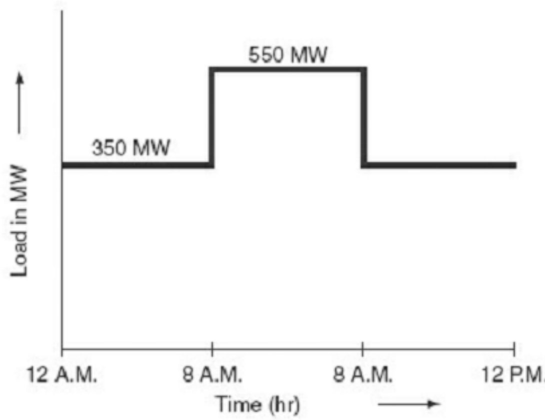
$C_T = (16 + 0.01P_{GT})P_{GT}$ Rs./hr

$w_2 = (4 + 0.0035P_{GH})P_{GH}$ m3/s

The maximum capacity of a hydro-plant and a steam plant are 400 and 270 MW, respectively. Determine the generating schedule of the system so that 130.426 million m^3 water is used during the 24-hr period.



(a)



(b)

5. A thermal station and a hydro-station supply an area jointly. The hydro-station is run 12 hr daily and the thermal station is run throughout 24 hr. The incremental fuel cost characteristic of the thermal plant is

$C_T = 3 + 5P_{GT} + 0.02P_{GT}$ Rs/hr

If the load on the thermal station, when both plants are in operation, is 250 MW, the incremental water rate of the hydro-power plant is

$$\frac{d\omega}{dP_{GH}} = 24 + 0.04P_{GH} \text{m}^3 \text{/MW-s}$$

The total quantity of water utilized during the 12-hr operation of a hydro-plant is 450 million m^3. Find the generation of the hydro-plant and the cost of water used. Assume that the total load on the hydro-plant is constant for the 12-hr period.

6. A two-plant system that has a thermal station near the load center and a hydro-power station at a remote location is shown in Fig.

The characteristics of both stations are:

$C_T = (20 + 0.03P_{GT})P_{GT}$ Rs./hr

$w_2 = (8 + 0.002P_{GH})P_{GH}$ m3/s

and γ_2 = Rs. 5×10^{-4}/m3

The transmission loss co-efficient, $B_{22} = 0.0005$.

i. if the load is 700 MW for 15-hr a day and 500 MW for 9 hr on the same day, find the generation schedule, daily water used by hydro-plant, and the daily operating cost of the thermal power.

ii. Determine the power generation at each station and the power received by the load when λ = 50 Rs./MWh.

7. A two-plant system that has a hydro-station near the load center and a thermal power station at a remote location is shown in Fig.

The characteristics of both stations are

$C_T = (20 + 0.03P_{GT})P_{GT}$ Rs./hr

$w_2 = (8 + 0.002P_{GH})P_{GH}$ m3/s

and γ_2 = Rs. 5.5/m3

The transmission loss co-efficient, $B_{22} = 0.0005$.

i. If the load is 700 MW for 15 hr a day and 500 MW for 9 hr on the same day, find the generation schedule, daily water used by the hydro-plant, and the daily operating cost of thermal power.

ii. Determine the power generation at each station and the power received by the load when λ = 50 Rs. /MWh.

8. What are the important methods of hydro-thermal co-ordination? Explain them in brief.
9. Explain the mathematical formulation of long-term hydro-thermal scheduling.
10. Explain the solution method of long-term hydro-thermal scheduling by discretization principle.
11. Develop an algorithm for the solution of long-term hydro-thermal scheduling problem.
12. Derive the condition for optimality of short-term hydro-thermal scheduling problem.

What are the advantages of hydro-thermal plants combinations?

UNIT-2

HYDRO-THERMAL SCHEDULING ASSIGNEMENT QUESTION

1. A thermal station and a hydro-station supply an area jointly. The hydro-station is run 12 hr daily and the thermal station is run throughout 24 hr. The incremental fuel cost characteristic of the thermal plant is

$C_T = 3 + 5P_{GT} + 0.02P_{GT}{}^2$Rs/hr

If the load on the thermal station, when both plants are in operation, is 250 MW, the incremental water rate of the hydro-power plant is

$$\frac{d\omega}{dP_{GH}} = 24 + 0.04P_{GH} m^3 \ / \text{MW-s}$$

The total quantity of water utilized during the 12-hr operation of a hydro-plant is 450 million m3. Find the generation of the hydro-plant and the cost of water used. Assume that the total load on the hydro-plant is constant for the 12-hr period.

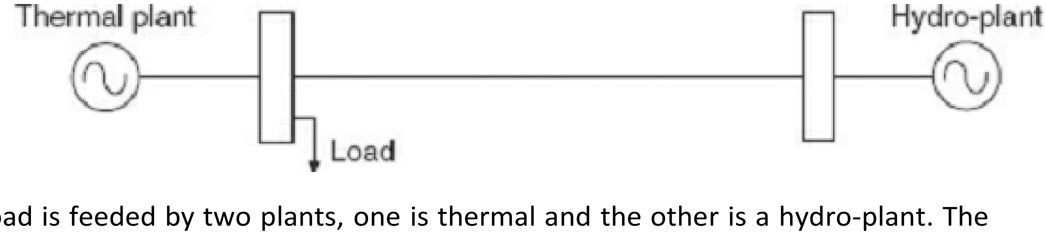
2. A load is feeded by two plants, one is thermal and the other is a hydro-plant. The load is located near the thermal power plant as shown in Fig. The characteristics of the two plants are as follows:

$C_T = 0.04P_{GT}{}^2 + 30P_{GT} + 20$ Rs./hr

$w_H = 0.0012$ PGH2 + 7.5PGH m^3/s γ_H =

2.5 × 10–5 Rs./m

3. The transmission loss co-efficient is B 22 = 0.0015 MW−1. Determine the power generation of both thermal and hydro-plants, the load connected when λ = 45 Rs./MWh



4. A load is feeded by two plants, one is thermal and the other is a hydro-plant. The load is located near the thermal power plant as shown in Fig. The characteristics of the two plants are as follows:

$C_T = 0.04P_{GT}{}^2 + 30P + 20$ Rs./hr

GT

$w_H = 0.0012\ P_{GH}^2 + 7.5P_{GH}$ m^3/s γ_H =

2.5 × 10–5 Rs./m

The transmission loss co-efficient is $B_{22} = 0.0015$ MW−1. Determine the power generation of both thermal and hydro-plants, the load connected when $\lambda = 45$ Rs./MWh. Determine the daily water used by the hydro-plant and the daily operating cost of the thermal plant with the load connected for totally 24 hr.

5. A two-plant system that has a hydro-plant near the load center and a steam plant at a remote location is shown in Fig. The load is 400 MW for 14 hr a day and 200 MW, for 10 hr a day. The characteristics of the units are

$C_1 = 150 + 60 P_{GT} + 0.1 P_{GT}^2$ Rs/hr $w_2 =$

$0.8 P_{GH} + 0.000333 P_{GH}^2$ m3/s

Loss coefficient, $B_{22} = 0.001$ MW−1. Find the generation schedule, daily water used by the hydro-plant, and the daily operating cost of a thermal plant for $\gamma j = 77.5$ Rs./m^{3}hr.

6. Derive the condition for optimality of short-term hydro-thermal scheduling problem.
7. What are the advantages of hydro-thermal plants combinations?

UNIT-3

MODELING OF GOVERNOR AND EXCITATION

MULTIPLE-CHOICE QUESTIONS

1. If the load on an isolated generator is increased without increasing the power input to the prime mover:
   a. The generator will slow down.
   b. The generator will speed up.
   c. The generator voltage will increase.
   d. The generator field.
2. Governors of controlling the speed of electric-generating units normally provide:
   a. A flat-speed load characteristic.
   b. An increase in speed with an increasing load.
   c. A decrease in speed with an increasing load.
   d. None
3. When two identical AC-generating units are operated in parallel on governor control, and one machine has a 5% governor droop and the other a 10% droop, the machine with the greater governor droop will:
   a. Tend to take the greater portion of the load changes.
   b. Share the load equally with the other machine.
   c. Tend to take the lesser portion of the load changes.
   d. None.
4. On LFC installations, error signals are developed proportional to the frequency error. If the frequency declines, the error signal will act to:
   a. Increase the prime mover input to the generators.
   b. Reduce the prime mover input to the generators.
   c. Increase generator voltages.
   d. None.
5. If KE reduces
   a. *w* decreases.
   b. Speed falls.
   c. Frequency reduces.
   d. All.
6. The changing of slope of a speed governer characteristic is achevied by changing the ratio of lever L of governer and can be made during
   a. On-line condition only.
   b. Off-line condition only.
   c. Both (a) and (b).
   d. Either (a) or (b).
7. Unit of *R* is_________.
   a. Hz/MVAr.
   b. Hz/MVA.
   c. Hz/MW.

d. Hz-s.

8. Unit of B is_________.
   a. MVAr/Hz.
   b. MVA/Hz.
   c. MW/Hz.
   d. MW-s.
9. Unit of H of a synchronous machine is:
   a. MJ/MW.
   b. MJ/MVA.
   c. MJ/s.
   d. MW-s.
10. KE and frequency of a synchronous machine are related as:
   a. KE = f.
   b. KE = $1/f$.
   c. KE = $f2$.
   d. None of these.
11. Input signals to an ALFC loop is ________.
   a. ΔPref
   b. ΔPD
   c. Both (a) and (b).
   d. None of these.
12. Two main control loops in generating stations are:
   a. ALFC.
   b. AVR.
   c. Both (a) and (b).
   d. None of these.
13. The speed regulation can be expressed as
   a. Ratio of change in frequency from no-load to full load to the rated frequency of the unit.
   b. Ratio of change in frequency to the corresponding change in real-power generation.
   c. (a) and (b).
   d. None of these.
14. In an ALFC loop, Δf can be reduced using ________ controller.
   a. Differential.
   b. Integral.
   c. Proportional.
   d. All of these.
15. Time constant of a power syste when compared to a speed governor is:
   a. Less.
   b. More.
   c. Same.
   d. None of these.
16. Δf is of the order of_________Hz.
   a. 0 to 0.05.

b. –0.05 to 0.

c. Both (a) and (b).
d. None of these.

17. In a power system________are continuously changing.
   a. Active and reactive power generation.
   b. Active and reactive power demands.
   c. Voltage and its angle.
   d. All of these.
18. In a normal state, the frequency and voltage are kept at specified values that carefully
   maintain a balance between:
   a. Real-power demand and real-power generation.
   b. Reactive power demand and reactive power generation.
   c. Both.
   d. None of these.
19. Real-power balance will control the variations in________.
   a. Voltage.
   b. Frequency.
   c. Both.
   d. None of these.
20. The excitations of the generators must be continuously regulated:
   a. To match the reactive power generations with reactive power demand.
   b. To control the variations in voltage.
   c. Both.
   d. None of these.
21. ________ is the basic control mechanism in the power system.
   a. LFC.
   b. Voltage.
   c. Both.
   d. None of these
22. Setting of speed-load characteristic parallel to itself is known as________and its adapted as on-line control.
   a. Primary control.
   b. Supplementary control.
   c. Basic.
   d. All of these.
23. The basic function of LFC is:
   a. To maintain frequency for variations in real-power demand.
   b. To maintain voltage for variations in reactive power demand.
   c. To maintain both voltage and frequency for variations in real-power demand.
   d. To maintain both voltage and frequency for variations in real-power demand.
24. The degree of unbalance between real-power generation and real-power demand is indicated by the index:
   a. Speed regulation *R*.
   b. Change in voltage,

c. Frequency error.

d. None.

25. The LFC system__________in the system.

a. Does consider the reactive power flow.

b. Does not consider the reactive power flow.

c. Does not consider the real-power flow.

26. ________ controls the excitation voltage and modifies the excitation.

a. Change in real-power, ΔPa.

b. Change in frequency Δ.

c. Change in tie-line power, ΔPtie.

d. Change in reactive power ΔQci.

27. The *p*–*f* controller is employed to:

a. Control the frequency.

b. Monitor the active power flows in interconnection.

c. Control the voltage.

i. Only (a).

ii. Only (b).

iii. (b) and (c).

iv. (a) and (b).

28. Which of the following is correct regarding *p*–*f* controller?

a. It senses the frequency error.

b. It changes the tie-line powers.

c. Provides the information about incremental error in power angle $\Delta\delta$.

i. (a) and (b).

ii. (b) and (c).

iii. (a) and (c).

iv. All of these.

29. The control signal that will change the position of the inlet valve of the prime mover is:

a. ΔPci.

b. ΔPgi.

c. ΔPdi.

d. None of these.

30. The objective of *Q*–*V* controller is to transform the:

a. Terminal voltage error signal into a reactive power control signal, ΔQci.

b. Terminal voltage error signal into a real-power control signal, ΔPci.

c. Frequency error signal into a real-power control signal, ΔPci.

d. None of these.

31. The active power *P* is:

a. Mainly dependent on the internal torque angle, δ.

b. Almost independent of the voltage magnitude.

c. totally dependent on both the torque angle and the voltage.

d. Mainly dependent on voltage and independent of torque angle, δ.

i. (a) and (d).

ii. (b) and (c).

iii. (a) and (b).

iv. Only (d).

32. The bus voltage V is:

a. Dependent on the internal torque angle, δ.

b. Almost independent of active power, P.

c. Dependent on machine excitation and hence on reactive power.

d. Almost independent of internal torque angle, δ.

i. and (d).

ii. (b) and (c).

iii. (a) and (b).

iv. (c) and (d).

33. Usually p–f controller and Q–V controller for_________change, can be considered as ________ type.

a. Dynamic, non-interacting.

b. Static, interacting.

c. Static, non-interacting.

d. None of these.

34. AVR loop is__________control mechanism.

a. Slow.

b. Faster.

c. Slow in some cases and faster in some other cases.

d. None of these.

35. ALFC loop is__________control mechanism.

a. Slow.

b. Faster.

c. Slow as well as fast.

d. None of these.

36. Which of the following indicates the large-signal analysis of power system dynamics?

a. Large and sudden variations in the system variables due to sudden disturbances.

b. Mathematical model is a set of non-linear differential equations.

c. Mathematical model is a set of linear differential equations.

d. Small and gradual variations of system variables.

i. (a) and (b).

ii. (b) and (c).

iii. (c) and (d).

iv. None of these.

37. Laplace transform methods are employed to determine the response of the system in ________ analysis.

a. Large signal.

b. Small signal.

c. Both.

d. None of these.

38. A signal area system is one in which:

a. It is not connected to any other system.

b. Total demand on the system should be fully met by its own local generation.
c. All generators swing together.
d. All of these.

39. In a signal area system, all generators working remain in synchronism maintaining their relative power angles; such a group of generators is called _.
a. Swing group.
b. Synchro group.
c. Coherent group.
d. None of these.

40. The heart of the speed governor system, which controls the change in speed is:
a. Linkage mechanism.
b. Fly-ball speed governor.
c. Speed changer.
d. Hydraulic amplifier.

41. In a hydraulic amplifier:
a. High-power-level pilot valve moment is converted into low-power-level main piston movement.
b. Low-power pilot valve moment is converted into low-power-level piston movement.
c. Low-power-level pilot valve moment is converted into high-power-level piston movement.
d. Low-power-level pilot valve moment is converted into high-power-level pilot valve moment.

42. Linkage mechanism provides:
a. The moment of control valve in propositional to the inlet steam.
b. The feedback from the control valve moment.
c. Both (a) and (b).
d. None of these.

43. The primary control loop in generator control is:
a. Linkage mechanism.
b. Fly-ball speed governor.
c. Speed changer.
d. Hydraulic amplifier.

44. The position of the pilot valve can be affected through linkage mechanism in ________ way.
a. Directly by the speed changer.
b. Indirectly through feedback due to position changes of the main system.
c. Indirectly through feedback due to position changes of the linkage point E resulting from a change in speed.
d. All of these.

45. For non-reheat type of steam turbine, the mathematical model is:

a. $\frac{\Delta P_G(s)}{\Delta X_E(s)} = \frac{K_t}{1+s\tau_t}$

b. $\frac{\Delta P_G(s)}{\Delta X_E(s)} = \mathbf{1} - \frac{K_t}{1+s\tau_t}$

c. $\frac{\Delta P_G(s)}{\Delta X_E(s)} = \left(\frac{K_E}{1+s\tau_t}\right)\left(\frac{1+s\tau_r K_r}{1+s\tau_t}\right)$

d. None of these.

46. In reheat type of steam turbine,

a. Steam at high pressure with low temperature is transformed into steam at low pressure with higher temperature.

b. Steam at low pressure with higher temperature is transformed into steam at high pressure with low temperature.

c. Steam at low pressure with low temperature is transformed into steam at high pressure with higher temperature.

d. None of these.

47. Transfer function of reheat type of steam turbine is of________order.

a. First.

b. Second.

c. Third.

d. None of these.

48. Transfer function of non-reheat type of steam turbine is of________order.

a. First.

b. Second.

c. Third.

d. None of these.

49. The surplus power (ΔPG – ΔPD) can be absorbed by a system:

a. By increasing the stored *K ∈* of the system at the rate d(W_{ke}/dt)

b. By motor loads.

c. There is no absorption of surplus power by the system.

d. Both (a) and (b).

50. The block diagram of the LFC of an isolated power system is of__________model.

a. First.

b. Second.

c. Third.

d. Fourth.

ANSWER

(1) a	(14) b	(27) d	(40) b
(2) c	(15) b	(28) d	(41) c

(3) c	(16) b	(29) a	(42) c
(4) a	(17) b	(30) a	(43) c

(5) d	(18) c	(31) c	(44) d
(6) b	(19) b	(32) d	(45) a
(7) c	(20) c	(33) c	(46) a
(8) c	(21) a	(34) b	(47) b
(9) b	(22) b	(35) a	(48) a
(10) c	(23) a	(36) a	(49) d
(11) c	(24) c	(37) b	(50) c
(12) c	(25) b	(38) d	
(13) c	(26) d	(39) c	

SHORT QUESTIONS AND ANSWERS

1. What is the effect of speed of a generator on its frequency? The effect of speed of a generator on its frequency is

$$f = \frac{pN}{120}\,\text{Hz}$$

where *p* is the number of poles and *N* the speed in rpm.

2. Why should the system frequency be maintained constant? Constant frequency is to be maintained for the following functions:

All the AC motors should be given constant frequency supply so as to maintain the speed constant. In continuous process industry, it affects the operation of the process itself. For synchronous operation of various units in the power system network, it is necessary to maintain the frequency constant.

3. What is the nature of the generator–load frequency characteristic? The nature of the generator is drooping straight-line characteristics.
4. How do load frequency characteristics change during on-line control?

By shifting the load frequency characteristics as a whole up or down varying the inlet valve opening of the prime mover.

5. How do load frequency characteristics change during off-line control?

By changing the slope of the load characteristics by varying the lever ratio of the speed governor.

6. State why *P–f* and *Q–V* control loops can be treated as non-interactive?

The active power *P* is mainly dependent on the internal angle δ and is independent of bus

voltage magnitude $|V|$. The bus voltage is dependent on machine excitation and hence on
reactive power Q and is independent of the machine angle δ. The change in the machine
angle δ is caused by a momentary change in the generator speed and hence the frequency.

Therefore, the load frequency and excitation voltage controls are non-interactive for small changes and can be modeled and analyzed independently.

7. What will be the order of the system for non-reheat steam turbine and reheat turbine? The order of the system for non-reheat and reheat steam turbine are first order and second

order, respectively.

8. What are the transfer functions of non-reheat steam turbine and reheat turbine? What will

be the value of their time constants?

The transfer function of non-reheat type of steam turbine is

$$G_{T(s)} = \frac{K_t}{1 + s\tau_t}, \quad \tau_1 = 0.2 \text{ to } 2 \text{ s}$$

The transfer function of reheat type of steam turbine is

$$G_T(s) = \frac{\Delta P_G(s)}{\Delta X_E(s)} = \left[\frac{K_t}{(1 + s\tau_t)}\right] \frac{(1 + sK_r\tau_r)}{(1 + s\tau_r)}$$

The time constant τr has a value in the range of 10 s.

9. Under what condition will the model developed for a turbine be valid?

The condition for the turbine is the first 20 s following the incremental disturbance.

10. Explain the control area concept.

It is possible to divide a very large power system into sub-areas in which all the generator

are tightly coupled such that they swing in unison with change in load or due to a speed changer setting. Such an area, where all the generators are running coherently, is termed

the control area. In this area, frequency may be same in steady-state and dynamic conditions. For developing a suitable control strategy, a control area can be reduced to a single generator, a speed governor, and a load system.

11. What is meant by single-area power system?

A single area is a coherent area in which all the generators swing in unison to the changes

in load or speed-changer settings and in which the frequency is assumed to be constant

throughout both in static and dynamic conditions. This single control area can be represented by an isolated power system consisting of a turbine, its speed governor, generator, and load.

12. What is meant by dynamic response in LFC?

The meaning of dynamic response is how the frequency changes as a function of time immediately after disturbance before it reaches the new steady-state condition.

13. What is meant by uncontrolled case?

For uncontrolled case, $\Delta PC = 0$; i.e., constant speed-changer position with variable load.

14. What is the need of a fly-ball speed governor?

This is the heart of the system, which controls the change in speed (frequency).

15. What is the need of a speed changer?

It provides a steady-state power output setting for the turbines. Its upward movement opens the upper pilot valve so that more steam is admitted to the turbine under steady conditions. This gives rise to higher steady-state power output. The reverse happens for downward movement of the speed changer.

16. What is meant by area control error?

The area control error (ACE) is the change in area frequency, which when used in an integral-control loop forces the steady-state frequency error to zero.

17. What is the nature of the steady-state response of the uncontrolled LFC of a single area?

The nature of the steady-state response of a single area is the linear relationship between frequency and load for free governor operation.

18. How and why do you approximate the system for the dynamic response of the uncontrolled LFC of a single area?

The characteristic equation of the LFC of an isolated power system is third order, dynamic response that can be obtained only for a specific numerical case. However, the characteristic equation can be approximated as first order by examining the relative magnitudes of the different time constants involved.

19. What are the basic requirements of a closed-loop control system employed for obtaining the frequency constant?

The basic requirements are as follows:

i. Good stability;

ii. Frequency error, accompanying a step-load change, returns to zero;

iii. The magnitude of the transient frequency deviation should be minimum;

iv. The integral of the frequency error should not exceed a certain maximum value.

20. What are the basic components of an integral controller It consists of a frequency sensor and an integrator.

21. Why should the integrator of the frequency error not exceed a certain maximum value?

The frequency error should not exceed a maximum value so as to limit the error of synchronous clocks.

22. What are the assumptions made in the simplified analysis of the integral control? The time constant of the speed-governing mechanism τsg and that of the turbine are both neglected, i.e., it is assumed that $\tau sg = \tau t = 0$. The speed changer is an electromechanical device and hence its response is not instantaneous. However, it is assumed to be instantaneous in the present analysis. All non-linearities in the

equipment, such as dead zone, etc., are neglected. The generator can change its generation ΔPG as fast as it is commanded by the speed-changer. The ACE is a continuous signal.

23. State briefly how the time response of the frequency error depends upon the gain setting of the integral control.

If KI is less than its critical value, then the response will be damped non-oscillatory. $\Delta f(t)$ reduces to zero in a longer time. Hence, the response is sluggish. This is an over damped case. This is the subcritical case of integral control.

If KI is greater than its critical value, the time response would be damped oscillatory. $\Delta f(t)$ approaches zero faster. This is an under damped case. This is the supercritical case of the control.

If K I equals its critical value, no oscillations would be present in the time response and $\Delta f(t)$ approaches zero in less time than in the subcritical case. The integral of the frequency error would be the least in this case.

DESCRIPTIVE QUESTIONS

1. Develop the block diagram of the LFC of a single-area system.
   Compare the steady state and dynamic operations of an isolated system.
2. Draw the schematic diagram of a speed-governing system and explain its components on the dynamic response of an uncontrolled system with necessary equations. Hence, obtain the transfer function of a speed-governing system.
   How do the governor characteristics of the prime mover affect the control of system frequency and system load?
   Explain why it is necessary to maintain the frequency of the system constant.
3. What do you mean by LFC?
4. Draw a neat sketch of a typical turbine speed-governing system and derive its block diagram representation.
5. For a single-area system, show that the static error in frequency can be reduced to zero using frequency control and comment on the dynamic response of an uncontrolled system with necessary equations.
6. Explain the p–f and Q–V control loops of power system.
7. What is meant by control area and ACE?
8. Explain clearly about proportional plus integral LFC with a block diagram.
9. Discuss the adverse effects of change in the voltage and the frequency of a power system. Mention the acceptable ranges of these changes.
10. A 250-MVA synchronous generator is operating at 1,500 rpm, 50 Hz. A load of 50 MW is suddenly applied to the machine and the station valve to the turbine opens only after 0.35 s due to the time lag in the generator action. Calculate the frequency at which the generated voltage drops before the steam flow commences to increase to meet the new load. Given that the valve of H of the generator is 3.5 kW-s per kVA of the generator energy.

11. Two generating stations A and B have full-load capacities of 250 and 100 MW, respectively. The interconnector connecting the two stations has an induction motor/synchronous generator (Plant C) of full-load capacity 30 MW; percentage changes of speeds of A, B, and C are 4, 3, and 2, respectively. The loads on bus bars A and B are

MW and 50 MW, respectively. Determine the load taken by Plant C and indicate the direction of the power flow.

12. A 750-MW generator has a speed regulation of 3.5%. If the frequency drops by 0.1 Hz with an unchanged reference, determine the increase in turbine power. And also find by how much the reference power setting should be changed if the turbine power remains unchanged.

UNIT-3

MODELING OF EXCITER AND GOVERNOR
ASSIGNEMENT QUESTION

1. Develop a mathematical model of an exciter system and brief on its control action
2. Explain the static and dynamic performance of AVRloop.
3. Model the components of a typical Excitation system and derive its transfer function.
4. Develop a mathematical model of speed governing system with neat sketch
5. Obtain the Model of Speed governor, Generator and Turbine and hence give the Block diagram representation of an isolated powersystem.
6. Two synchronous generators operating in parallel. Their capacities are 300MW and 400MW. The droop characteristics of their governors are 4% and 5% from no load to full load. Assuming that the generators are operating at 50HZ at no load, how would be a load of 600MW shared between them. Calculate the system frequency at this load? Assume free governor action.

UNIT-4

LOAD FREQUENCY CONTROL SINGLE AND TWO AREA SYSTEM MULTIPLE-

CHOICE QUESTIONS

1. Changes in load division between AC generators operation in parallel are accomplished by:
   a. Adjusting the generator voltage regulators.
   b. Changing energy input to the prime movers of the generators.
   c. Lowering the system frequency.
   d. Increasing the system frequency.
2. When the energy input to the prime mover of a synchronous AC generator operating in parallel with other AC generators is increased, the rotor of the generator will:
   a. Increase in average speed.
   b. Retard with respect to the stator-revolving field.

c. Advance with respect to the stator-revolving field.
d. None of these.

3. When two or more systems operate on an interconnected basis, each system:
a. Can depend on the other system for its reserve requirements.

b. Should provide for its own reserve capacity requirements.

c. Should operate in a 'flat frequency' mode.

4. When an interconnected power system operates with a tie-line bias, they will respond to:

a. Frequency changes only.

b. Both frequency and tie-line load changes.

c. Tie-line load changes only.

5. In a two-area case, ACE is:

a. Change in frequency.

b. Change in tie-line power.

c. Linear combination of both (a) and (b).

d. None of the above.

6. An extended power system can be divided into a number of LFC areas, which are interconnected by tie lines. Such an operator is called

a. Pool operation.

b. Bank operation.

c. (a) and (b).

d. None.

7. For the static response of a two-area system,

a. $\Delta P ref1 = \Delta ref2$.

b. $\Delta P ref1 = 0$.

c. $\Delta P ref2 = 0$.

d. Both (b) and (c).

8. Area of frequency response characteristic 'β' is:

a. $1/R$.

b. B.

c. $B + 1/R$.

d. $B - 1/R$.

9. The tie-line power equation is $\Delta P12$ = ______

a. $T\,(\Delta\delta 1 + \Delta\delta 2)$.

b. $T/(\Delta\delta 1 + \Delta\delta 2)$.

c. $T/(\Delta\delta 1 - \Delta\delta 2)$.

d. $T(\Delta\delta 1 - \Delta\delta 2)$.

10. The unit of synchronizing coefficients 'T' is:

a. MW-s.

b. MW/s.

c. MW-rad.

d. MW/rad.

11. For a two-area system, Δf is related to increased step load $M1$ and $M2$ with area frequency

response characteristics $\beta 1$ and $\beta 2$ is:

a. M

$1 + M2/\beta 1 + \beta 2$.

b. $(M1 + M2)\,(\beta 1 + \beta 2)$.

c. $-(M1 + M2)/(\beta1 + \beta2)$.

d. None of these.

12. Tie-line power flow for the above question (11) is $\Delta P12$ = ______

a. $(\beta1\ M2 + \beta2\ M1)/\beta1 + \beta2$.

b. $(\beta1\ M2 - \beta2\ M1)/\beta1 + \beta2$.

c. $(\beta1\ M1 - \beta2\ M2)/\beta1 + \beta2$.

d. None of these.

13. Advantage of a pool operation is:

a. Added load can be shared by two areas.

b. Frequency drop reduces.

c. Both (A) and (B).

d. None of these.

14. Damping of frequency oscillations for a two-area system is more with:

a. Low-R.

b. High-R.

c. $R = \alpha$.

d. None of these.

15. ACE equation for a general power system with tie-line bias control is:

a. $\Delta Pij + Bi\Delta fi$.

b. $\Delta Pij - Bi\Delta fi$.

c. $\Delta Pij / Bi\ \Delta fi$.

d. None of these.

16. For a two-area system Δf, ΔPL, $R1$, $R2$, and D are related as Δf = ______

a. ΔPL / $R1 + R2$.

b. $-\Delta P$L / $(1/R1 + R2 +$
$B)$. c. $-\Delta P$L / $(B + R1 +$
$1/R2)$.

d. None of these.

17. If the two areas are identical, then we have:

a. $\Delta f1 = 1/\Delta f2$.

b. $\Delta f1\ \Delta f2 = 2$.

c. $\Delta f1 = \Delta f2$.

d. None of these.

18. Tie-line between two areas usually will be a_____line.

a. HVDC.

b. HVAC.

c. Normal AC.

d. None of these.

19. Dynamic response of a two-area system can be represented by a____order transfer function.

a. Third.

b. Second.

c. First.

d. Zero.

20. Control of ALFC loop of a multi-area system is achieved by using _______ mathematical

technique.

a. Root locus.

b. Bode plots.

c. State variable.

d. Nyquist plots.

ANSWER

(1) b	(6) a	(11) c	(16) b
(2) c	(7) d	(12) b	(17) c
(3) b	(8) c	(13) c	(18) a
(4) b	(9) d	(14) a	(19) b
(5) c	(10) d	(15) a	(20) c

SHORT QUESTIONS

1. Show the conditions necessary for sharing load operating in parallel between the two synchronous machines?
2. Define area control error.
3. Summarize load frequency control.
4. Classify system load?
5. Contrast the functions of "speed Governor" and "speed changer" in a speed governing systems of a turbine generator set.
6. Quote about coherent group of generators?
7. Analyze tie-line bias control.
8. Explain the function of load frequency control on power system?
9. Discuss the frequency and voltage to be regulated in a power system?
10. A speed governor system cannot completely eliminate frequency error caused by a step load change in power system. Evaluate this statement.
11. Interpret real power in power system controlled?
12. Illustrate the advantages of state variable model
13. Define AGC?
14. Define speed droop.
15. What are the advantages of a pool operation?

    The advantages of a pool operation (i.e., grid operation) are:

    i. Half of the added load (in Area-2) is supplied by Area-1 through the tie line.
    ii. The frequency drop would be only half of that which would occur if the areas were operating without interconnection.

16. Without speed-changer position control, can the static frequency deviation be zero? No, the static frequency deviation cannot be zero.
17. State the additional requirement of the control strategy as compared to the single-area control.

The tie-line power deviation due to a step-load change should decrease to zero.

18. Write down the expressions for the ACEs.

The ACE of Areas-1 and 2 are:

ACE1 (S) = ΔPTL1 (S) +

$b1\Delta F1$(S). ACE2 (S) = ΔPTL2

(S) + $b2\Delta F2$(S).

19. What is the criterion used for obtaining optimum values for the control parameters? Integral of the sum of the squared error criterion is the required criterion.
20. Give the error criterion function for the two-area system.
21. What is the order of differential equation to describe the dynamic response of a two- area system in an uncontrolled case?
    It is required for a system of seventh-order differential equations to describe the dynamic response of a two-area system. The solution of these equations would be tedious.

22. What is the difference of ACE in single-area and two-area power systems? In a single-area case, ACE is the change in frequency. The steady-state error in frequency will become zero (i.e., Δfss = 0) when ACE is used in an integral-control loop. In a two-area case, ACE is the linear combination of the change in frequency and change in tie-line power. In this case to make the steady-state tie-line power zero (i.e., ΔPTL = 0), another integral-control loop for each area must be introduced in addition to the integral frequency loop to integrate the incremental tie-line power signal and feed it back to the speed-changer.
23. What is the main difference of load frequency and economic dispatch controls? The load frequency controller provides a fast-acting control and regulates the system around an operating point, whereas the EDC provides a slow-acting control, which adjusts the speed-changer settings every minute in accordance with a command signal generated by the CEDC.
24. What are the steps required for designing an optimum linear regulator? An optimum linear regulator can be designed using the following steps:
    i. Casting the system dynamic model in a state-variable form and introducing appropriate control forces.
    ii. Choosing an integral-squared-error control index, the minimization of which is the control goal.
    iii. Finding the structure of the optimal controller that will minimize the chosen control index.

DESCRIPTIVE QUESTIONS

1. Obtain the mathematical modeling of the line power in an interconnected system and its

block diagram. Obtain the block diagram of a two-area system.

2. Explain how the control scheme results in zero tie-line power deviations and zero frequency deviations under steady-state conditions, following a step-load change in one of the areas of a two-area system.

3. Deduce the expression for static-error frequency and tie-line power in an identical two area system. Explain about the optimal two-area LFC.
4. What is meant by tie-line bias control?
5. Derive the expression for incremental tie-line power of an area in an uncontrolled two-area

system under dynamic state for a step-load change in either area.

6. Draw the block diagram for a two-area LFC with integral controller blocks and explain

each block.

7. What are the differences between uncontrolled, controlled, and tie-line bias LFC of a two area system.
8. Explain the method involved in optimum parameter adjustment for a two-area system.
9. Explain the combined operation of an LFC and an ELDC system.
10. Two interconnected areas 1 and 2 have the capacity of 250 and 600 MW, respectively. The incremental regulation and damping torque coefficient for each area on its own base are0.3 and 0.07 p.u. respectively. Find the steady-state change in system frequency from a nominal frequency of 50 Hz and the change in steady-state tie-line power following a 850 MW change in the load of Area-1.
11. Two control areas of 1,500 and 2,500 MW capacities are interconnected by a tie line.

The

speed regulations of the two areas, respectively, are 3 and 1.5 Hz/p.u. MW. Consider that a 2% change in load occurs for a 2% change in frequency in each area. Find the steady-state change in the frequency and the tie-line power of 20 MW change in load occurring in both areas. Find the nature of dynamic response if the two areas of the above problem are of uncontrolled type, following a disturbance in either area in the form of a step change in an electric load. The inertia constant of the system is given as H = 2 s and assume that the tie line has a capacity of 0.08 p.u. and is operating at a power angle of 35o before the step change in load.

12. Develop the block diagram of uncontrolled two area ALFC system and explain the static and dynamic conditions
13. Estimate the primary ALFC loop parameters for a control area: Total rated area capacity Pr=2000MW. Normal operating load Pd=1000MW. Inertia constant H=5.0 Regulation R=2.40 Hz/pu MW (all area generators) We shall assume that the load frequency dependency as linear meaning that the old load would increase 1% for 1%

.frequency increase. Having the following data.

14. Deduce the expression for steady state frequency change for single area system with the following cases. (i)Changes in load with fixed speed,(ii)changes in speed with fixed demand
15. Two 1000KW alternators operate in parallel. The speed regulation of first alternator is 100% to 103% from full load to no load and that of other 100% to 105%. Show how will the two alternators share load of 1200KW and at what will one machine

cease to supply any portion of the load.

16. Evaluate steady state frequency in HZ for an isolated control area having the following data. Total rated area capacity, pr=300Mw, f=50hz,inertia constant

H=5S,regulation R=0.05 pu, turbine time constant=0.5sec,governor time constant=0.2 sec, load change=60Mw.the load varies by 0.8% for a 1% in frequency.

17. Evaluate the transfer function model and draw the block diagram for a single control area provided with governor system. From the transfer function derive the expression for steady state frequency error for step change

UNIT-4

LOAD FREQUENCY CONTROL OF SINGLE AREA AND TWO AREA SYSTEM

ASSIGNEMENT QUESTION

1. For the single area control system we have the following data Time constant of power system, T_p = 10 sec

   Time constant of speed governor, Tg = 0

   Time constant of Turbine, T_t = 0

   Reciprocal of load damping factor, K_p = 100 Hz / p.u. MW

   Regulation, R = 3 Hz / p.u. MW

   Integral gain Ki =0.1

   Compute the time error caused by a step disturbance of magnitude 0.1 p.u. MW . Prove in particular, that the error is reduced by increasing the given K, Express the error in seconds and cycle if the system frequency is 50 Hz. Also find in what proportion the increase in load demand is met by the increase in generation and decrease in load .due to drop in frequency.

2. Two identical areas are interconnected by a tie line. If the two areas are of uncontrolled type, find the nature of dynamic response following a disturbance in either area in the form of step change in electrical load. The parameters of the two identical areas are

   Regulation R=3.0 HZ/p.u MW

   Inertia constant I=5 sec

   Damping coefficient B=0.02 p.u MW/HZ Nominal frequency f^0=50Hz

Assume that the line has a capacity of 0.1 p.u. (10% of area capacity) and is operating at a power angle of 45^0 before the step change in load.

3. A 100 MVA synchronous generator operates on full load at a frequency of 50 Hz. The load is suddenly reduced to 50 MW. Due to time lag governor system, the steam valve begins to close after 0.4 sec. Determine the change in frequency that occurs

in this time. Given the initial constant H=5 KW-sec/KVA

4. A control area has total rated capacity of 10000MW. The regulation R for all the units in the area is 2 HZ/P.U, A 1% change in frequency causes a 1% change in load. If the system operates at half the rated capacity and increases by 2% i) Find the static frequency drop ii) If the speed governor loop were open, what will be the frequency
5. Two control areas have the following characteristics:

Area-1: Speed regulation = 0.02 pu ,Damping coefficient = 0.8 pu ,Rated MVA = 1500

Area-2: Speed regulation = 0.025 pu, Damping co-efficient = 0.9 pu, Rated MVA = 500

Determine the steady state frequency change and the changed frequency following a load change of 120MW occurs in area-1. Also find the tie-line power flow change.

6. The two area system has the following data: Capacity of area 1, Pr1 =1000 MW,

Capacity of area 2, Pr2 =2000 MW,

Nominal load of area 1, PD1=500 MW

Nominal load of area 1, PD1=1500 MW

Speed regulation of area 1=4%

Speed regulation of area 2=3%

Find the new steady state frequency and change in the line ow for a load change of area 2 by 125 MW. For both the areas each percent change in frequency causes 1 percent change in load. Find also the amount of additional frequency drop if the interconnection is lost due to certain reasons.

7. Give a typical block diagram for a two area system interconnected by a tie line and explain each block. Also deduce relations to determine the frequency of oscillations of tie line power and static frequency drop. List out assumptions made.
8. Draw and explain complete block diagram representation of single area having a turbo-generator supplying an isolated load for load frequency problem. Discuss the response of the system for a sudden change in load demand.

UNIT-5

REACTIVE POWER CONTROL

MULTIPLE-CHOICE QUESTIONS

1. The major reason for low lagging p.f. of supply system is due to the use of __________ motors.
   a. Induction.
   b. Synchronous.
   c. DC.
   d. None of these.
2. The maximum value of p.f. can be__________.
   a. 1.
   b.
   0.9. c.
   0.8.
   d.
   0.7.
3. By improving the p.f. of the system, the kilowatts delivered by generating stations are __________________.
   a. Decreased.
   b. Increased.
   c. Not changed.
   d. None of these.
4. Power factor can be improved by installing such a device in parallel with load, which takes:
   a. Lagging reactive power.
   b. Leading reactive power.
   c. Apparent power.
   d. None of these.
5. The main reason for low p.f. of supply system is due to the use of__________.
   a. Resistive load.
   b. Inductive load.
   c. Synchronous motor.
   d. All of these.
6. The only motor that can also be worked at leading p.f. and can supply mechanical power __________________.
   a. Synchronous induction generator.
   b. Synchronous motor.
   c. Alternator.
   d. None of these.
7. An over-excited synchronous motor on no-load is known as__________.

a. Synchronous induction generator.
b. Synchronous condenser.
c. Alternator.
d. None of these.

8. For synchronous condensers, the p.f. improvement apparatus should be located at ___________________.

a. Sending end.
b. Receiving end.
c. Both (a) and (b).
d. None of these.

9. A disadvantage of synchronous condenser is:

a. Continuous losses in motor.
b. High maintenance cost.
c. Noisy.
d. All of the above.

10. The smaller the lagging reactive power drawn by a circuit, its p.f. will be ___________________.

a. Better.
b. Poorer.
c. Unity.
d. None of these.

11. kVAR is equal to____________.

a. kW tan ϕ.
b. kW sin ϕ.
c. kVA cos ϕ.
d. None of these.

12. For a particular power, the current drawn by the circuit is minimum when the value of p.f. is___________________.

a. 0.8 lagging.
b. 0.8 leading.
c. Unity.
d. None of these.

13. Synchronous capacitors are normally_____________cooled.

a. Air.
b. Oil.
c. Water.
d. None of these.

14. To improve the p.f. of 3-ϕ circuits, the size of each capacitor when connected in delta with respect to when connected in star is________________.

a. 1/6th.
b. 1/4th.
c. 3 times.
d. 1/3rd.

15. The p.f. improvement equipment is always placed__________.

a. At the generating station.
b. Near the transformer.
c. Near the apparatus responsible for low p.f.

d. Near the bus bar.

16. A synchronous machine has higher capacity for:
    a. Leading p.f.
    b. Lagging p.f.
    c. It does not depend upon the p.f. of the machine.
    d. None of these.
17. If a synchronous machine is underexcited, it takes lagging VARs from the system when it
is operated as a________________.
    a. Synchronous motor.
    b. Synchronous generator.
    c. Synchronous motor as well as generator.
    d. None of these.
18. A synchronous phase modifier as compared to synchronous motor used for mechanical
loads has_________________.
    a. Larger shaft and higher speed.
    b. Smaller shaft and higher speed.
    c. Larger shaft and smaller speed.
    d. Smaller shaft and smaller speed
19. The phase advancer is mounted on the main motor shaft and is connected in the
__________________ motor.
    a. Rotor.
    b. Stator.
    c. Core.
    d. None of these.
20. Industrial heating furnaces such as arc and induction furnaces operate on_________.
    a. Very low lagging p.f.
    b. Very low leading p.f.
    c. Very high leading p.f.
    d. None of these
21. If a synchronous machine is overexcited, it takes lagging VARs from the system when it is operated as:
    a. Synchronous motor.
    b. Synchronous generator.
    c. Synchronous motor as well as generator.
    d. None of these.
22. A machine designed to operate at full load is physically heavier and is costlier if the operating p.f. is:
    a. Lagging.
    b. Leading.
    c. The size and cost do not depend on p.f.
    d. None of these.
23. Unit of reactive power is:
    a. MW.

b. MVAr.

c. MVA.
d. KVA.
24. Reactive power is_____________power.
a. Wattfull.
b. Wattless.
c. Loss.
d. None of these.
25. Transmission line parameters are:
a. R.
b. *L.*
c. C.
d. All of these.
26. On fundamental *Tγ*. line expression *V*(*x*) = *A*e*γ x* + *B*e-*γ x*, *γ* represents:
a. Distance (or) length.
b. Velocity of light.
c. Propagation constant.
d. None of these.
27. Characteristic impedance is_____________.
a. $\sqrt{L-C}$.
b. $\omega\sqrt{LC}$.
c. $\omega / \sqrt{LC}$.
d. $\sqrt{\frac{L}{C}}$.
28. *β* is_____________.
a. $\omega\sqrt{L / C}$.
b. $\omega\sqrt{LC}$.
c. $\omega/\sqrt{LC}$.
d. All of these.

29. Advantage of operating at natural load is:
a. Insulation is uniformly stressed.
b. Reactive power balance is achieved.
c. Both (a) and (b).
d. None of these.
30. An uncompensated line on open-circuit leads to__________.
a. Ferranti effect.
b. line-charging current flowing into generators is more.
c. Both (a) and (b).
d. None of these.
31. A symmetrical line at no-load means__________.
a. No power transmission.
b. *V*

$s = Vr$.

c. Both (a) and (b).
d. None of these.

32. During the underexcited operation of a synchronous generator:
    a. Heating of the ends of the stator core increases.
    b. Reduces field current, results in the internal emf, which causes weak stability.
    c. Both (a) and (b).
    d. None of these.
33. For a symmetrical line with $V_s = V_0$, the maximum voltage occurs at:
    a. Sending end.
    b. Receiving end.
    c. Midpoint.
    d. None of these.
34. Unit of p.f. is:
    a. s.
    b. m.
    c. No units.
    d. None of these.
35. Unit of time constant is:
    a. m.
    b. kg.
    c. s.
    d. miles.
36. Power transmission through a line is improved by:
    a. Increasing the line voltage.
    b. Decreasing the line reactance.
    c. Both (a) and (b).
    d. None of these.
37. A linear device must satisfy:
    a. Homogeneity.
    b. Additivity.
    c. Both (a) and (b).
    d. None of these
38. Fundamental requirements of AC-power transmission is:
    a. Synchronous machines must remain stably in synchronizer.
    b. Voltages must be kept near to their rated values.
    c. Both (a) and (b).
    d. None of these.
39. Load compensation is:
    a. The control of reactive power to improve quality of supply.
    b. The control of real power to improve quality of supply.
    c. The control of voltage and its angle to improve the quality of supply.
    d. Both (a) and (b).
40. Power factor under natural load is:
    a. Lagging.

b. Leading.

c. Unity.

d. None of these.

41. Steady-state stability of unit occurs when δ =__________.

a. 30°.

b. 20°.

c. 90°.

d. 0°.

42. 'ϑ' in fundamental transmission line equation is:

a. β.

b. αx.

c. βl.

d. β/α.

43. Rating of a compensator is:

a. MVAr.

b. Time of response.

c. Both (a) and (b).

d. None of these.

44. Load compensation includes:

a. p.f. correction.

b. Voltage regulation.

c. Load balancing.

d. All of these

45. For a symmetrical line, the voltage is more at:

a. Sending end.

b. Receiving end.

c. Midpoint.

d. All of these.

46. Load compensation can be achieved by:

a. Installing the compensating equipment near the source.

b. Installing the compensating equipment near the load.

c. Either (a) or (b).

d. Both (a) and (b).

47. pf correction of load is achieved by:

a. Generating reactive power as close as possible to the source.

b. Generating reactive power as close as possible to the load.

c. Generating real power as close as possible to the load.

d. Generating real power as close as possible to the source.

48. The main function of an ideal compensator is:

a. Instantaneous pf correction to unity.

b. Elimination (or) reduction of voltage regulation.

c. Phase balance of the load currents and voltages.

d. All.

49. The important characteristic of an ideal compensator is:

a. To provide a controllable and variable amount of reactive power without any delay.

b. To maintain a constant voltage characteristic at its terminals.
c. Should operate independently in the three phases.
d. All the above.

50. Characteristic impedance of the line depends upon:
a. The characteristic of the line per unit length.
b. Length of the line.
c. Radius and spacing between conductors.
d. All.

51. The surge impedance loading (SIL) is expressed as:
a. $\text{SIL} = \dfrac{(V_{L\text{-}L})^2}{\text{surge impedance}}$.
b. $\text{SIL} = \dfrac{V_{L\text{-}L}}{\text{surge impedance}}$.
c. $\text{SIL} = (V_{L\text{-}L})^2 \times \text{surge impedance}$.
d. None.

52. When a line is loaded above its SIL, it acts like:
a. Shunt reactor absorbing MUAR from the system.
b. Shunt capacitor supplying MUAR to the system.
c. Series capacitor supplying MUAR to the system.
d. Series reactor absorbing MUAR from the system.

53. When a line is loaded below its SIL, it acts like:
a. Shunt reactor absorbing MUAR from the system.
b. Shunt capacitor supplying MUAR to the system.
c. Shunt capacitor supplying MUAR to the system.
d. Shunt reactor absorbing MUAR from the system.

54. If any inductive load is connected at the sending end of the line, it will support the synchronous generators:
a. To absorb the line-charging reactive power.
b. To absorb the load-charging reactive power.
c. To supply the line-charging reactive power.
d. To supply the load-charging reactive power.

55. The change in electrical properties of a transmission line in order to increase its power transmission capability is known as:
a. Load compensation.
b. Line compensation.
c. Load synchronism.
d. Line synchronism.

56. Apply series capacitors to reduce X_L and thereby reduce ϑ at the fundamental frequency.

This method is called:
a. Line-length compensation (or) ϑ-compensation.
b. Compensation by sectioning.

c. Load balancing.
d. All the above.

57. Series compensation results in:
a. Increase in maximum transferable power capacity.
b. Decrease in transmission angle for considerable amount of power transfer.
c. Increase in virtual surge impedance loading.
d. All the above.

58. For a heavy loading condition, a flat voltage profile can be obtained by:
a. Series compensation.
b. Shunt compensation.
c. (a) or (c).
d. None.

59. Inductive shunt compensation__________the virtual surge impedance and __________ the virtual SIL of the line:
a. Decreases, decreases.
b. Decreases, increases.
c. Increases, decreases.
d. Decreases, increases.

60. If the inductive shunt compensation is 100% then:
a. Flat voltage profile exists at zero loads.
b. Ferranti effect can be eliminated.
c. Both (a) and (b).
d. None.

61. Sub-synchronous resonance (SSR) is treated as___________type of phenomenon.
a. Electrical.
b. Mechanical.
c. Combined electrical–mechanical.
d. Damped frequency resonance.

62. UPFC is able to perform:
a. Voltage support.
b. Power flow control.
c. Improved stability.
d. All.

63. The voltage stability analysis is carried out by which power flow-based method?
a. *P–V* curves.
b. *Q–V* curves.
c. Both (a) and (b).
d. None.

64. Voltage collapse proximate indicator (VCPI) for a radial line is defined as:

a. $\frac{dQ_s}{dQ_r}$.

b. $\frac{dQ_r}{dQ_s}$.

c. $\frac{dQ_s}{dV_s}$.

d. $\frac{dQ_r}{dV_r}$.

ANSWER

(1) a	(17) c	(33) c	(49) d
(2) a	(18) a	(34) c	(50) d
(3) b	(19) a	(35) c	(51) a
(4) b	(20) a	(36) c	(52) a
(5) b	(21) d	(37) c	(53) b
(6) b	(22) a	(38) c	(54) b
(7) b	(23) b	(39) a	(55) b
(8) b	(24) b	(40) c	(56) a
(9) d	(25) d	(41) c	(57) d
(10) a	(26) c	(42) c	(58) a
(11) a	(27) d	(43) c	(59) c
(12) c	(28) b	(44) d	(60) c
(13) a	(29) c	(45) c	(61) c
(14) d	(30) c	(46) b	(62) d
(15) c	(31) c	(47) b	(63) c
(16) b	(32) c	(48) d	(64) a

SHORT QUESTIONS AND ANSWERS

1. Define the need of compensation.

For maintaining the quality power, i.e., voltage and frequency at every supply point would remain constant, free from harmonics and the p.f. would remain unity and compensation is needed.

2. What are the objectives of load compensation? The objectives of load compensationare:

   i. p.f. correction.

   ii. Voltage regulation improvement.

   iii. Balancing of load.

3. What are the characteristics of an ideal compensator? The characteristics of the ideal compensator are:

   i. To provide a controllable and variable amount of reactive power without any delay according to the requirements of the load.

   ii. To maintain a constant-voltage characteristic at its terminals and

   iii. Should operate independently in the three phases.

4. Define the voltage regulation.

It is defined as the proportional change in supply voltage magnitude associated with a defined change in load current, i.e., from no load to full load.

5. Define the surge impedance loading (SIL) of a transmission line.

It is the MW loading of a transmission line at which a natural reactive power balance occurs (zero resistance).

6. What is meant by voltage stability?

A power system at a given operating state and subjected to a given disturbance is voltage
stable if voltages near loads approach post-disturbance equilibrium values. The disturbed
state is within the regions of attractions of stable post-disturbance equilibrium.

7. What is meant by voltage collapse?

Following voltage instability, a power system undergoes voltage collapse if the post disturbance equilibrium voltages near the load are below acceptable limits. The voltage
collapse may be either total or partial.

8. Name the sources of reactive power? State what is SVC? 1 Remember
9. Quote in detail how voltage and reactive power inter related.
10. State excitation system involved in power system.
11. Formulate the need of reactive power control in electrical power transmission lines?
12. Distinguish between load compensation and system compensation.
13. Point out the formula for surge impedance of transmission system.
14. Summarize the methods used for compensating the uncompensated transmission lines?

15. State reactive power generation.
16. Write any two applications of synchronous condensers.
17. Write down the TCSC base reactance value.
18. Summarize the common advantages of STATCOM?

19. Give the explanation about reactive power exchange between converter and the ac system.
20. Define the term Static VAR Compensator.
21. Explain booster transformer? Where is it used?
22. Analyze the methods to improve the voltage profile in the power system.
23. Distinguish between ON load tap changing transformer and OFF load tap changing transformer.
24. Summarize the SVC slope in the dynamic characteristics?
25. Invent importance of V-I characteristics of STATCOM?
26. Develop the V-I characteristics of the SVC.

DESCRIPTIVE QUESTIONS

1. Examine various methods of voltage control and explain any three in detail.
2. Name the generators and consumers of reactive power in a power system.
3. Describe static VAR compensators? Quote the advantages of SVC.
4. Explain the following methods of voltage control(i) Tap changing transformers (ii) Shunt reactors (iii) Synchronous phase modifiers (iv) Shunt capacitors (v) series capacitors.
5. Examine the circuit for a typical excitation system and derive the transfer function model and draw the block diagram.
6. Describe the different methods of FACTS control? Examine any two methods in detail.
7. Develop a IEEE Type 1 excitation arrangement to control the voltage of an alternater and explain.
8. Explain Static VAR compensator? Explain its operation. Also state the merits of static VAR compensator over the other methods of voltage control.
9. Demonstrate in brief about Brushless excitation system.
10. Point out the relations between voltage, power and reactive power at a node for applications in power system control
11. Analyze various methods of static excitation system and explain any two in detail.
12. Discuss static and dynamic analysis of AVR.
13. A 415kv line is fed through an 132/415 KV transformer from a constant 132KV supply. At the load end of the line, the voltage is reduced by another transformer of ratio 415/132 KV. The total impedance of line is 40+ j80 ohms both transformers are equipped with tap changing; the product of the two off nominal setting is unity. if the load on the system is 200 MW at 0.8 p.f lagging. Calculate the settings of the tap changers required to maintain the voltage at 132KV.
14. A 415kv line is fed through an 132/415 KV, transformer from a constant 132KV supply. At the load end of the line, the voltage is reduced by another transformer of ratio 415/132 KV. The total impedance of line is 30+ j60 ohms both transformers are equipped with tap changing; the product of the two off nominal setting is unity. if the load on the system is 200 MW at 0.8 p.f lagging. Calculate the settings of the tap changers required to maintain the voltage at 132KV.

15. Explain why reactive power management and control is critical for overall system stability. Write about the various Reactive power sources and sinks.

16. Why should voltage be maintained within acceptable levels? Explain the Voltage Collapse phenomenon.
17. A three phase overhead line has resistance and reactance per phase of 5Ω and 25 Ω, respectively. The load at the receiving-end is 15 MW, 33kV,0.8 p.f. lagging. Find the capacity of the compensation equipment needed to deliver this load with a sending- end voltage of 33 kV.
18. Discuss the generation and absorption of reactive power.
19. Explain the role of tap changing transformer in voltage control.
20. Develop the block diagram of AVR and obtain its transfer function and explain the static and dynamic response.
21. The load at the receiving end of a 3 phase OHL is 25 MW at 0.8 p.f lag at a line voltage of 33kv.the line has a resistance 5 ohm per phase and an inductive reactance at 20 ohm per phase .calculate the sending end voltage. A synchronous compensator connected at the receiving end and the voltage at both end of the line is maintained at 33kv.calculate (i) the MVAR of the compensator (ii) transmission losses and efficiency with and without compensator and (iii) the maximum load that can be transmitted with the compensator.
22. Draw the neat diagram of solid state electronic AVR for a synchronous generator and explain its working.

UNIT-5

REACTIVE POWER CONTROL ASSIGNEMENT QUESTION

1. Derive the equations to get the relation between voltage between voltage, power and reactive power at a node.
2. The load at receiving end of a three-phase, over head line is 25.5 MW, power factor 0.8 lagging, at a line voltage of 33 kV. A synchronous compensator is situated at receiving end and the voltage at both the ends of the line is maintained at 33 kV. Calculate the MVAR of the compensator. The line has a resistance of 4.5 ohms per phase and inductive reactance (line to neutral) of 20 ohms per phase.
3. Explain clearly what you mean by compensation of line and discuss briefly different methods of compensation.
4. A 3-ph transmission line has resistance and inductive reactance of 25 and 90 respectively. With no load at the receiving end a synchronous compensator there takes a current lagging by 900, the voltage at the sending end is 145 kV and 132 kV at the receiving end. Calculate the value of the current taken by the compensator. When the load at the receiving end is 50 MW, it is found that the line can operate with unchanged voltages at sending and receiving ends, provided that the compensator takes the same current as before but now leading by 900. Calculate the reactive power of the load.
5. A 3-phase single circuit, 220kV, line runs at no load. Voltage at the receiving end of the line is 205kV. Find the sending end voltage, if the line has resistance of 21.7ohms, reactance of 85.2ohms and the total susceptance of 5.32X10-4 mho. The transmission line is to be represented by Pie-model.
6. Explain briefly about the shunt and series compensation.

HIGH VOLTAGE ENGINEERING

PROGRAMME: B.Tech EEE AC:YEAR: **2018-2019**	DEGREE: **B.TECH IV YEAR**
COURSE: **HIGH VOLTAGE ENGINEERING**	SEMESTER: **I** CREDITS: 4 COURSE COORDINATOR: **Dr. R. Devasaran**
COURSE CODE: **A70228** REGULATION:**R13**	COURSE TYPE: **Elective**
COURSE AREA/DOMAIN: EEE	CONTACT HOURS: 4 hours/Week.

CORRESPONDING LAB COURSE CODE : NILL	LAB COURSE NAME: NILL

BRIEF NOTE ON THE IMPORTANTANCE OF THE COURSE AND HOW IT FITS IN TO THE CURRICULAM

After going through this course the student gets a thorough knowledge on, breakdown occurring in gases, liquids and solid dielectrics. Students will be able to know the different types of generating high DC voltages, high AC voltages and AC and DC currents. They are also able to know the measurement of high DC voltages, High AC voltages and high AC and DC currents. They can have the concepts of insulation coordination, testing of various materials and electrical apparatus used in high voltage engineering with which he/she can able to apply the above Conceptual things to real-world electrical and electronics problems and applications.

PREREQUISITES, IF ANY

- Electrical Power systems
- Electro magnetic field theory

MARKS DISTRIBUTION:

Session Marks	University End Exam Marks	Total Marks

There shall be two mid tem examinations. Each Mid-term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part- B. Where part consists of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.awarded considering the average of two	75	100

assignments in each course		

EVALUATION SCHEME:

S.No	Component	Total Duration	Marks
1.	I Mid Examination	90 Minutes	20
2.	I Assignment	----	05
3.	II Mid Examination	90 Minutes	20
4.	II Assignment	------	05
5.	External Examination	3 hours	75

Course Objectives:

This subject deals with the detailed analysis of breakdown occurring in gaseous, liquids and solid electronics. Information and generation and measurement of High voltage and current. In addition high voltage testing methods are also discussed.

Course Outcomes:

After going through this course the student gets a thorough knowledge on, basics of high voltage engineering, break-down phenomenon in different types of dielectrics, generation and measurement of high voltages and currents, the phenomenon of over-voltages, concept of insulation coo rdination, testing of various materials and electrical apparatus used in high voltage engineering, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

<u>JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,</u>
<u>HYDERABAD</u>

II Year B.Tech EEE I-Sem	**T**	**P**	**C**
	4+1*	**0**	**4**

HIGH VOLTAGE ENGINEERING

Unit 1:

Introduction to high voltage engineering: Electric field stresses, gas/vacuum as insulator, liquid dielectrics, solids and composites, estimation and control of electric stress, numerical methos for electric field computation, surge voltages, their distribution and control, Apllications of insulationg materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.

Unit 2:

Break Down In Dielectric Materials:Gases as insulating media, collision process, ionization process, townsend's criteria of breakdown in gases, Paschen's law. Liquid as insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrensic breakdown, electromechanical breakdown, thermal breakdown, breakdown in solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

Unit 3:

Generation & measurement of high voltages & currents: Generation of high direct current voltages, Generation of high alternating voltages, Generation of impulse voltages, Generation of impulse currents, Tripping and control of impulse generators. Measurement of high direct current voltages, Measurement of high voltage alternating and impulse, Measurement of high current direct, alternating and impulse, Oscilloscope for impulse voltage and current measurements

Unit 4:

Over voltages and insulation co ordination:

Natural causes for over voltage Lightning phenomenon, Overvoltage due to switching surges, system faults another abnormal conditions, Principles of insulation coordination on high voltage and extra high voltage power systems.

Unit 5

Testing of materials and electrical apparatus:

Measurement of D.C resistivity, Measurement of dielectric constant and loss factor, Partial discharge measurements .Testing of insulators and bushings Testing of isolators and circuit breakers, testing of cables, Testing of transformers, Testing of surge arresters and radio interference measurements.

TEXT BOOKS

- High Voltage Engineering, M.S.Naidu and V. Kamaraju, TMH Publications.
- High Voltage Engineering, C.L.Wadhwa, New Age Internationals (P) Limited.

REFERENCE BOOKS

- High Voltage Engineering: Fundamentals, E.Kuffel, W.S.Zaengi, J.Kuffel by Elsevier.
- High Voltage Insulation Engineering, Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited.
- High Voltage Engineering, Theory and Practice, Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, Roshdy Radwan, Marcel Dekker

COURSE PLAN:

S. No	Unit No	Topic	No of sessions planned	Mode of teaching BB/PPT/ OHP/MM	Reference *	Remarks
1	I	Electric field stresses	1	BB	A1,B1	
2		Gas/vacuum as insulator, liquid dielectrics, solids and composites	1	BB	A1,B1	
3		Estimation and control of electric stress	2	BB	A1,B1	
4		Numerical methos for electric field computation	1	BB	A1,B1	
5		Surge voltages, their distribution and control	2	BB	A1,B1	
6		Applications of insulationg materials in transformers	1	BB	A1,B1	
7		Rotating machines	2	BB	A1,B1	
8		Circuit breakers	1	BB	A1,B1	
9		Cable power capacitors and bushings				
10	II	Gases as insulating media	2	**PPT**	A1,B1	
11		Collision process, ionization process	1	BB	A1,B1	
12		Townsend’s criteria of breakdown in gases	1	BB	A1,B1	
13		Paschen’s law	1	BB	A1,B1	
14		experimental determination of X_d and X_q (Slip test)	1	**PPT**	A1,B1	
15		Phasor diagrams	1	**PPT**	A1,B1	
16		Pure and commercial liquids	1	**PPT**	A1,B1	
17		Breakdown in pure and commercial liquids	1	**PPT**	A1,B1	
18		Intrensic breakdown				

19		Electromechanical breakdown	1	BB	A1,C1	
20		Thermal breakdown	1	BB	A1,C1	
		Breakdown in solid dielectrics in practice	1	BB	A1,C1	
21		Breakdown in composite dielectrics	1	BB	A1,C1	
22		Solid dielectrics used in practice	1	BB	A1,C1	
23						
24	III	Generation of high direct current voltages	1	BB	A1,C1	
25		Generation of high alternating voltages	2	**PPT**	A1,C1	
26		Generation of impulse voltages	2	**PPT**	A1,C1	
27		Generation of impulse currents	2	**PPT**	A1,C1	
28		Tripping and control of impulse generators	1	BB	A1,C1	
29		Measurement of high direct current voltages	1	BB	A1,C1	
30		Measurement of high voltage alternating and impulse	2	BB	A1,C1	
31		Direct alternating and impulse	2	BB	A1,C1	
32		Oscilloscope for impulse voltage	2	BB	A1,C1	
33		Current measurements	1	BB	A1,C1	
34	IV	Natural causes for over voltage				
35		Lightning phenomenon	1	BB	A1	
36		Overvoltage due to switching surges	1	BB	A1	
37		System faults another abnormal conditions	2	BB	A1	
38		Principles of insulation coordination on high voltage	2	BB	A1	

39		. Extra high voltage power systems	1	BB	A1	
40	V	Measurement of D.C resistivity				
41		Measurement of dielectric constant and loss factor	1	BB	A1	
42		Partial discharge measurements	1	BB	A1	
43		Testing of insulators and bushings	1	BB	A1	
44		Testing of isolators and circuit breakers	1	BB	A1	
45		Testing of cables	1	BB	A1	
46		Testing of transformers	1	BB	A1	
47		Testing of surge arresters	1	BB	A1	
48		Radio interference measurements	1	BB	A1	

MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objective	Course Outcomes				
	a	**b**	**c**	**d**	**e**
I	S				

II	S	S			
III			H		
IV				H	S
V					S

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes													
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**
a	S	S												
b	S	S	S								S		S	S
c	S	S		S										
d		S					S				S		H	S
e	S		S		S		S				S		S	

QUESTION BANK

OBJECTIVES:

UNIT-1

1. Dielectric strength in case of mica can be expected to be more than

(A) 500 kV/mm

(B) 1500 kV/mm

(C) 2500 kV/mm

(D) 3500 kV/mm.

Get Answer

A

2. All of the following dielectric materials are preferred for high frequency applications EXCEPT

(A) Polyethylene

(B) Butyl rubber

(C) Teflon

(D) Polystyrene.

Get Answer

B

3. Polar dielectrics are normally used for

(A) high frequencies

(B) microwaves

(C) dc and power frequencies

(D) none of the above.

Get Answer

C

4. Which of the following is a polar dielectric ?

(A) Teflon

(B) Quartz

(C) Nylon

(D) Polyethylene.

Get Answer

C

5. Which of the following is a non-polar dielectric ?

(A) Polystyrene

(B) Phenolic plastics

(C) Plasticized cellulose acetate

(D) Castor oil.

Get Answer

A

6. The impurity in liquid dielectric which has significant effect in reducing the breakdown strength, is

(A) dust

(B) dissolved gases

(C) moisture

(D) ionic impurities.

Get Answer

C

7. The relationship between the breakdown voltage V and gap d is normally given as

(A) $d = kV^2$

(B) $d=kV^3$

(C) $V = kd$

(D) $v = kd^n$.

Get Answer

D

8. A good dielectric should have all the following properties EXCEPT

(A) high mechanical strength

(B) high resistance to thermal deterioration

(C) high dielectric loss

(D) freedom from gaseous inclusions.

Get Answer

C

9. The variety of paper used for insulation purpose is

(A) blotting paper

(B) rice paper

(C) craft paper

(D) mill-board.

Get Answer

C

10. Which variety of mica is hard and brittle ?

(A) Muscovite

(B) Phlogopite

(C) Fibiolite

(D) Lipidolite.

Get Answer

D

11. Corona effect can be identified by

(A) bushy sparks

(B) faint violet glow

(C) red light

(D) arcing between conductors and earth.

Get Answer

B

12. The phenomenon of corona is generally accompanied by

(A) a bang

(B) a hissing sound

(C) magnetic hum

(D) all of the above.

Get Answer

B

13. Van de Graaff generators are useful for

(A) Very high voltage and low current applications

(B) Very high voltage and high current applications

(C) Constant high voltage and current applications

(D) High voltage pulses only.

Get Answer

A

14. In Van de Graaff generators output voltage is controlled by

(A) controlling the corona source voltage

(B) controlling the belt speed

(C) controlling the lower spray point

(D) any of the above.

Get Answer

15. A Tesla coil is a

(A) cascaded transformer

(B) coreless transformer

(C) high frequency resonant transformer

(D) low impedance transformer.

UNIT-2

1) The example of artificial fibre is

a. Rayon
b. Cotton
c. Flax
d. Silk

Answer Explanation

ANSWER: Rayon

Explanation:

No explanation is available for this question!

---

2) Which among the following is not an example of impregnants?

a. Mineral oil
b. Chlorinated diphenyl
c. Vegetable oils
d. None of these

Answer Explanation

ANSWER: None of these

Explanation:

No explanation is available for this question!

3) For very small cavities, discharge inception voltage

a. Decreases as the cavity depth increases
b. Increases as the cavity depth increases
c. Remains unaffected as the cavity depth increases
d. None of these

Answer Explanation

ANSWER: Decreases as the cavity depth increases

Explanation:

No explanation is available for this question!

---

4) The liquid dielectrics contain voids or cavities within the medium or at the boundaries b the dielectric and the electrodes. The electric field strength in the voids is

a. Lower than that across the dielectric
b. Higher than that across the dielectric
c. Equal to that across the dielectric
d. None of these

Answer Explanation

ANSWER: Higher than that across the dielectric

Explanation:

No explanation is available for this question!

---

5) Treeing phenomenon is observed in

a. Capacitors
b. Cables
c. Insulators
d. Only (a) and (b)

Answer Explanation

ANSWER: Only (a) and (b)

Explanation:

No explanation is available for this question!

6) The spreading of spark channels during tracking, in the form of the branches of a tree i

a. Bunching
b. Treeing
c. sparking
d. none of these

Answer Explanation

ANSWER: Treeing

Explanation:

No explanation is available for this question!

7) The thermal breakdown stresses are

a. Lower under ac conditions than under dc condition
b. Greater under ac condition than dc condition
c. Equal in both condition
d. None of these

Answer Explanation

ANSWER: Lower under ac conditions than under dc condition

Explanation:

No explanation is available for this question!

8) Within dielectric, an electron starting from the cathode will drift towards the anode and motion

a. Gains energy from the field and loses during collision
b. Gains energy during both motion and collision
c. Loses energy during both motion and collision
d. Loses energy from the field and gains during collision

Answer Explanation

ANSWER: Gains energy from the field and loses during collision

Explanation:

No explanation is available for this question!

---

9) Intrinsic breakdown occurs in time of the order of

a. 10^{-5} s

b. 10^{5} s

c. 10^{-8} s

d. 10^{8} s

Answer Explanation

ANSWER: 10^{-8} s

Explanation:

No explanation is available for this question!

---

10) Which is having higher breakdown strength?

a. Solid dielectrics

b. Liquid dielectrics

c. Gases dielectrics

d. Equal in all

Answer Explanation

ANSWER: Solid dielectrics

Explanation:

No explanation is available for this question!

UNIT-3

1. Which of the following technique/method is-used for the measurements of ac high frequency voltages ?

(A) Peak voltmeter

(B) Series resistance micro ammeter

(C) Resistance potential divider

(D) Any of the above.

Get Answer

A

2. Which of the following method or technique can be used for the measurement of high dc voltages ?

(A) Generating voltmeter

(B) Electrostatic voltmeter

(C) Peak voltmeter

(D) Any of the above.

Get Answer

A

3. All of the following methods/techniques can be used for the measurement of high ac voltages EXCEPT

(A) Potential dividers

(B) Potential transformers

(C) Electrostatic voltmeters

(D) Half effect generators.

Get Answer

D

4. Surge diverters are

(A) non-linear resistors in series with spark gaps which act as fast switches

(B) arc quenching devices

(C) shunt reactors to limit the voltage rise due to Ferranti effect

(D) over-voltages of power frequency harmonics.

Get Answer

A

5. Impulse voltages are characterized by

(A) polarity

(B) peak value

(C) time of half the peak value

(D) all of the above.

Get Answer

D

6. Paschen's law is associated with

(A) breakdown voltage

(B) ionization

(C) thermal radiations

(D) none of the above.

Get Answer

A

7. The essential condition for the Paschen's law to be valid is that

(A) voltage must be dc

(B) voltage must be ac

(C) temperature must be constant

(D) humidity must be low.

Get Answer

C

8. The breakdown voltage in gases depends on

(A) distance between the electrodes

(B) relative air density

(C) humidity

(D) all of the above.

Get Answer

D

9. At unvarying temperature breakdown voltage in a uniform field is a function of the product of gas pressure and distance between the electrodes. The above statement is known as

(A) Electron avalanche

(B) Thermal stability principle

(C) Paschen's law

(D) Breakdown voltage law.

Get Answer

C

10. Large capacity generators are manufactured to generate power at

(A) 440 V

(B) 6.3 to 10.5 kV

(C) 132 kV to 220 kV

(D) 400 kV.

Get Answer

B

11. Which soil has the least specific resistance ?

(A) Land

(B) Loamy soil

(C) Clay

(D) Peat.

Get Answer

D

12. Which soil has the maximum specific resistance ?

(A) Black cotton soil

(B) Sand

(C) Peat

(D) Loamy soil.

Get Answer

B

13. In sphere gaps, the sphere are made of

(A) aluminium

(B) brass

(C) bronze

(D) any of the above.

Get Answer

D

14. In 'plasma' state a gas

(A) loses electrical conductivity

(B) conducts electricity

(C) becomes perfect insulator

(D) attracts moisture.

Get Answer

B

15. Which of the following statement about corona is incorrect ?

(A) Corona gives rise to radio interference

(B) Corona results in loss of power in transmission

(C) Corona discharge can be observed as red luminescence

(D) Corona is always accompanied by a hissing noise.

Get Answer

C

UNIT-4

1. The over-voltage surges in power systems may be caused by

(A) lightning

(B) switching

(C) resonance

(D) any of the above.

Get Answer

D

2. The protection against over-voltage due to lightening is provided by

(A) use of surge diverters

(B) low tower footing resistance

(C) use of overhead ground wires

(D) any of the above.

Get Answer

D

3. Which of the following is a conducting medium for electric current ?

(A) Low temperature gas

(B) High temperature gas

(C) Dissociated gas

(D) Plasma.

Get Answer

D

4. In circuit-breakers the contact space is ionized by

(A) thermal ionization of gas

(B) thermal emission from surface of contacts

(C) field emission from the surface of contacts

(D) any of the above.

Get Answer

D

5. Which of the following are air-break switching devices ?

(A) Isolator

(B) Limit switch

(C) Earthing switch

(D) All of the above.

Get Answer

D

6. Which of the following statement about SF_6 gas is incorrect ?

(A) It is non-toxic gas

(B) It is non-inflammable

(C) It has density 5 times that of air at 20^0C

(D) It has dark yellow color.

Get Answer

D

7. SF_6 gas is transported in

(A) gas cylinders

(B) liquid form in cylinders

(C) solid form in boxes

(D) air cylinders.

Get Answer

B

8. During arc extinction SF_6 gas

(A) decomposes into S and F ions

(B) decomposes into $SF_4$and SF_2

(C) gets oxidized

(D) reduces to SF_3.

Get Answer

B

9. Dielectric strength of SF_6 is

(A) less than that of air at atmospheric pressure

(B) less than that of oil used in OCB

(C) more than that of oil used in OCB

(D) more at lower pressure and low at higher pressures.

Get Answer

B

10. Which of the following is the demerit of SF_6 circuit breakers ?

(A) sealing problem of gas

(B) In flux of moisture in the gas system is dangerous

(C) Deterioration of quality of circuit breaker affects reliability of circuit breaker

(D) All of the above.

Get Answer

11. Sphere gaps are used for

(A) measurement of high dc voltages

(B) measurement of high ac voltages

(C) measurement of impulse voltages

(D) all of the above.

Get Answer

D

12. Flash point of dielectric is usually above

(A) 80°C

(B) 100°C

(C) 140°C

(D) 240°C.

Get Answer

C

13. A fuse is normally a

(A) current limiting device

(B) voltage limiting device

(C) power limiting device

(D) power factor correcting device.

Get Answer

A

14**.** Most of the fuses operate due to

(A) heating effect of current

(B) magnetic effect of current

(C) electrostatic effect of current

(D) none of the above.

Get Answer

A

15. Normally the fuse elements are in parts which are connected in the middle by ten bridge. The melting point of tin bridge is

(A) 35°C

(B) 88°C

(C) 230°C

(D) 540°C.

Get Answer

C

UNIT-5

1) For The Measurement Of Radio Interference Voltages, The Detector Circuit Is Provided With A Device To Measure

A. Average Value
B. Peak Value
C. Quasi-Peak Value
D. All Of These.

Answer Explanation

Answer: All Of These.

---

2) For Operating Power Frequency Voltages, A Surge Arrester Has To Be A

A. Conductor
B. Non-Conductor
C. Semiconductor
D. None Of These

Answer Explanation

Answer: Non-Conductor

---

3) Failure During Switching Impulse Tests Are Can Be Determined By

A. Visible In Oscillograms
B. Loud Noise Produced
C. External Flashovers
D. All Of These

Answer Explanation

Answer: All Of These

---

4) Impulse Testing Of Transformers Is Done Using

A. Full Wave Standard Impulse

B. Chopped Wave Standard Impulse

C. Half Wave Standard Impulse

D. Only (A) And (B)

E. None Of These

Answer Explanation

Answer: Only (A) And (B)

---

5) The Expected Life At The Rated Stress Can Be Determined By Conducting Long Duration Life
Increased Stress For

A. Less Than 1 Hr

B. 1 Hr To About 1000 Hr

C. More Than 1000 Hr

D. None Of These

Answer Explanation

Answer: 1 Hr To About 1000 Hr

---

6) In Routine Tests, The Cable Is Tested By Applying An Ac Voltage Of

A. 2 Times The Rated Value

B. 2.5 Times The Rated Value

C. 3 Times The Rated Value

D. 3.5 Times The Rated Value

Answer Explanation

Answer: 2.5 Times The Rated Value

---

7) At The Instant Of Contact Separation In Asymmetrical Tests, The Dc Component Is

A. Equal To The Ac Component

B. Equal To The 50% Of Ac Component

C. Greater Than 50% Of The Ac Component

D. Less Than The 50% Of The Ac Component

Answer Explanation

Answer: Greater Than 50% Of The Ac Component

---

8) While Performing Temperature Rise Tests, At Any Part Of The Bushing The Steady Temperat Above The Ambient Air Temperature Should Not Exceed

A. 20 °C

B. 25 °C

C. 35 °C

D. 45 °C

Answer Explanation

Answer: 45 °C

---

9) The Tests Which Is Not Performed Under Power Frequency Tests Is

A. Partial Discharge Tests

B. Momentary Withstand Test

C. Visible Discharge Tests

D. Full Wave Withstand Tests

Answer Explanation

Answer: Full Wave Withstand Tests

---

10 The Voltage Which Produces The Loss Of Dielectric Strength Of Insulation Is Known As

A. Withstand Voltage

B. Disruptive Discharge Voltage

C. Flashover Voltage

D. Impulse Voltage

Answer Explanation

Answer: Disruptive Discharge Voltage

This set of Power Systems Multiple Choice Questions & Answers (MCQs) focuses on “Insulator for Overhead L

11. Which of the following material is not used for overhead line insulators?
a) Porcelain
b) Glass
c) PVC
d) Steatite
View Answer

Answer: c
Explanation: In addition to high insulation resistance and high relative permittivity, overhead line insulators mus mechanical strength to bear the weight of line insulators, wind stress and ice loading if any. PVC have good ins resistance but it does not have such mechanical strength so it is not suitable for overhead line insulators.

12. Pin type insulator are mostly subjected to which type of mechanical stress?
a) Compressive stress
b) Tensile stress
c) Both tensile and compressive stress
d) Twisting stress
View Answer

Answer: d
Explanation: The conductor is placed in the governor at the top of the insulator and is tied down. So the weight on the top of the insulator in downward direction causing compressive stress on insulator. No tensile stress is a pin type insulator.

13. Which of the following is the main field of application of pin type insulator?
a) Distribution system
b) Transmission system
c) Transmission and distribution system
d) EHV transmission system
View Answer

Answer: a
Explanation: Pin type insulator become very bulky and cumbersome when designed for higher voltage. Pin insu beyond 50,000 Volts becomes uneconomical. the modern practice is not to use pin type insulator SBI on 33kv pin insulator is limited to distribution level voltage.

14. Suspension type insulator are subjected to _______________
a) tensile stress
b) compressive stress
c) tensile and compressive stress
d) depends on its use

View Answer

Answer: a
Explanation: Suspension type insulator hangs from the cross arms of the suspending supporting structure. The conductor is attached to its lower end hence the load of the conductor causes tensile stress on the suspension

15. A transmission line consists of 9 discs of suspension insulator in each string. What is the operating voltage transmission line?

a) 11 KV

b) 33 KV

c) 66 KV

d) 132 KV

View Answer

Answer: d
Explanation: For different voltage it does not need to use different suspension insulator. Srength of insulator ca increased just by adding extra disc of suspension insulators. For 130 KV transmission lines 9 or 10 disks are u

16. Suspension insulator are made up of _____________

a) glass

b) porcelain

c) steatite

d) epoxy resin

View Answer

Answer: b
Explanation: Suspension insulators consist of a number of porcelain disks flexibly connected in series by meta form of Strings. Glass is used for making pin type insulators.

17. Which of the following insulator is similar to pin type insulator?

a) Suspension insulator

b) Post insulator

c) Strain insulator

d) Shackle insulator

View Answer

Answer: b
Explanation: Post insulators are very similar to pin type insulator, but has a metal base with a metal cap so tha one unit can be mounted in series. Suspensions train and shackle insulators are completely different from pin t insulator on the basis of construction.

18. Which type of insulator is used where there is dead end of the line or there is a corner or a sharp curve, for voltage line?

a) Pin type insulator

b) Shackle insulator

c) Strain insulator

d) Stay insulator

View Answer

Answer: c
Explanation: Pin type insulators cannot be used in such situations because they cannot take conductor mecha intention which often occurs in such situations for low voltage line. Shackle insulator can be used but for highe transmission lines strain insulator consisting of assembly of suspension type insulator are used.

19. What is the most common cause of failure of overhead line insulators?

a) Flashover

b) Mechanical stress

c) Porosity of materials

d) Improper vitrification

View Answer

Answer: a
Explanation: Failure of overhead line insulators due to mechanical stress is rare because defective pieces are during routine factory test. Failure due to porosity and improper vitrification is also very low. The most commo failure of overhead line insulator is flashover.

10. If a string of suspension insulator has three units, each can withstand a maximum 11 KV and total string ca 25.76 KV. What is the string efficiency?

a) 234.1%

b) 46.3%

c) 68.75%

d) 78%

View Answer

Answer: d
Explanation: String Efficiency = [(flashover voltage of the string) /(n × flashover voltage of 1 unit)] × 100
Where 'n' is number of units in one string
Hence, String Efficiency = [25.76/(3×11)] × 100
= 78%.

11. Voltage distribution across disc of strings of suspension insulator assembly is ______

a) same for all disks

b) maximum for unit nearest to the line

c) maximum for unit nearest to the tower

d) equal to transmission line voltage rating

View Answer

Answer: b
Explanation: Thee voltage between line conductor and Earth is not distributed uniformly across individual disks nearest the conductor has the maximum value across it. The figure progressively decreases as the unit neares on is approach.

QUESTION BANK:

GROUP-I (SHORT ANSWER TYPE QUESTIONS)

S.No	QUESTION	BLOOMS TAXONOMY	COURSE OUTCOME
	UNIT-I		
1	Explain different insulating materials used in rotating machines	Remember	1
2	What are the different insulating materials used in Circuit breakers?	Remember	1
3	Define surge voltages	Analyze	1
4	What are the different insulating materials used in Circuit breakers?	Understand	1
5	How is transformer insulation divided?	Analyze	1
6	Explain about uniform and non-uniform electric fields.	Analyze	1
7	What is Finite Element Method?	Understand	1
8	Briefly explain various industrial applications to high voltage engineering	Remember	1
9	What is electrostatic photo copier.	Remember	1
10	What are impulse voltages in power apparatus?	evaluate	1

UNIT-II

1	What is paschen's law?	Remember	2
2	Define Townsend's first and second Ionization coefficients..	Remember	2
3	What is meant by Intrinsic strength?	Remember	2
4	What are commercial liquid dielectrics?	Remember	2
5	What is Ionization process?	Understand	2
6	Mention the drawbacks of streamer theory?	Remember	2

7	What is thermal breakdown in solid dielectrics	Analyze	2
8	What are different theories of breakdown in commercial liquids.?	Understand	2
9	What are ionization processes?	Understand	2
10	Mention different theories of breakdown in commercial liquids.	evaluate	2
UNIT-1II			
1	Define wave front time and wave tail time.	Understand	4
2	What is the working principle of Tesla coil?	Analyze	4
3	What are the different methods of producing switching impulses in test laboratories	Analyze	4
4	What are the different methods of high A.C voltage measurements with their relative merits And demerits	evaluate	4
5	What is a typical impulse current generator circuit	evaluate	4
6	What is a Cockroft-Walton circuit	Remember	4
7	What are the different types of resistive shunts used for impulse current measurements?	Understand	4
8	What are the requirements of a sphere gap for measurement of high voltages?	Remember	4
9	What is a mixed potential divider?	Analyze	4
10	What is an electrostatic voltmeter?	Understand	4

UNIT-IV			
1	What is the function of surge arrestor?	Remember	5
2	List the characteristics of switching surges.	Understand	5
3	What are the mechanisms by which lightning strokes develop an induce over voltages on overhead power lines?	Understand	5
4	What do you mean by back-flashover?	Analyze	5
5	What are the practical characteristics of a surge diverter?	Understand	5
6	What are the mechanisms by which lightning strokes develop and induced overhead powerlines?	Understand	5
7	What are the causes for switching and power frequency over voltages?	Remember	5
8	What is meant by Insulation co-ordination?	Remember	5
9	What is the principle of electro static separator.	Analyze	5
10	What are the applications of electro static copying in high voltage engineering.	Remember	5

UNIT-V

1	What are isolators?	Remember	6
2	List the characteristics of switching surges.	Understand	6
3	What are the mechanisms by which lightning strokes develop an induce over voltages on overhead power lines?	Remember	6
4	What do you mean by back-flashover?	Remember	6
5	Mention the practical characteristics of a surge diverter?	Understand	6
6	Mention the mechanisms by which lightning strokes develop and induced overhead powerlines?	Understand	6
7	What are the causes for switching and power frequency over voltages?	Remember	6
8	State the principle of electro static separator.	Remember	6
9	What are the application of electro static copying in high voltage engineering?	Remember	6

10	What is the working principle of Electrostatic precipitator.	Analyze	6

GROUP-II (LONG ANSWER QUESTIONS)

S.No	QUESTION	BLOOMS TAXONOMY LEVEL	COURSE OUTCOME
	UNIT-I		
1	Why the temperature classification is not done for liquids and gases?	Understand	1
2	Discuss the different dielectric materials according to their physical nature.	Analyze	1
3	Briefly explain various numerical methods for estimation of electric field in dielectric materials.	understand	1
4	Discuss the relative advantages and disadvantages of different numerical methods for solution of field problems.	Remember	1
5	Explain different insulating materials used in rotating machines.	Understand	1
6	Explain about uniform and non-uniform electric fields.	Analyze	1
7	Discuss about surge voltage and their distribution and control in high voltage power apparatus.	Remember	1
8	Explain how the Boundary Element Method is different from Charge Simulation metho	Understand	1
9	Briefly explain various industrial applications to high voltage engineering	Analyze	1
10	Explain the necessity of control of transient or impulse voltages in power apparatus	Analyze	1
	UNIT-II		
1	Derive and explain Paschen Law?	Understand	2
2	Explain how the temperature affects the breakdown strength of solid dielectrics?	Understand	2

3	Define Townsend's first and second Ionization coefficients. Explain the procedure of Townsend's criterion for breakdown in detail.	Remember	2
4	Explain intrinsic breakdown mechanism in solid dielectrics.	Understand	2
5	Give the concept of Townsend's criteria of breakdown in gases.	Understand	2
6	What is Ionization process? Explain different ionization process in detail.	evaluate	2
7	Explain the streamer theory of breakdown in gases.	Analyze	2
8	What is thermal breakdown in solid dielectrics, and how is it practically more significant than other mechanics?	evaluate	2
9	Explain different theories of breakdown in commercial liquids.	Understand	2
10	Explain various primary ionization processes of Townsend's mechanism. Derive an expression for current growth due to these processes.	evaluate	2

UNIT-III			
1	Discuss the functions of trigatron gap.	evaluate	4
2	Derive the expressions for voltage ripple and regulation in a voltage multiplier circuit. Explain about tripping and control of impulse generators	evaluate	4
3	Explain how a sphere gap can be used to measure the peak value of voltages, and illustrate it with a neat sketch.	Remember	4
4	What are the parameters and factors that influence such Define rise time and decay time of impulse voltage wave.	Remember	4
5	Explain the different methods of producing switching impulses in test laboratories.	Understand	4
6	Draw a typical impulse current generator circuit and explain its operation and application	Understand	4
7	Discuss why three electrode gaps are required for impulse generator.	Remember	4
8	What is a mixed potential divider? How is it used for impulse voltage measurements?	Understand	4
9	A ten stage Cockroft-Walton circuit has all capacitors of 0.06 μF. The secondary voltage of the supply transformer is 100 kV at frequency of 150 Hz. If the load current is 1 mA, find (i) the optimum number of stages for maximum output voltage (ii) the maximum output voltage (iii) Voltage regulation (iv) the ripple.	Remember	4
10	Explain with diagrams, different types of rectifier circuits for producing high DC voltages.	Understand	4

UNIT-IV			
1	List the characteristics of switching surges. Explain	Understand	6
2	Explain the different aspects of insulation design and insulation coordination adopted for EHV system	Analyze	6
3	What are the mechanisms by which lightning strokes develop an induce over voltages on overhead power lines? Explain.	Understand	6
4	What do you mean by back-flashover?	Analyze	6
5	With neat sketches, explain the three electrode arrangements used in dielectric measurements for solid and liquid specimen.	Remember	6
6	Briefly explain the terminology used in partial discharge phenomenon.	Analyze	6
7	Explain the working principle of Electrostatic precipitator.	evaluate	6
8	Explain how the Electrostatic copying is done using high voltages.	evaluate	6
9	What are the mechanisms by which lightning strokes develop and induced overhead powerlines?	evaluate	6
10	Explain the importance of switching overvoltages in EHV power systems	Understand	6

UNIT-V

1	Briefly explain how partial discharges in an insulation system can be detected and displayed.	evaluate	6

2	Explain the High voltage Schering Bridge for the measurement	evaluate	6
3	What are the partial discharges and how are they detected under operating conditions	Understand	6
4	What are the different tests done on high voltage circuit breakers of each test	Understand	6
5	What is the procedure of conducting impulse test on high voltage transformers?	evaluate	6
6	Draw a neat diagram of the high voltage Schering Bridge and analyze it for the balance condition. Also draw its phasor diagram. Assume series equivalent representation of the insulating material.	Understand	6
7	Following measurements are made to determine the dielectric constant and complex permittivity of a test specimen: the air capacitance of the electrode system is 50 pF, the capacitance and loss angle of the electrodes with specimen are 190 pF and 0.0085 respectively. Calculate the values of dielectric constant and complex permittivity of the test specimen.	Analyze	6
8	What are the different power frequency and impulse tests done on insulators?	Remember	6
9	Mention the procedure for testing on bushings	Analyze	6
10	What is an operating duty cycle test on a surge arrester? Why is it more significant than other tests?	Analyze	6

ELECTRICAL DISTRIBUTION SYSTEMS

PROGRAMME: B.Tech ECE AC:YEAR: **2018-2019**	DEGREE: **B.TECH IV YEAR**
COURSE: **ELECTRICAL DISTRIBUTION SYSTEMS**	SEMESTER: **I** CREDITS: 4 COURSE COORDINATOR: Mr. V.VISHNUVARDHAN YADAV
COURSE CODE: **127CT** REGULATION:**R15**	COURSE TYPE: **Core**
COURSE AREA/DOMAIN: EEE	CONTACT HOURS: 4 hours/Week.
CORRESPONDING LAB COURSE CODE : NILL	LAB COURSE NAME: NILL

BRIEF NOTE ON THE IMPORTANTANCE OF THE COURSE AND HOW IT FITS IN TO THE CURRICULAM

This course gives the complete knowledge of electrical distribution systems, the design of feeders, substations. It also gives conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e., voltage drops and power losses and the very important thing that protection of the system by means of protective devices and their co-ordination during the several fault conditions. It also specifies how to improve the voltage profiles and power factor of the system to better value using various voltage control and compensation techniques.

PREREQUISITES, IF ANY

- Power systems-I
- Power systems-II
- Computer methods in power systems

MARKS DISTRIBUTION:

Session Marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each Mid-term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part- B. Where part consists	75	100

of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.awarded considering the average of two assignments in each course		

EVALUATION SCHEME:

S.No	Component	Total Duration	Marks
1.	I Mid Examination	90 Minutes	20
2.	I Assignment	----	05
3.	II Mid Examination	90 Minutes	20
4.	II Assignment	------	05
5.	External Examination	3 hours	75

Course Objectives:

1. This course gives the complete knowledge of electrical distribution systems, the design of feeders, substations.
2. It also gives conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e., voltage drops and power losses.
3. The very important thing that protection of the system by means of protective devices and their co-ordination during the several fault conditions.
4. It also specifies how to improve the voltage profiles and power factor of the system to better value using various voltage control and compensation techniques.
5. Various electric heating concepts and their related applications are also discussed. Various electric welding concepts and their related applications are also discussed.

Course Outcomes:

On completion of this subject, the student should be able to

1. The students will Able to know the general concepts of electrical distribution systems. And types of loads
2. The students will have the ability to understand the concepts of designing and analysis of distribution feeders and substations.
3. The students will have the ability to understand the distribution systems analysis through voltage-drop and power loss calculations
4. The student will have the ability to understand the operation of protective devices used in distribution systems and their co-ordination.
5. The student will have the ability to analyses the concept of voltage control and power factor improvement through capacitor compensation.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

IV Year B.Tech. EEE - I Sem **L T/P/D C**

Regulation: R15 **4 -/-/- 4**

ELECTRICAL DISTRIBUTION SYSTEMS

OBJECTIVE:

This course gives the complete knowledge of electrical distribution systems, the design of feeders, substations. It also gives conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e., voltage drops and power losses and the very important thing that protection of the system by means of protective devices and their co-ordination during the several fault conditions. It also specifies how to improve the voltage profiles and power factor of the system to better value using various voltage control and compensation techniques.

UNIT-I:

Introduction & General Concepts: Introduction to distribution systems: Load modeling and characteristics. Coincidence factor, contribution factor, loss factor – Relationship between the load factor and loss factor.

Classification of loads: Residential, commercial, Agricultural and Industrial loads and their characteristics.

UNIT-II:

Distribution Feeders & Substations: Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system. **Substations:** Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT-III:

Distribution System Analysis: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

UNIT–IV:

Protective Devices & Co-ordination: Objectives of distribution system protection, types of common faults and procedure for fault calculations.

Protective Devices: Principle of operation of Fuses, Circuit Reclosers, and line sectionalizers, and circuit breakers.

Coordination of Protective Devices: General coordination procedure.

UNIT-V:

Voltage Control & P.F. Improvement: Equipment for voltage control, effect of series capacitors, line drop compensation, effect of AVB/AVR. Power factor control using different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and Switched), capacitor allocation – Economic justification – Procedure to determine the best capacitor location.

TEXT BOOKS:

1. Electrical Power Distribution Systems, V.Kamaraju, TMH.

2. Electrical Distribution Systems, Dr. S.Sivanagaraju, Dr. K.Shankar, Dhanpatrai Publications.

REFERENCE BOOKS:

1. Electrical Power Distribution System Engineering, Turan Gonen, CRC Press.

2. Electric Power Generation, Transmission and Distribution, SN.Singh, PHI Publishers.

COURSE PLAN:

S. No	Unit No	Topic	No of sessions planned	Mode of teaching BB/PPT/ OHP/MM	Reference *	Remarks
1	I	**General Concepts**	2	BB	A1,B1	
2		Introduction to distribution systems	2	BB	A1,B1	
3		Load modelling and characteristics	1	BB	A1,B1	
4		Coincidence factor, contribution factor and loss factor	2	BB	A1,B1	
5		Load factor,diversity factor,maximum diversified demand and annual load factor	2	BB	A1,B1	
6		Relationship between the load factor and loss factor	2	BB	A1,B1	
7		Classification of loads(Residential,Commercial,Agricultural and Industrial)	1	BB	A1,B1	
8		Load characteristics	2			
9	II	**Distribution Feeders**	1	**PPT**	A1,B1	
10		Design Considerations of Distribution Feeders	1	BB	A1,B1	
11		Radial and loop types of primary feeders	1	BB	A1,B1	
12		Voltage levels	2	BB	A1,B1	
13		Feeder loading	1	**PPT**	A1,B1	
14		Ring type primary feeder	2	**PPT**	A1,B1	
15		Basic design practice of the secondary distribution system	2	**PPT**	A1,B1	
16		**Substations**	1	**PPT**	A1,B1	
17		Location of Substations	1			

18		Rating of distribution substation	2	BB	A1,C1	
19		Service area within primary feeders	1	BB	A1,C1	
20	III	**Distribution System Analysis**	1	BB	A1,C1	
21	III	Voltage drop and power-loss calculations	2	**PPT**	A1,C1	
22	III	Derivation for voltage drop and power loss in lines	2	**PPT**	A1,C1	
23	III	Manual methods of solution for radial networks	2	**PPT**	A1,C1	
24	III	Three phase balanced primary lines	1	BB	A1,C1	
25	IV	**Protective Devices & Co-ordination**				
26	IV	Objectives of distribution system protection	1	BB	A1	
27	IV	Types of common faults and procedure for fault calculations	1	BB	A1	
28	IV	Protective Devices: Principle of operation of Fuses	2	BB	A1	
29	IV	Circuit Reclosures, line sectionalizes, and circuit breakers	2	BB	A1	
32	IV	**Coordination**	1			
33	IV	Coordination of Protective Devices				
34	IV	General coordination procedure.				
33	**V**	**Voltage Control**				
34	**V**	Equipment for voltage control	1	BB	A1	
35	**V**	Effect of Series capacitors	1	BB	A1	
36	**V**	Effect of AVB/AVR and Line drop compensation	1	BB	A1	
37	**V**	**power factor improvement**	1	BB	A1	
38	**V**	Capacitive compensation for power-factor control	1	BB	A1	
39	**V**	Different types of power capacitors, shunt and series capacitors	1	BB	A1	

40		Effect of shunt capacitors (Fixed and switched)	1	BB	A1	
41		Power factor correction, capacitor allocation	1			
42		Economic justification				
		Procedure to determine best capacitor location				

TEXT BOOKS:

1. Electrical Power Distribution Systems, V.Kamaraju, TMH.

2. Electrical Distribution Systems, Dr. S.Sivanagaraju, Dr. K.Shankar, Dhanpatrai Publications.

REFERENCE BOOKS:

1. Electrical Power Distribution System Engineering, Turan Gonen, CRC Press.

2. Electric Power Generation, Transmission and Distribution, SN.Singh, PHI Publishers.
3. Electric Power Distribution System. S.Pabla, TMH.

MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objective	Course Outcomes				
	a	b	c	d	e
I	S				
II	S	S			
III			H		
IV				H	S
V					S

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes													
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**
a	S													
b	S	S									S		S	S
c	S	S												
d		S					S				S		H	S
e	S		S		S		S				S		S	

QUESTION BANK

OBJECTIVES:
UNIT-I

1. By which of the following systems electric power may be transmitted ?
(a) Overhead system
(b) Underground system
(c) Both (a) and (b)
(d) None of the above
Ans: c

2 are the conductors, which connect the consumer's terminals to the distribution
(a) Distributors
(b) Service mains
(c) Feeders
(d) None of the above
Ans: b

3. The underground system cannot be operated above
(a) 440 V
(b) 11 kV
(c) 33 kV
(d) 66 kV
Ans: d

4. Overhead system can be designed for operation up to
(a) 11 kV
(b) 33 kV
(c) 66 kV
(d) 400 kV
Ans: c

5. If variable part of annual cost on account of interest and depreciation on the capital outlay is equal to the annual cost of electrical energy wasted in the conductors, the total annual cost will be minimum and the corresponding size of conductor will be most economical. This statement is known as
(a) Kelvin's law
(b) Ohm's law
(c) Kirchhoffs law
(d) Faraday's law
(e) none of the above
Ans: a

6. The wooden poles well impregnated with creosite oil or any preservative compound have life
(a) from 2 to 5 years
(b) 10 to 15 years
(c) 25 to 30 years
(d) 60 to 70 years
Ans: c

7. Which of the following materials is not used for transmission and distribution of electrical power ?
(a) Copper
(b) Aluminium
(c) Steel
(d) Tungsten
Ans: d

8. Galvanised steel wire is generally used as
(a) stay wire
(b) earth wire
(c) structural components
(d) all of the above
Ans: d

9. The usual spans with R.C.C. poles are
(a) 40—50 meters
(b) 60—100 meters
(c) 80—100 meters
(d) 300—500 meters
Ans: c

10. The corona is considerably affected by which of the following ?
(a) Size of the conductor
(b) Shape of the conductor
(c) Surface condition of the conductor
(d) All of the above
Ans: d

11. Which of the following are the constants of the transmission lines ?
(a) Resistance
(b) Inductance
(c) Capacitance
(d) All of the above
Ans: d

12. 310 km line is considered as
(a) a long line
(b) a medium line
(c) a short line
(d) any of the above
Ans: a

13. The phenomenon qf rise in voltage at the receiving end of the open-circuited or lightly loaded line is called the
(a) Seeback effect
(b) Ferranti effect
(c) Raman effect
(d) none of the above
Ans: b

14. The square root of the ratio of line impedance and shunt admittance is called the
(a) surge impedance of the line
(b) conductance of the line
(c) regulation of the line
(d) none of the above
Ans: a

15. Which of the following is the demerit of a 'constant voltage transmission system' ?
(a) Increase of short-circuit current of the system
(b) Availability of steady voltage at all loads at the line terminals
(c) Possibility of better protection for the line due to possible use of higher terminal reactants
(d) Improvement of power factor at times of moderate and heavy loads
(e) Possibility of carrying increased power for a given conductor size in case of long-distance heavy power transmission
Ans: a

16. Low voltage cables are meant for use up to

(a)l.lkV
(b)3.3kV
(c)6.6kV
(d)llkV
Ans: e

17. The operating voltage of high voltage cables is up to
(a)l.lkV
(b)3.3kV
(c)6.6kV
(d)llkV
Ans: d

18. The operating voltage of supertension cables is up to
(a) 3.3 kV
(b) 6.6 kV
(c) 11 kV
(d) 33 kV
Ans: d

19. The operating voltage of extra high tension cables is upto
(a) 6.6 kV
(b) 11 kV
(c) 33 kV
(d) 66 kV
(e) 132 kV
Ans: d

UNIT-II

20. Which of the following methods is used for laying of underground cables ?
(a) Direct laying
(b) Draw-in-system
(c) Solid system
(d) All of the above
Ans: d

21. Which of the following is the source of heat generation in the cables ?
(a) Dielectric losses in cable insulation
(b) losses in the conductor
(c) Losses in the metallic sheathings and armourings
(d) All of the above
Ans:

22. Due to which of the following reasons the cables should not be operated too hot ?
(a) The oil may loose its viscosity and it may start drawing off from higher levels
(b) Expansion of the oil may cause the sheath to burst
(c) Unequal expansion may create voids in the insulation which will lead to ionization
(d) The thermal instability may rise due to the rapid increase of dielectric losses with temperature
(e) All of the above
Ans: e

23. Which of the following D.C. distribution system is the simplest and lowest in first cost ?
(a) Radial system
(b) Ring system
(c) Inter-connected system
(d) None of the above
Ans: a

24. A booster is a
(a) series wound generator
(b) shunt wound generator
(c) synchronous generator
(d) none of the above
Ans: a

25. Besides a method of trial and error, which of the following methods is employed for solution of network problems in interconnected system ?
(a) Circulating current method
(b) Thevenin's theorem
(c) Superposition of currents
(d) Direct application of Kirehhoffs laws

(e) All of the above
Ans: e

26. Which of the following faults is most likely to occur in cables ?
(a) Cross or short-circuit fault
(b) Open circuit fault
(c) Breakdown of cable insulation
(d) All of the above
Ans:

27. The cause of damage to the lead sheath of a cable is
(a) crystallisation of the lead through vibration
(b) chemical action on the lead when buried in the earth
(c) mechanical damage
(d) all of the above
Ans:

28. The voltage of the single phase supply to residential consumers is
(a) 110 V
(b) 210 V
(c) 230 V
(d) 400 V
Ans: c

29. Most of the high voltage transmission lines in India are
(a) underground
(b) overhead
(c) either of the above
(d) none of the above
Ans: b

30. The distributors for residential areas are
(a) single phase
(b) three-phase three wire
(c) three-phase four wire
(d) none of the above
Ans: c

31. The conductors of the overhead lines are
(a) solid
(b) stranded
(c) both solid and stranded
(d) none of the above
Ans:

32. High voltage transmission lines use
(a) suspension insulators
(b) pin insulators
(c) both (a) and (b)
(d) none of the above
Ans: a

33. Multicore cables generally use
(a) square conductors
(b) circular conductors
(c) rectangular conductors
(d) sector-shaped conductors
(e) none of the above
Ans: d

34. Distribution lines in India generally use
(a) wooden poles
(b) R.C.C. poles
(c) steel towers
(d) none of the above
Ans: b

35. The material commonly used for insulation in high voltage cables is
(a) lead
(b) paper
(c) rubber
(d) none of the above
Ans: b

36. The loads on distributors systems are generally
(a) balanced
(b) unbalanced
(c) either of the above
(d) none of the above
Ans: b

37. The power factor of industrial loads is generally
(a) unity
(b) lagging
(c) leading
(d) zero
Ans: b

38. Overhead lines generally use
(a) copper conductors
(b) all aluminium conductors

(c) A.C.S.R. conductors
(d) none of these
Ans: c

39. In transmission lines the cross-arms are made of
(a) copper
(b) wood
(c) R.C.C.
(d) steel
Ans: d

40. The material generally used for armour of high voltage cables is
(a) aluminium
(b) steel
(c) brass
(d) copper
Ans: b

41. Transmission line insulators are made of
(a) glass
(b) porcelain
(c) iron
(d) P.V.C.
Ans:

42. The material commonly used for sheaths of underground cables is
(a) lead
(b) rubber
(c) copper
(d) iron
Ans: a

43. The minimum clearance between the ground and a 220 kV line is about
(a) 4.3 m
(b) 5.5 m
(c) 7.0 m
(d) 10.5 m
Ans: c

44. The spacing between phase conductors of a 220 kV line is approximately equal to
(a) 2 m
(b) 3.5 m
(c) 6 m
(d) 8.5 m
Ans: c

45. Large industrial consumers are supplied electrical energy at
(a) 400 V
(b) 11 kV
(c) 66 kV
(d) 400 kV

Ans: c

UNIT-III

46. In a D.C. 3-wire distribution system, balancer fields are cross-connected in order to
(a) boost the generated voltage
(b) balance loads on both sides of the neutral
(c) make both machine^ run as unloaded motors
(d) equalize voltages on the positive and negative outers
Ans:

47. In a D.C. 3-wire distributor using balancers and having unequal loads on the two sides
(a) both balancers run as generators
(b) both balancers run as motors
(c) balancer connected to lightly- loaded side runs as a motor
(d) balancer connected to heavily- loaded side runs as a motor
Ans:

48. Transmitted power remaining the same, if supply voltage of a D.C. 2-wire feeder is increased 100 percent, saving in copper is
(a) 25 percent
(b) 50 percent
(c) 75 percent
(d) 100 percent
Ans: b

49. A uniformly-loaded D.C. distributor is fed at both ends with equal voltages. As compared to a similar distributor fed at one end only, the drop at the middle point is
(a) one-fourth
(b) one-third
(c) one-half
(d) twice
(e) none of the above
Ans: a

50. As compared to a 2-wire D.C. distributor, a 3-wire distributor with same maximum voltage to earth uses only
(a) 31.25 percent of copper
(b) 33.3 percent of copper
(c) 66.7 percent of copper
(d) 125 percent of copper
Ans: a

51. Which of the following is usually not the generating voltage ?
(a) 6.6 kV

(b) 8.8 kV
(c) 11 kV
(d) 13.2 kV
Ans: b

52. For an overhead line, the surge impedance is taken as
(a) 20-30 ohms
(b) 70—80 ohms
(c) 100—200 ohms (d)
500—1000 ohms
(e) none of the above
Ans: c

53. The presence of ozone due to corona is harmful because it
(a) reduces power factor
(b) corrodes the material
(c) gives odour
(d) transfer energy to the ground
(e) none of the above
Ans: b

54. A feeder, in a transmission system, feeds power to
(a) distributors
(b) generating stations
(c) service mains
(d) all of the above
Ans: a

55. The power transmitted will be maximum when
(a) corona losses are minimum
(b) reactance is high
(c) sending end voltage is more
(d) receiving end voltage is more
Ans: c

56. A 3-phase 4 wire system is commonly used on
(a) primary transmission
(b) secondary transmission
(c) primary distribution
(d) secondary distribution
Ans: d

57. Which of the following materials is used for overhead transmission lines ?
(a) Steel cored aluminium
(b) Galvanised steel
(c) Cadmium copper

(d) Any of the above
Ans: d

58. Which of the following is not a constituent for making porcelain insulators ?
(a) Quartz
(b) Kaolin
(c) Felspar
(d) Silica
Ans: d

59. There is a greater possibility of occurence of corona during
(a) dry weather
(b) winter
(c) summer heat
(d) humid weather
(e) none of the above
Ans: d

60. Which of the following relays is used on long transmission lines ?
(a) Impedance relay
(b) Mho's relay
(c) Reactance relay
(d) None of the above
Ans: b

61. The steel used in steel cored conductors is usually
(a) alloy steel
(b) stainless steel
(c) mild steel
(d) high speed steel
(e) all of the above
Ans: c

62. Which of the following distribution systems is more reliable ?
(a) Radial system
(b) Tree system
(c) Ring main system
(d) All are equally reliable
Ans: c

63. Which of the following characteristics should the line supports for transmission lines possess ?
(a) Low cost
(b) High mechanical strength
(c) Longer life
(d) All of the above
Ans: d

64. Transmission voltage of ll kV is normally used for distances upto
(a) 20—25 km
(b) 40—50 km
(c) 60—70 km (d)
80—100 km Ans:
a

65. Which of the following regulations is considered best?
(a) 50%
(b) 20%
(c) 10%
(d) 2%
Ans: d

66. Skin effect is proportional to
(a) (conductor diameter)
(b) (conductor diameter)
(c) (conductor diameter)
(d) (conductor diameter)
(e) none of the above
Ans: c

67. A conductor, due to sag between two supports, takes the form of
(a) semi-circle
(b) triangle
(c) ellipse
(d) catenary
Ans: d

68. In AC.S.R. conductors, the insulation between aluminium and steel conductors is
(a) insulin
(b) bitumen
(c) varnish
(d) no insulation is required
Ans: d

69. Which of the following bus-bar schemes has the lowest cost ?
(a) Ring bus-bar scheme
(b) Single bus-bar scheme
(c) Breaker and a half scheme
(d) Main and transfer scheme
Ans: b

UNIT-IV

70. Owing to skin effect

(a) current flows through the half cross-section of the conductor
(b) portion of the conductor near the surface carries more current and core of the

conductor carries less current
(c) portion of the conductor near the surface carries less current and core of the conductor carries more cur¬rent
(d) any of the above
(e) none of the above
Ans: b

71. By which of the following methods string efficiency can be improved ?
(a) Using a guard ring
(b) Grading the insulator
(c) Using long cross arm
(d) Any of the above
(e) None of the above
Ans: d

72. In aluminium conductors, steel core is provided to
(a) compensate for skin effect
(b) neutralise proximity effect
(c) reduce line inductance
(d) increase the tensile strength
Ans: d

73. By which of the following a bus-bar is rated ?
(a) Current only
(b) Current and voltage
(c) Current, voltage and frequency
(d) Current, voltage, frequency and short time current
Ans: d

74. A circuit is disconnected by isolators when
(a) line is energized
(b) there is no current in the line
(c) line is on full load
(d) circuit breaker is not open
Ans: b

75. For which of the following equipment current rating is not necessary ?
(a) Circuit breakers
(b) Isolators
(c) Load break switch
(d) Circuit breakers and load break switches
Ans: b

76. In a substation the following equipment is not installed
(a) exciters
(b) series capacitors
(c) shunt reactors

(d) voltatre transformers
Ans: a

77. jCorona usually occurs when the electrostatic stress in air around the conductor exceeds
(a) 6.6 kV (r.m.s. value)/cm
(b) 11 kV (r.m.s. value)/cm
(c) 22 kV (maximum value)/cm
(d) 30 kV (maximum value)/cm
Ans: d

78. The voltage drop, for constant voltage transmission is compensated by installing
(a) inductors
(b) capacitors
(c) synchronous motors
(d) all of above
(e) none of the above
Ans: c

79. The use of strain type insulators is made where the conductors are
(a) dead ended
(b) at intermediate anchor towers
(c) any of the above
(d) none of the above
Ans: c

80. The current drawn by the line due to corona losses is
(a) non-sinusoidal
(b) sinusoidal
(c) triangular
(d) square
Ans: a

81. Pin type insulators are generally not used for voltages beyond
(a) 1 kV
(b) 11 kV
(c) 22 kV
(d) 33 kV
Ans: d

82. Aluminium has a specific gravity of
(a) 1.5
(b) 2.7
(c) 4.2
(d) 7.8
Ans: b

83. For transmission of power over a distance of 200 km, the transmission voltage should be
(a) 132 kV
(b) 66 kV
(c) 33 kV
(d) 11 kV
Ans: a

84. For aluminium, as compared to copper, all the following factors have higher values except
(a) specific volume
(6) electrical conductivity
(c) co-efficient of linear expansion
(d) resistance per unit length for same cross-section
Ans: b

85. Which of the following equipment, for regulating the voltage in distribution feeder, will be most economical ?
(a) Static condenser
(b) Synchronous condenser
(c) Tap changing transformer
(d) Booster transformer
Ans: d

86. In a tap changing transformer, the tappings are provided on
(a) primary winding
(b) secondary winding
(c) high voltage winding
(d) any of the above
Ans: c

87. Constant voltage transmission entails the following disadvantage
(a) large conductor area is required for same power transmission
(b) short-circuit current of the system is increased
(c) either of the above
(d) none of the above
Ans: b

88. On which of the following factors skin effect depends ?
(a) Frequency of the current
(b) Size of the conductor
(c) Resistivity of the conductor material
(d) All of the above
Ans: d

89. The effect of corona can be detected by
(a) presence of ozone detected by odour

(b) hissing sound
(c) faint luminous glow of bluish colour
(d) all of the above
Ans: d

90. For transmission of power over a distance of 500 km, the transmission voltage should be in the range
(a) 150 to 220 kV
(b) 100 to 120 kV
(c) 60 to 100 kV
(d) 20 to 50 kV
Ans: a

UNIT-V

91. In the analysis of which of the following lines shunt capacitance is neglected ?
(a) Short transmission lines
(b) Medium transmission lines
(c) Long transmission lines
(d) Medium as well as long transmission lines
Ans: a

92. When the interconnector between two stations has large reactance
(a) the transfer of power will take place with voltage fluctuation and noise
(b) the transfer of power will take place with least loss
(c) the stations will fall out of step be¬cause of large angular displacement between the stations
(d) none of the above
Ans: c

93. The frequency of voltage generated, in case of generators, can be increased by
(a) using reactors
(b) increasing the load
(c) adjusting the governor
(d) reducing the terminal voltage
(e) none of the above
Ans: c

94. When an alternator connected to the bus-bar is shut down the bus-bar voltage will
(a) fall
(b) rise
(c) remain unchanged
(d) none of the above
Ans: c

95. The angular displacement between two interconnected stations is mainly due to
(a) armature reactance of both alternators

(b) reactance of the interconnector
(c) synchronous reactance of both the alternators
(d) all of the above
Ans: a

96. Electro-mechanical voltage regulators are generally used in
(a) reactors
(b) generators
(c) transformers
(d) all of the above
Ans: b

97. Series capacitors on transmission lines are of little use when the load VAR requirement is
(a) large
(b) small
(b) fluctuating
(d) any of the above
Ans: b

98. The voltage regulation in magnetic amplifier type voltage regulator is effected by
(a) electromagnetic induction
(b) varying the resistance
(c) varying the reactance
(d) variable transformer
Ans: c

99. When a conductor carries more current on the surface as compared to core, it is due to
(a) permeability variation
(b) corona
(c) skin effect
(d) unsymmetrical fault
(e) none of the above
Ans: c

100. The following system is not generally used
(a) 1-phase 3 wire
(b) 1-phase 4 wire
(c) 3-phase 3 wire
(d) 3-phase 4 wire
Ans: a

101. The skin effect of a conductor will reduce as the
(a) resistivity of conductor material increases
(b) permeability of conductor material increases

(c) diameter increases
(d) frequency increases Ans: a

110. When a live conductor of public electric supply breaks down and touches the earth which of the following will happen ?
(a) Current will flow to earth
(b) Supply voltage will drop
(c) Supply voltage will increase
(d) No current will flow in the conductor
(e) None of the above Ans: a

QUESTION BANK:

QUESTION BANK ON SHORTANSWER QUESTION

S. No	Question	Blooms Taxonomy Level	Course Outcome
UNIT -1 GENERAL CONCEPTS			
1	Discuss about load management functions?	Understand	1
2	Define Demand?	Remember	1
3	Obtain the relation between the load factor and loss factor?	Remember	1
4	Discuss about coincidence Factor?	Remember	1
5	Discuss about contribution factor.	Remember	2
6	Discuss about loss factor.	Remember	2
7	What is load factor?	Remember	2
8	Discuss about load diversity.	Remember	4
9	What is Maximum demand?	Remember	1
10	Explain coincident demand?	Remember	1
11	What is Non-coincident demand?	Understand	1
12	What is meant by term load? How loads can be classified?	Understand	1
13	What is distribution system?	Understand	1
UNIT – II DISTRIBUTION FEEDERS & SUBSTATIONS			

S. No	Question	Blooms Taxonomy Level	Course Outcome
1	Discuss the differences between radial and loop types of primary distribution feeders	Remember	1
2	Draw neat sketches radial type and loop type sub transmission systems	Understand	1
3	Define the terms feeder and Distributor	Create	4
4	What are the advantages and disadvantages of loop type primary distribution feeder	Remember	1
5	Draw the neat sketch of ring main distribution system.	Remember	1
6	Compare Radial and loop type feeders.	Remember	1
7	What are the advantages and disadvantages of radial type primary distribution feeder	Remember	1
8	Compare loop type and ring main.	Remember	1
9	What are the advantages and disadvantages of Switching scheme of Single bus.	Remember	1
10	What are the advantages and disadvantages of ring bus scheme	Remember	1
11	What are the advantages and disadvantages of inter connected primary distribution feeder	Understand	4
12	What are the advantages and disadvantages of Switching scheme of Double bus double breaker	Understand	2
13	Define substation.	Remember	3
14	Define distribution transformer.	Remember	3
15	Give the classification of Different types of substations.	Remember	3
16	What are the advantages and disadvantages of Outdoor Substations	Understand	3
17	What are the rules to be considered to locate the substation	Remember	3
18	Discuss advantages of optimal location of substation?	Remember	3
19	What are the advantages and disadvantages of Indoor Substations	Remember	3
20	What are the advantages and disadvantages of Underground Substations	Analyze	3
21	Discuss about industrial substation.	Remember	3
22	Differentiate Indoor and outdoor substation?	Evaluate	3
UNIT – III LOADING ON FEEDER			
1	Define multi grounded system	Remember	1
2	Define real power	Remember	1
3	Define reactive power	Remember	1
4	Define apparent power	Understand	2
5	Define power loss	Remember	1
6	Define voltage drop	Remember	1
7	Discuss voltage drop for loads of different power factor	Remember	1
8	Discuss the voltage drop for uniformly distributed load	Analyze	1
UNIT –IV PROTECTION & COORDINATION			

1	Describe the operating principle of Fuses	Remember	5
2	Describe the operating principle of Circuit breakers	Remember	5

S. No	Question	Blooms Taxonomy Level	Course Outcome
3	Describe the operating principle of Line sectionalizer	Remember	5
4	Define Fuse	Understand	5
5	What is the main objective of distribution system protection?	Understand	5
6	What are the advantages of circuit breaker	Remember	5
7	Define Circuit recloser	Remember	5
8	Define Circuit breaker?	Remember	5
9	Define relay?	Remember	5
10	Discuss about transmission line protective devices	Remember	5
11	Define coordination	Remember	5
12	Discuss about importance of coordination	Remember	5
13	Define protective device	Remember	5
14	Discuss about advantages of fuse to fuse coordination	Remember	5
15	Difference between the fuse to fuse coordination and fuse to recloser coordination	Remember	5
16	Define fuse to recloser coordination	Remember	5
17	Discuss about advantages and disadvantages of fuse to recloser coordination	Remember	5
18	Discuss about Advantages and disadvantages of fuse to circuit breaker coordination.	Evaluate	5
UNIT –V COMPENSATION FOR POWER FACTOR IMPROVEMENT			
1	Discuss the disadvantages of low voltage and low p.f of the system?	Remember	6
2	Discuss the importance of power factor correction	Analyze	6
3	Discuss the financial benefits due to voltage improvement	Analyze	6
4	Discuss advantages of series compensation	Analyze	6
5	Discuss importance of shunt capacitor compensation	Remember	6
6	Discuss benefits due to released distribution substation capacity	Remember	6
7	Define power factor?	Remember	6
8	Discuss advantages of shunt compensation	Remember	6
9	Discuss about power factor correction	Remember	6
10	Discuss financial benefits due to voltage improvement	Remember	6
UNIT –V VOLTAGE CONTROL			
1	Define voltage regulation	Remember	6
2	Define voltage drop	Remember	6
3	Define nominal voltage	Understand	6
4	Define rated voltage	Understand	6
5	Define utilization voltage	Remembe	6

		r	
6	Discuss the applications of induction regulators	Remember	5
7	What are the advantages and disadvantages of automatic voltage booster	Understand	5
8	Define maximum voltage	Understand	6
9	Define minimum voltage	Understand	6
10	Discuss use of tap-changing transformer	Understand	8

Group – II LONG ASNWERS QUASTIONS

S. No	Question	Blooms Taxonomy Level	Course Outcome
	UNIT -1 GENERAL CONCEPTS		
1	Explain the various factors affecting the distribution system planning.	Remember	1
2	Draw a block diagram in flow chart form for a typical distribution system planning process and explain the techniques for distribution planning.	Remember	1
3	Discuss about different load modelling and its characteristics	Create	2
4	Obtain the relation between the load factor and loss factor	Create	2
5	Discuss in detail about residential and industrial loads and their respective characteristics.	Remember	1
6	Discuss the characteristics of different loads	Create	2
7	Explain briefly the classification of loads and modeling of load in distribution networks.	Remember	3
8	Explain the load characteristics of distribution system.	Understand	3
9	Discuss the characteristics of the following categories of loads: (i) Residential (iii) Agriculture (ii) Commercial (iv) Industrial	Remember	2
10	Make a comparison between DC and AC systems	Create	2
	UNIT –II DISTRIBUTION FEEDERS & SUBSTATIONS		
1	What are the various factors that are to be considered in selecting a primary feeder rating? Describe the arrangement with suitable diagram.	Understand	2
2	Draw the single line diagram of radial type feeder and mention the factors that influences the selection of primary feeder	Understand	2
3	With neat sketches explain the various types of sub transmission systems.	Remember	3
4	Discuss the basic design practice of the secondary distribution system	Remember	3
5	Explain various factors that influence voltage levels in design and operation of the distribution system	Remember	3
6	Distinguish between primary and secondary distribution systems with suitable examples.	Remember	3
7	State the Different voltage levels of secondary distribution system	Remember	3
8	Classify different types of primary feeders and give their merits and demerits	Remember	2
9	Derive the condition of load factor for which the voltage drop is maximum	Remember	2
10	Explain radial type primary feeder with neat diagram	Create	2

11	Draw and explain secondary network supplied by three primary feeders.		2
12	What are the various factors that are to be considered in selecting optimal location of substation?	Remember	4
13	Compare the four and six feeder's patterns in substation location.	Create	4
14	How the rating of distribution substation can be calculated. Explain taking a general case with `n' no. of feeders	Remember	1,2
15	How do you analyze a substation service area with `n' primary feeders	Remember	4
16	Discuss how the rating of distribution substation is fixed	Create	4
17	Explain the criteria for location of a substation and what are the benefits obtained through optimal location of Substation	Remember	4
18	Explain the single bus bar system with sectionalization and what are its merits and demerits.	Remember	4
19	Explain the main and transfer bus bar system with circuit diagram.	Understand	4
20	What is the difference between single bus bar with and without sectionalization arrangement?	Create	4
21	Discuss about the classification of different types of substations. State the advantages and disadvantages of Each substation.	Create	4
UNIT –III SYSTEM ANALYSIS			
1	Derive an approximate voltage drop & power loss equation of primary feeder and give the condition for load p.f. at which voltage drop is maximum	Remember	6
2	Prove the power loss due to the load currents in the conductors of single-phase lateral ungrounded neutral case is 2 times larger than one in the equivalent three phase lateral	Remember	2
3	Discuss about non-three phase primary lines.	Understand	4
4	Prove the power loss due to load currents in the conductors of the 2-phase, 3 wire lateral with multi-grounded neutral is approximately 1.64 times larger than the one in the equivalent 3-phase lateral	Understand	4
5	In terms of resistance and reactance of the circuit, derive the equation for load power factor for which voltage drop is minimum	Understand	3
6	What are the power losses in A.C distribution? how it is estimated approximately	Remember	3
7	What is the importance of % Voltage drop in feeder lines? What are the factors that affect % voltage drop?	Understand	2
8	Discuss a four wire multi-grounded common neutral distribution system.	Remember	3
9	Discuss about the different types of manual methods used for the solution of radial networks? Explain them	Understand	3
10	Prove that the power loss due to the load currents in the conductors of single- phase lateral ungrounded neutral case is 2 times larger than one in the equivalent three phase lateral.	Understand	2
UNIT –IV PROTECTION			
1	The per unit values of positive, negative and zero sequence reactance's of a network at fault are 0.08, 0.07 and 0.05 respectively. Determine the fault current if the fault is double line to ground.	Remember	5
2	Discuss advantages and disadvantages of fuses	Remember	5
3	Discuss about when maximum faults and minimum faults occur in distribution system.	Remember	5
4	What are the objectives of a distribution protection?	Understand	5

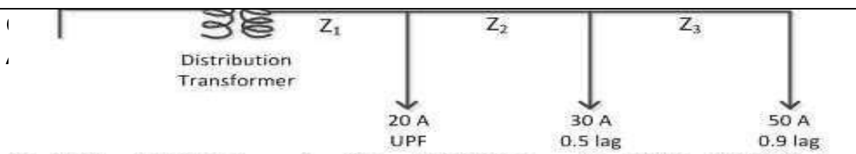
S. No	Question	Blooms Taxonomy Level	Course Outcome
5	Discuss the Principle of a circuit recloser used in protection of distribution system	Understand	5
6	Discuss the procedure for fault current calculation in following faults. i. Double Line Ground fault ii. Line-Line fault.	Understand	5
7	What are the common faults occur in distribution system? Explain with line diagrams	Understand	5
8	Discuss the procedure for fault current calculation in following faults. i. Three phase Ground fault ii. Phase to phase ground fault.	Understand	5
9	What are the common types of faults in a single phase 2-wire and 3-wire systems? Explain how fault current is computed with proper single line diagrams.	Understand	5
10	Explain briefly secondary system fault current calculation for, a. Single phase 120/240 V three wire secondary service b. Three phase 240/120 star/ delta or delta/star four secondary	Understand	5
UNIT –IV COORDINATION			
1	Discuss the overall coordination procedure employed for protection of distribution systems	Understand	5
2	Discuss in detail how the co-ordination of various protective devices helps in improving system performance	Understand	5
3	Discuss about Fuse-Fuse coordination	Analyze	5
4	Discuss about Fuse-Circuit breaker coordination	Analyze	5
5	Discuss about different types of coordination of protective devices	Analyze	5
6	What is the data required for the general coordination procedure?	Analyze	5
7	Discuss briefly the general coordination procedure?	Analyze	5
8	Discuss recloser-circuit breaker coordination.	Analyze	5
9	Discuss about Fuse-Recloser coordination.	Remember	5
UNIT –V COMPENSATION FOR POWER FACTOR IMPROVEMENT			
1	Discuss the effect of shunt compensation on distribution system	Understand	6
2	Compare and explain the role of shunt and series capacitors in power factor correction.	Remember	6
3	What are the differences between fixed and switched capacitors? What are their effects on distribution systems	Remember	6
4	Discuss the procedure employed to determine the best capacitor location	Remember	6
5	Discuss how a series capacitor boosts the voltage with the help of a phasor diagram? What are the drawbacks of this method?	Remember	6
6	Discuss different types of capacitors used in distribution network to improve p.f	Remember	6
7	Why the improvement of power factor is very important for both consumers and generating stations? List the various causes of low power factor and explain	Remember	6
8	How economic power factor arrived at for a given distribution system with different loads?	Remember	6
9	Voltage control and p.f correction are necessary in power systems. Explain. What are the disadvantages of low voltage and low p.f of the system?	Remember	6
10	Discuss how an overexcited synchronous machine improves power factor.	Remember	6
UNIT –V VOLTAGE CONTROL			

S. No	Question	Blooms Taxonomy Level	Course Outcome
1	How an AVR can control voltage? With the aid of suitable diagram, explain its function.	Understand	7
2	Briefly explain the line drop compensation on voltage control.	Create	6
3	How do the shunt capacitors and reactors control the voltage? List the disadvantages of using a shunt capacitor for voltage control	Remember	6
4	Compare and explain the role of shunt and series capacitor in voltage control.	Understand	7
5	Describe different types of equipment for voltage control with neat diagrams.	Understand	6
6	Discuss need for maintaining good voltage profile in power systems and need to improve power factor.	Analyze	6
7	Discuss the various methods adopted for voltage control	Analyze	6
8	Discuss about the control and rating of voltage regulators	Analyze	6
9	Discuss about the induction type regulator	Analyze	7

GROUP – III ANALYTICAL QUESTIONS

<table>
<tr><th>S. No</th><th>Question</th><th>Blooms Taxonomy Level</th><th>Course Outcome</th></tr>
<tr><td colspan="4">UNIT -1</td></tr>
<tr><td>1</td><td>At the end of a power distribution system, a certain feeder supplies three distribution transformer, each one supplying a group of customers whose connected loads are as under, If the diversity factor among the transformers is 1.3, find the maximum load on the feeder.
<table>
<tr><th>Transformer</th><th>Load</th><th>Demand Factor</th><th>Diversity Factor</th></tr>
<tr><td>No.1</td><td>10kw</td><td>0.65</td><td>1.5</td></tr>
<tr><td>No 2</td><td>12kw</td><td>0.</td><td>3.5</td></tr>
<tr><td>No.3</td><td>15kw</td><td>0.7</td><td>1.5</td></tr>
</table></td><td>Apply</td><td>1</td></tr>
<tr><td>2</td><td>Distribution substation experiences an annual peak load of 3, 500 KW. The total annual energy supplied to the primary feeder circuits is 10^7 kwh. Find i)The annual average Factor ii) The annual Load Factor</td><td>Apply</td><td>1</td></tr>
<tr><td>3</td><td>Annual peak load input to a primary feeder is 2000kw at which the power loss is total copper loss at the time of peak load is $\sum I^2R$=100kw. The total annual energy supplied to the sending end of the feeder is $5.61*10^6$ kwh. Determine. I) Annual loss factor
ii) Total annual copper loss energy and its value Rs.1.50 per kwh</td><td>Apply</td><td>1</td></tr>
<tr><td>4</td><td>Assume that load of 100kw is connected at the riverside substation, the 15 min. weekly maximum demand is given as 75 kw, and the weekly energy consumption is 4200 kwh. Assuming a week is 7 days; find the demand factor and the 15 min. weekly load factor of the substation.</td><td>Apply</td><td>1</td></tr>
<tr><td>5</td><td>Discuss how the maximum demand and average demand can be obtained from daily demand variation curve.</td><td>Apply</td><td>1</td></tr>
<tr><td>6</td><td>A 50 MW hydro generator delivers 320 million kwh during the year. Calculate the plant load factor.</td><td>Apply</td><td>1</td></tr>
<tr><td>7</td><td>Annual peak load input to a primary feeder is 2000kw at which the power loss is total copper loss at the time of peak load is $\sum I^2R$=100kw. The total annual energy supplied to the sending end of the feeder is $5.61*10^6$ kwh.</td><td>Apply</td><td>1</td></tr>
</table>

	Determine. I)		
S. No	**Question**	**Blooms Taxonomy Level**	**Course Outcome**
	Annual loss factor ii) Total annual copper loss energy and its value Rs0.03 per kwh		
8	Assume that the annual peak load of a primary feeder is 2000 kw , at which the power is 80 kw per three phase. Assuming an annual loss factor of 0.15, determine i) The average annual power loss. ii) The total annual energy loss due to the copper loss of the feeder.	Apply	1
9	A small city experiences an annual peak load of 3500 kw. The total annual energy supplied to the primary feeder's circuits is $10^* 10^6$ kwh. The peak demand occurs in July/August and Is due to air Conditioning load. i) Find the annual average power demand ii) Find the annual load factor iii) Find the annual loss factor	Apply	1
10	The annual average load is 1241 kw and monthly peak load is 3600 kw. Find the load factor by using approximate formula.	Apply	1
	UNIT-II		
1	A 3 phase radial express feeder has a line to line voltage of 22.0 kv at the receiving end, a total impedance of 5.25+J10.95 Ω/phase, and a load of 5MW with a logging power factor of 0.90. determine the following i) Line to neutral and line to line voltage at the sending end ii) Load angle	Apply	2
2	Show that with an increase in working voltage to n times, the cross section of a feeder and a distributor would be reduced to 1/n and $1/n^2$ of their respective values.	Apply	2
3	Define secondary banking and explain different connections of secondary banking.	Apply	2
4	How do you apply an concept of ABCD constants to radial feeders?	Apply	2
5	A 2-wire DC distributor AB, 600m long as loaded as under: Distance from (metes): 150 300 350 450 Loads (Amps) : 100 200 250 300. The feeding point A is maintained at 440V and that of B at 430V. If each conductor has a resistance of 0.01 per 100 m, calculate i. The currents supplied from A to B. ii. The power dispatched in the distributor.		2
6	Find the new load and area that can be served with the same percent voltage drop if the new feeder voltage level is increased to twice the previous voltage level of the feeder.	Apply	2
7	Assume that feeder has a length of 2 miles and that the new feeder uniform loading has increased to 3 times the old feeder loading. Determine the new maximum length of the feeder with the same percent voltage drop if the new feeder voltage level is increased to 3.45 kv from the previous voltage level of 12.47 kv.	Apply	2
8	Assume that a star connected three phase load is made up of three impedances of $50\angle 25^0$ ohms each and that the load is supplied by a three phase four wire primary express feeder. the balanced line to neutral voltages at the receiving end are $v_{an}=7630\angle 0^0$V, $V_{bn}=7630\angle 240^0$v, $V_{cn}=7630\angle 120^0$ v. Determine the following, a) The phase currents in each line b) The line to line phase voltages c) The total active and reactive power supplied to the load.	Apply	2
9	Derive the equations for voltage drop and power loss in a radial feeder with	Apply	2

S. No	Question	Blooms Taxonomy Level	Course Outcome
	uniformly distributed load.		
10	Discuss the various substation bus schemes? Explain them with neat sketches.	Apply	2
	UNIT-III		
1	Derive the total area served by four feeders is 0.667 times the total area served by six feeders if they are thermally loaded	Apply	2
2	Discuss about the methodology to fix the rating of a distribution substation.	Analyze	4
3	A three phase 4.16 kv wye grounded feeder main has 4 copper conductors with an equivalent spacing of 1.0 m between phase conductors and a lagging load power factor of 0.9. determine the 'k' constant of the main feeder, let, r=1.503Ω/m, and x=0.7456 Ω/m Also, calculate the percent voltage drop in the main, if a lumped sum load of 500 kva with a lagging p.f of 0.9 is connected at the load end of 1 m long feeder main.	Apply	2
6	Calculate % voltage drop of hexagonally shaped area of distribution substation.	Apply	4
7	Calculate the % voltage drop in the main, if load 500 kva is uniformly distributed along the feeder main is shown in figure .Consider K=0.01% VD(kva-miles).	Apply	3
8	Define 'k' constant and give its importance.	Apply	4
	UNIT-IV		
1	 $Z_1 = (0.03 + j0.01)\Omega/phase$ $Z_2 = (0.1 + j0.03)\Omega/phase$ $Z_3 = (0.05 + j0.05)\Omega/phase$	Apply	3
2	Consider a single-phase, 2-wire secondary distributor of length 'l' meters from the distribution transformer .At a length of 'l_1" meters from source, a load of I_1 amps with a p.f of $\cos\theta_1$ (lag) is tapped. At a length of 'l_2' amps with a power factor $\cos\theta_2$ (lead) is tapped. At a length of l_3 meters from second load, a third load of I_3 amps with a UPF is tapped. If resistance and reactance of each wire are r and x ohms/meter respectively, derive approximate voltage drop equation in the distributor.	Apply	3
3	A single phase feeder circuit has total impedance (2+j6) ohms, receiving end voltage is 11 kv and current is $40\angle -45^o$ A. Determine i) P.f of load ii) Load p.f for which the drop is maximum iii) Load p.f for which impedance angle is maximum and also , derive the formula used	Apply	5
4	A single phase feeder circuit has total impedance (2+j6) ohms, receiving end voltage is 11 kv and current is $50\angle -30^o$ A. Determine i) P.f of load ii) Load p.f for which the drop is maximum Load p.f for which impedance angle is maximum and also , derive the formula	Apply	4

S. No	Question	Blooms Taxonomy Level	Course Outcome
	used		
5	A single phase feeder circuit has total impedance of (1+j3)Ω V_R= 2400∟0° v and I_R= 50∟-30° A, respectively. Find i) P.f of load ii) Load p.f for which the drop is maximum	Evaluate	4
6	Electrical energy is supplied to a consumer from a substation at a distance of 250 m. if the power required by the consumer is three phase 100kw at 415 v unity power factor and resistance of single conductor of the connecting cable is 0.1/1000Ω/m. calculate, i) The voltage at the bus bar of the substation ii) The power loss in the cable.	Apply	3
7	Consider the single phase radial distributor shown in the following figure The magnitude of the load currents, p.fs and distances are indicated in the figure. The resistance and reactance of each wire are 0.1 ohm and 0.2 ohms per km respectively. It is required to maintain voltage at point B as 230∟0° volts. Find. i) Voltage drop in the three sections ii) Ii) the voltage drop in the feeder iii) Supply voltage, current and power factor iv) Kva output of supply The p.f angle of individual loads are with respect to voltage at point B	Apply	3
8	An unbalanced three phase Delta connected load is connected to balanced three phase ,Three wire source the load impedance Z_a ,Z_b and Z_c are given by 60∟30° ohm/phase, 85∟-45°ohm/phase,50∟35° ohm/phase respectively, the phase 'a' line voltage has been an effective value of 12.6 kv .use the A phase to Phase voltage as the reference and determine the following line currents and real and reactive powers	Apply	3
9	Consider the three phase ,three wire 240v secondary system with balanced loads at a A,B and C as shown in figure .Determine, i) Calculate the total voltage drop ii) Calculate the kva output and load p.f of the distribution transformer iii) Calculate total power per phase for each load	Apply	3
10	An unbalanced three phase star connected load is connected to balanced three phase ,four wire source the load impedance Z_a ,Z_b and Z_c are given by 70∟30° ohm/phase, 85∟40°ohm/phase,50∟35° ohm/phase respectively, the phase 'a' line voltage has been an effective value of 13.8 kv .use the line to neutral voltage of phase 'a' as the reference and determine the following i) line to neutral currents ii) total power delivered to the load	Apply	3
	UNIT –V		
1	Discuss the operation of line sectionalizer with a neat sketch.	Apply	3
2	The per unit values of positive, negative and zero sequence reactance's of a network at fault are 0.08, 0.07 and 0.05 respectively. Determine the fault current if the fault is double line to ground.	Apply	8
3	Considering a typical example, describe the procedure for fault current calculations in a distribution system, mentioning the assumptions to be made for the analysis.	Apply	8

S. No	Question	Blooms Taxonomy Level	Course Outcome
4	The per unit positive, negative and zero sequence impedances of a distributed network are 0.06, 0.06 and 0.04 respectively. Determine the fault current for L-L and L-G faults.	Apply	8
5	A single phase 3 wire distribution line 600V-0-160V, feeds a load of 10 kVA on each line to ground. The transformer is 7620V/240V, 25KVA with 5% impedance. The line impedance is j0.15 ohm per wire. Calculate the fault current and fault MVA for a. L-L fault 1 km from the transformer b. L-G fault 1 km from the transformer	Apply	8
6	The per unit positive, negative and zero sequence impedances of a distributed network are 0.08, 0.08 and 0.05 respectively. Determine the fault current for L-L and L-G faults.	Apply	8
7	What is the data required for the selecting a circuit breaker.	Analyze	5
8	Discuss about the automatic line sectionalizers? Discuss the purpose and advantages of using them.	Analyze	5
9	Discuss about data required for selecting a circuit breaker?	Analyze	5
10	What are the different types of over current protective devices and explain their merits and demerits.	remember	5
	UNIT –IV		
1	Discuss in detail how the coordination of various protective devices helps in improving system performance.	Apply	5
2	Discuss about recloser to recloser coordination.	Apply	5
3	Discuss the coordination procedure between two fuses	Apply	5
	UNIT –V		
1	A 3-phase substation transformer has a name plate rating of 7500 kVA and a thermal capability of 125% of the name plate rating. If the connected load is 8816 kVA with a 0.9power factor (lagging), determine the following: i. the kVAR rating of the shunt capacitor bank required to decrease the kVA load of the transformer to its capability level ii. The power factor of the corrected level.	Apply	6
2	A 3phase transformer rated 7000kVA and has a over load capability of 125 % of the rating. Ifthe connected load is 1150 kVA with a 0.8 p.f(lag), determine the following: i. The kVAR rating of shunt capacitor bank required to decrease the kVA load of the transformer to its capability level, ii. The kVAR raring of the shunt capacitor bank required to correct the load p.f. to unity. iii. The p.f. of the corrected level.	Apply	6
3	A 440 V, 50 cycles three phase line delivers 250 KW at 0.7 p.f (lag). It is desire to bring the line p.f to unity by installing shunt capacitors. Calculate the capacitance if they are: i. star connected ii. delta connected	Apply	6
4	A 3 phase substation transformer has a name plate rating of 7250 KVA and a thermal capability of 120% of the name plate rating. If the connected load is is 8816 KVA with a 0.85 of lag p.f determine the following a. The KVAR rating of the shunt capacitor tank required to decrease the KVA load of the transformer to its capability level b. The power factor of the corrected level.	Apply	6
5	A single-phase motor takes a current of 10 amps at a p.f. of 0.707 lagging from	Apply	6

S. No	Question	Blooms Taxonomy Level	Course Outcome
	a 230V, 50 Hz supply. What value must a shunting capacitor have to raise the p.f. to unity		
6	Discuss the computerized method to determine the economic power factor.	Analyze	6
7	A 750 KVA load has a power factor of0.75 lag. It is derived to improve the power factor to 0.9 lag . Find the KVAR rating of the capacitor for the power factor improvement.	Apply	6
8	A synchronous motor having a power consumption of 40 KW is connected with a load of 150KW, a lag power factor of 0.8. if the combined load has a power factor of 0.9, what is the leading reactive KVA supplied by the motor and at what p.f is it working.	Apply	6
9	A 3 phase substation transformer has a name plate rating of 7000 KVA and a thermal capability of 125% of the name plate rating. If the connected load is is 1150 KVA with a 0.8 of lag p.f determine the following a. The KVAR rating of the shunt capacitor tank required to decrease the KVA load of the transformer to its capability level b. The power factor of the corrected level.	Apply	6
10	A 400 V 50 cycles three phase line delivers 207KW at 0.8 p.f lag. It is desired to bring the line p.f to unity by installing shunt capacitors, calculate the capacitance if they are i. star connected ii.delta connected	Evaluate	6
	UNIT –V		
1	Discuss about any two methods of voltage control.	Analyze	6
2	Discuss the way to improve the distribution system overall voltage regulation	Analyze	6
3	How to do the shunt capacitor and reactors control the voltage.	Analyze	6
4	Discuss the methods to calculate the voltage dips due to fluctuations in distribution systems.	remembering	6
5	With the help of a phasor diagram, show how a series capacitor boosts the voltage. what are the drawbacks of this method?	Analyze	6
6	Discuss the effect of AVR on voltage control.	Analyze	7

UTILIZATION OF ELECTRICAL ENERGY

PROGRAMME: B.Tech ECE AC:YEAR: **2018-2019**	DEGREE: **B.TECH IV YEAR**
COURSE: **UTILIZATION OF ELECTRICAL ENERGY**	SEMESTER: **I** CREDITS: 4 COURSE COORDINATOR: Mr.S.RADHA KRSIHNA REDDY
COURSE CODE: **A70232** REGULATION:**R15**	COURSE TYPE: **Core**
COURSE AREA/DOMAIN: EEE	CONTACT HOURS: 4 hours/Week.
CORRESPONDING LAB COURSE CODE : NILL	LAB COURSE NAME: NILL

BRIEF NOTE ON THE IMPORTANTANCE OF THE COURSE AND HOW IT FITS IN TO THE CURRICULAM

After going through this course the student gets a thorough knowledge on, electric drives characteristics and their applicability in industry, nature of different types of loads and their characteristics, concept of electric heating welding, illumination, electric traction and utilization of electric energy by the above mentioned means, with which he/she can able to apply the above Conceptual things to real-world electrical and electronics problems and applications.

PREREQUISITES, IF ANY

- Electrical Machines

7 . Static Drives

MARKS DISTRIBUTION:

Session Marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each Mid-term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is	75	100

the final internal marks. The external question paper is set by JNTUH consisting of part –A and part- B. Where part consists of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.awarded considering the average of two assignments in each course		

EVALUATION SCHEME:

S.No	Component	Total Duration	Marks
1.	I Mid Examination	90 Minutes	20
2.	I Assignment	----	05
3.	II Mid Examination	90 Minutes	20
4.	II Assignment	------	05
5.	External Examination	3 hours	75

Course Objectives:

2 This subject introduces the students with the concepts of electric drives and their characteristics.

3 Various electric heating concepts and their related applications are also discussed. Various electric welding concepts and their related applications are also discussed.

4 The fundamentals related to illumination are introduced to the students. Various design concepts related to the design of illuminations are discussed

5 Review of existing electric traction systems are the types of traction motors and their characteristics are introduced to the students. Different speed time curves of train movement are discussed at length.

6 Various calculations, related to the tractive effort and specific energy consumption are discussed.

Course Outcomes:

On completion of this subject, the student should be able to

6. The students will have the ability to understand the concepts of electric drives and their characteristics.

7. The students will have the ability to understand the concepts of various methods of electric heating and their related applications. The students will have the ability to understand the concepts related to various methods related to electric welding and their related applications in the industry.

8. The students will have the ability to understand the fundamentals related to illumination. The students will have the ability to understand various design concepts related to illumination.

- The students will have the ability to review the existing electric traction systems and the types of traction motors and their characteristics. The student will have the ability to understand the concepts related to Different speed time curves of train movement.

- The student will have the ability to understand various calculations related to the tractive effort and specific energy consumption of train movement.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

	L	T/P/D	C
IV Year B.Tech. EEE-I Sem			
	4	**-/-/-**	**4**

UTILIZATION OF ELECTRICAL ENERGY

Objective

This subject deals with the fundamentals of illumination and its classification and the electric heating and welding. It gives the detailed study of all varieties of Electric drives and their application to electrical traction systems.

UNIT – I

Electric Drives: Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

UNIT—II

Electric Heating & Welding: Electric Heating: Advantages and methods of electric heating, resistance heating induction heating and dielectric heating. Electric welding: resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT — III

Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps — comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

UNIT -IV

Electric Traction-I : System of electric traction and track electrification Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services — trapezoidal and quadrilateral speed time curves.

UNIT – V

Electric Traction-II: Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight an coefficient of adhesion.

TEXT BOOK

- Utilization of Electrical Power, Er. R. K. Rajput, Laxmi Publications.
- M & Science of Utilization of electrical Energy, Paab, Dhanpat Rai & Sons.

REFERENCE BOOKS

- Utilization of Electric Energy, E. Openshaw Taylor, University press.
- Generation, Distribution and Utilization of electrical Energy, C.L. Wadhwa, New Age International (P) Limited,
- Utilization of Electrical Power including Electric drives and Electric traction, N.V.Suryanarayana, New Age International (P) Limited.

Utilization of Electric Energy, VVL Rao, University Press

COURSE PLAN:

S.No	Unit No	Topic	No of sessions planned	Mode of teaching BB/PPT/OHP/MM	Reference *	Remarks
1	I	Electric Drives, Types of Electric drives	1	BB	A1,B1	
2		choice of motor, characteristics	1	BB	A1,B1	
3		Speed control	2	BB	A1,B1	
4		Temperature rise	1	BB	A1,B1	
5		Particular application of drives	2	BB	A1,B1	
6		Types of industrial loads	1	BB	A1,B1	
7		continuous, intermittent & variable load	2	BB	A1,B1	
8		load equalization & problems	1	BB	A1,B1	
9	II	Advantages and methods of electric heating	2	**PPT**	A1,B1	
10		Resistance heating	1	BB	A1,B1	
11		Indution heating	1	BB	A1,B1	
12		Dielectric heating	1	BB	A1,B1	
13		Problems	1	**PPT**	A1,B1	
14		Electric welding	1	**PPT**	A1,B1	
15		Resistance welding	1	**PPT**	A1,B1	
16		Arc welding	1	**PPT**	A1,B1	
		Electric welding equipment				

17		Comparsion of A.C. & D.C. welding	1	BB	A1,C1	
18		Problems	1	BB	A1,C1	
19	III	Introduction to Illumination fundamentals	1	BB	A1,C1	
20		Terms used in illumination	2	**PPT**	A1,C1	
21		Laws of Illumination	2	**PPT**	A1,C1	
22		Polar curves	2	**PPT**	A1,C1	
23		Integrating sphere	1	BB	A1,C1	
24		Sources of light	1	BB	A1,C1	
25		photometry	2	BB	A1,C1	
26		Problems	2	BB	A1,C1	
27		Introduction to discharge lamps	2	BB	A1,C1	
28		MV lamps	1	BB	A1,C1	
29		SV lamps	1	BB	A1	
30		Comparsion of tungsten filament lamps and fluorescent tubes	1	BB	A1	
31		Basic principles of light control	2	BB	A1	
32		Types and design of lighting	2	BB	A1	
33		Flood lighting	2	BB	A1	
34		Problems	1	BB	A1	
	IV	Introduction to electric traction				

35		Track electrification	1	BB	A1	
36		Existing electric traction systems	1	BB	A1	
37		Special features of traction motor	2	BB	A1	
38		plugging rheostatic braking	2	BB	A1	
39		Regenerative braking	1	BB	A1	
40		Problems	1	BB	A1	
		Mechanics of train movement	1			
41		Speed time curves	1	BB	A1	
42		Trapezoidal speed time curve	2	BB	A1	
43		Quadrilateral speed time curve	1	BB	A1	
		problems				
		Tractive effort				
44		Power, specific energy consumption	1	BB	A1	
45		Effect of varying acceleration and braking retardation	1	BB	A1	
46		Adhesive weight	1	BB	A1	
47	V	Braking retardation adhesive weight	1	BB	A1	
48		Coefficient of adhesion	1	BB	A1	
49		Problems	1	BB	A1	
49		Revision	1	BB	A1	
50		Revision	1			
51						

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- Utilization of Electrical Power including Electric drives and Electric traction, N.V.Suryanarayana, New Age International (P) Limited.

Utilization of Electric Energy, VVL Rao, University Press

MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objective	Course Outcomes				
	a	b	c	d	e
I	S				
II	S	S			
III			H		
IV				H	S
V					S

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
a	S													
b	S	S									S		S	S
c	S	S												
d		S					S				S		H	S
e	S		S		S		S				S		S	

QUESTION BANK

OBJECTIVES:

UNIT-1

1. The starting torque in case of centrifugal pumps is generally

(A) Less than running torque

(B) Same as running torque

(C) Slightly more than running torque

(D) Double the running torque

Answer **A**

2. The size of an excavator is usually expressed in terms of

(A) ‘Crowd’ motion

(B) Angle of swing

(C) Cubic meters

(D) Travel in meters

Answer **C**

3. In jaw crushers a motor has to often start against ________ load.

(A) Heavy

(B) Medium

(C) Normal

(D) Low

Answer A

4. Has relatively wider range of speed control.

(A) Synchronous motor

(B) Ship ring induction motor

(C) Squirrel cage induction motor

(D) D.C. shunt motor

Answer D

5. Battery operated scooter for braking uses

(A) Plugging

(B) Mechanical braking

(C) Regenerative braking

(D) Rheostatic braking

Answer B

6. A pony motor is used for the starting which of the following motors?

(A) Squirrel cage induction motor

(B) Schrage motor

(C) Synchronous motor

(D) None of the above

Answer **C**

7. By the use of which of the following D.C. can be obtained from AC.?

(A) Silicon diodes

(B) Mercury arc rectifier

(C) Motor generator set

(D) Any of the above

Answer **D**

8. The characteristics of drive for crane hoisting and lowering are which of the following?

(A) Precise control

(B) Smooth movement

(C) Fast speed control

(D) All of the above

Answer **D**

9. For which of the following applications motor has to start with high acceleration?

(A) Oil expeller

(B) Floor mill

(C) Lifts and hoists

(D) Centrifugal pump

Answer **C**

10. The cost of an induction motor will increase as

(A) Horsepower rating increases but r.p.m. decreases

(B) Horsepower rating decreases but r.p.m. increases

(C) Horsepower rating and operating speed increases

(D) Horsepower rating and operating speed decreases

Answer **A**

11. Which of the following types of motor enclosure is safest?

(A) Totally enclosed

(B) Totally enclosed fan cooled

(C) Open type

(D) Semi closed

Answer **B**

12. Which of the following motors is preferred for boom hoist of a traveling crane?

(A) Single phase motor

(B) Synchronous motor

(C) A.C. slip ring motor

(D) Ward-Leonard controlled D.C. shunt motor

Answer **C**

13. The traveling speed of cranes varies from

(A) 20 to 30 m/s

(B) 10 to 15 m/s

(C) 5 to 10 m/s

(D) 1 to 2.5 m/s

Answer **D**

14. _______ has least range of speed control.

(A) Slip ring induction motor

(B) Synchronous motor

(C) D.C. shunt motor

(D) Schrage motor

Answer **B**

15. In squirrel cage induction motors which of the following methods of starting cannot be used?

(A) Resistance in rotor circuit

(B) Resistance in stator circuit

(C) Autotransformer starting

(D) Star-delta starting

Answer **A**

16. Reluctance motor is a

(A) Variable torque motor

(B) Low torque variable speed motor

(C) Self starting type synchronous motor

(D) Low noise, slow speed motor

Answer **C**

17. In a paper mill where constant speed is required

(A) Synchronous motors are preferred

(B) A.C. motors are preferred

(C) Individual drive is preferred

(D) Group drive is preferred

Answer **C**

18. Which feature, while selecting a motor for centrifugal pump, will be of least significance?

(A) Starting characteristics

(B) Operating speed

(C) Horse power

(D) Speed control

Answer **D**

19. Which of the following motors are preferred for overhead traveling cranes?

(A) Slow speed motors

(B) Continuous duty motors

(C) Short time rated motors

(D) None of the above

Answer **C**

20. For a particular application the type of electric and control gear are determined by which of the following considerations?

(A) Starting torque

(B) Conditions of environment

☐ Limitation on starting current

☐ All of the above

Answer D

21. The load cycle for a motor driving a power press will be

(A) Variable load

(B) Continuous

(C) Continuous but periodical

(D) Intermittent and variable load

Answer D

22. Is preferred for synthetic fibre mills.

(A) Synchronous motor

(B) Reluctance motor

(C) Series motor

(D) Shunt motor

Answer B

23. __________ motor is a constant speed motor.

(A) Synchronous motor

(B) Schrage motor

(C) Induction motor

(D) Universal motor

Answer **A**

24. Which of the following is essentially needed while selecting a motor?

(A) Pulley

(B) Starter

(C) Foundation pedal

(D) Bearings

Answer **B**

25. Heat control switches are used in

(A) Transformers

(B) Cooling ranges

(C) Three phase induction motors

(D) Single phase

Answer **B**

26. In which of the following applications the load on motor changes in cyclic order?

(A) Electric shovels

(B) Cranes

(C) Rolling mills

(D) All of the above

Answer D

27. _______ has the least value of starting torque to full load torque ratio.

(A) D.C. shunt motor

(B) D.C. series motor

(C) Squirrel cage induction motor

(D) Slip ring induction motor

Answer C

28. In which of the following applications variable speed operation is preferred?

(A) Exhaust fan

(B) Ceiling fan

(C) Refrigerator

(D) Water pump

Answer B

29. The capacity of a crane is expressed in terms of

(A) Type of drive

(B) Span

(C) Tonnes

(D) Any of the above

Answer **C**

30. Which of the following motors has series characteristics?

(A) Shaded pole motor

(B) Repulsion motor

(C) Capacitor start motor

(D) None of the above

Answer **B**

UNIT-2

1. Heat transfer by condition will not occur when

(A) Bodies are kept in vacuum

(B) Bodies are immersed in water

(C) Bodies are exposed to thermal radiations

(D) Temperatures of the two bodies are identical

Answer **D**

2. Which of the following insulating materials was suitable for low temperature applications?

(A) Asbestos paper

(B) Diatomaceous earth

(C) 80 percent magnesia

(D) Cork

Answer **B**

3. By which of the following methods the temperature inside arcane can be varied?

(A) By disconnecting some of the heating elements

(B) By varying the operating voltage

(C) By varying the current through heating elements

(D) By any of the above method

Answer **D**

4. In an electric room heat convector the method of heating used is

(A) Arc heating

(B) Resistance heating

(C) Induction heating

(D) Dielectric heating

Answer **B**

5. For intermittent work which of the following furnaces is suitable?

(A) Indirect arc furnace

(B) Core less furnace

(C) Either of the above

(D) None of the above

Answer **A**

6. In arc furnace the function of choke is

(A) To stabilize the arc

(B) To improve power factor

(C) To reduce severity of the surge

(D) None of the above

Answer **A**

7. In heating the ferromagnetic material by induction heating, heat is produced due to

(A) Induced current flow through the charge

(B) Hysteresis loss taking place below Curie temperature

(C) Due to hysteresis loss as well as eddy current loss taking place in the charge

(D) None of the above factors

Answer **C**

8. Which of the following is an advantage of eddy current heating?

(A) The amount of heat generated can be controlled accurately

(B) Heat at very high rate can be generated

(C) The area of the surface over which heat is produced can be accurately controlled

(D) All of the above

Answer **D**

9. ________ has the highest value of thermal conductivity.

(A) Copper

(B) Aluminium

(C) Brass

(D) Steel

Answer **A**

10. When a body reflects entire radiation incident on it, then it is known as

(A) White body

(B) Grey body

(C) Black body

(D) Transparent body

Answer **A**

11. Heat is transferred simultaneously by condition, convection and radiation

(A) Inside boiler furnaces

(B) During melting of ice

(C) Through the surface of the insulted pipe carrying steam

(D) From refrigerator coils to freezer of a refrigerator

Answer A

12. The temperature inside a furnace is usually measured by which of the following?

(A) Optical pyrometer

(B) Mercury thermometer

(C) Alcohol thermometer

(D) Any of the above

Answer **A**

13. In induction heating _________ is abnormally high.

(A) Phase angle

(B) Frequency

(C) Current

(D) Voltage

Answer **B**

14. For heating element high resistivity material is chosen to

(A) Reduce the length of heating element

(B) Increase the life of the heating element

(C) Reduce the effect of oxidation

(D) Produce large amount of heat

Answer A

15. Which of the following methods is used to control temperature in resistance furnaces?

(A) Variation of resistance

(B) Variation of voltage

(C) Periodical switching on and off of the supply

(D) All of the above methods

Answer D

16. Resistance variation method of temperature control is done by connecting resistance elements in

(A) Series

(B) Parallel

(C) Series-parallel connections

(D) All of the above ways

Answer D

17. For radiant heating around 2250°C, the heating elements are made of

(A) Copper alloy

(B) Carbon

(C) Tungsten alloy

(D) Stainless steel alloy

Answer C

18. Which of the following is an advantage of heating by electricity?

(A) Quicker operation

(B) Higher efficiency

(C) Absence of flue gases

(D) All of the above

Answer D

19. Induction heating process is based on which of the following principles?

(A) Thermal ion release principle

(B) Nucleate heating principle

(C) Resistance heating principle

(D) Electromagnetic induction principle

Answer D

20. In a resistance furnace the atmosphere is

(A) Oxidizing

(B) Deoxidizing

(C) Reducing

(D) Neutral

Answer **A**

21. Which of the following will happen if the thickness of refractory wall of furnace is increased?

(A) Heat loss through furnace wall will increase

(B) Temperature inside the furnace will fall

(C) Temperature on the outer surface of furnace walls will drop

(D) Energy consumption will increase

Answer **C**

22. Which of the following has the highest value of thermal conductivity?

(A) Water

(B) Steam

(C) Solid ice

(D) Melting ice

Answer **C**

23. Which of the following methods of heating is not dependent on the frequency of supply?

(A) Induction heating

(B) Dielectric heating

(C) Electric resistance heating

(D) All of the above

Answer **C**

24. Radiations from a black body are proportional to

(A) T

(B) T^2

(C) T^3

(D) T^4

Answer **D**

25. A non-dimensional number generally associated with natural convection heat transfer is

(A) Prandtl number

(B) Grashoff number

(C) Peclet number

(D) Nusselt number

Answer **B**

26. Induction furnaces are employed for which of the following?

(A) Heat treatment of castings

(B) Heating of insulators

(C) Melting aluminium

(D) None of the above

Answer **A**

27. Properly of low temperature coefficient of heating element is desired due to which of the following reasons?

(A) To avoid initial rush of current

(B) To avoid change in kW rating with temperature

(C) Both (A) and (B)

(D) Either (A) or (B)

Answer **C**

28. In direct arc furnace, which of the following has high value?

(A) Current

(B) Voltage

(C) Power factor

(D) All of the above

Answer **A**

29. Which of the following devices is necessarily required for automatic temperature control in a furnace?

(A) Thermostat

(B) Thermocouple

(C) Autotransformer

(D) Heating elements of variable resistance material

Answer **B**

30. The electrode of a direct arc furnace is made of

(A) Tungsten

(B) Graphite

(C) Silver

(D) Copper

Answer **B**

UNIT-3

 Radiant efficiency of the luminous source depends on

(A) shape of the source

(B) temperature of the source

(C) wavelength of light rays

(D) all of the above.

Answer B

Light waves travel with a velocity of

- 3×10^{10} cm/s
- 3×10^{12} cm/s
- 3×10^{15} cm/s
- 3×10^{18}

cm/s. Answer A

Carbon arc lamps are commonly used in

- domestic lighting
- street lighting
- cinema projectors
- photography.

Answer C

The unit of solid angle is

- solid angle
- radian
- steradian
- candela.

Answer C

- Candela is the unit of
- Luminous flux
- Luminous intensity
- Wavelength
- None of the above.

Answer B

The unit of luminous flux is

- steradian

- candela
- lumen
- lux.

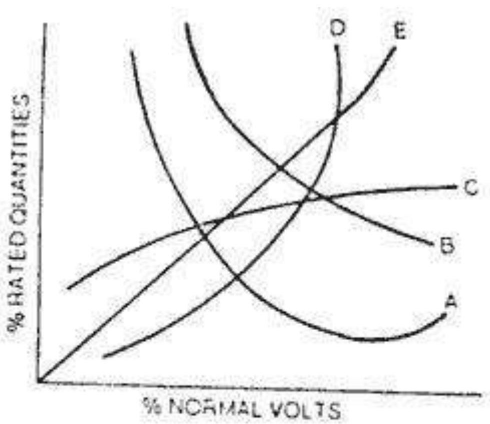
Answer C

The illumination is directly proportional to the cosine of the angle made by the normal to the illuminated surface with the direction of the incident flux. Above statement is associated with

- Planck's law
- Macbeth's law of illumination
- Bunsen's law of illumination
- Lambert's cosine law.

Answer D

- Which curve represents life of the lamp ?



curve A

 curve B

 curve C

 curve D.

Answer B

 Illumination level required for precision work is around

(A) 50 lm/m^2

2. 100 lm/m^2

3. 200 lm/m^2

4. 500 lm/m^2.

Answer D

Which of the following will need the highest level of illumination ?

2. Proof reading
3. Bed rooms
4. Hospital wards
5. Railway platforms.

11. Which of the following will need lowest level of illumination ?

(A) Displays

(B) Fine engraving

(C) Railway platform

(D) Auditoriums.

Which of the following lamp gives nearly monochromatic light ?

2. Sodium vapor lamp
3. GLS lamp
4. Tube light
5. Mercury vapor lamp.

The illumination level in houses is in the range

3. 10-20 lumen/m^2
4. 30 - 50 lumen/m^2
5. 40-75 lumen/m^2

6. 100-140 lumen/m^2.

14. Luminous efficiency of a fluorescent tube is

4 5- 10 lumens/watt

5 15-20 lumens/watt

6 30 - 40 lumens/watt

7 60 - 65 lumens/watt.

1 One lumen per square meter is the same as

6. One lux

7. One candela

2 One foot candle

3 One lumen meter.

Answer A

11. Standard wattage of 3 ft. fluorescent tube is

(A) 10 W

(B) 40 W

(C) 65 W

(D) 100 W.

Answer B

1 For the same wastage which lamp is cheapest ?

(A) Sodium vapor lamp

(B) Mercury vapor lamp

(C) Fluorescent tube

(D) GLS lamps.

Answer D

2 Optical instruments used for the comparison of candle powers of different sources arc known as

(A) Candle meters

(B) Radio meters

(C) Bunsen meter

(D) Photo meter.

Answer D

3 Which photometer is used for comparing the lights of different colors ?

(A) Bunson photometer

(B) Grease spot photometer

(C) Lummer Brodhum photometer

(D) Guilds Flicker Photometer.

Answer D

20. Which photometer depends for its operation on Lambert's cosine law ?

3 Macbeth lllumino meter

4 Trotter Illumination Photometer

5 Lummer Brodhum Photometer

21. Guild's Flicker

Photometer. Answer B

Which photometer depends for its operation on Inverse Square Law ?

3. Guilds Flicker Photometer
4. Lummer Brodhum Photometer
5. Macbeth llluminometer
6. Trotter Illumination Photometer.

The color temperature of day light is around

2. 50 K
3. 160 K
4. 600 K
5. 6000 K.

Light is produced in electric discharge lamps by

2. heating effect of current
3. magnetic effect of current
4. ionization in a gas or vapor
5. carbon electrodes.

24. Lumen/watt is the unit of

iv) Light flux

v) Luminous intensity

vi) Brightness

vii) Luminous

efficiency. Answer D

Candela is-the unit for

ii Light flux

iii Luminous intensity

iv Brightness

v Luminous efficiency.

iv. Which gas is sometimes used in filament lamps ?

(A) Argon

(B) Krypton

ii Nitrogen

iii Carbon dioxide.

Answer A

iv. Which bulb operates on lowest power ?

vi. Night bulb

vii. Neon bulb

viii. GLS bulb

ix. Torch bulb.

Answer D

i The output of a tungsten filament lamp depends on

x. size of lamp

xi. size of shell

xii. temperature of filament

xiii. all of the above.

Answer C

A zero watt lamp consumes

iv. no power

v. about 5 to 7 W power

vi. about 15 to W power

vii. about 25 to 30 W power.

Answer A

Melting temperature of tungsten is

vii. 2000°K

viii.2500°K

(C)2655°K

ix. 3655°K.

Answer D

UNIT-4

vii. Overall efficiency of steam locomotive system is close to

(A) 5 to 10%

(B) 25 to 30%

(C) 55 to 60%

(D) 75 to 80%.

Answer A

In a steam locomotive electric power is provided through

(A) battery system

(B) diesel engine generator

(C) overhead wire

(D) small turbo

generator. Answer D

Maximum horse power of steam locomotive is

(A) 100

(B) 500

(C) 1500

(D)2500.

Answer C

4. The pressure of steam in a locomotive is

(A) 10-15 kg/cm^2

(B) 20 - 30 kg/cm^2

(C) 40 - 50 kg/cm^2

(D) 80 - 90
kg/cm^2.

Answer B

5. The efficiency of diesel locomotives is nearly

(A) 20 - 25 percent

(B) 35 - 40 percent

(C) 50 - 55 percent

(D) 70 - 75
percent.

Answer A

6. The advantage of electric traction over other methods is

(A) no pollution problems

(B) faster acceleration

(C) better braking action

(D) all of the above.

Answer D

7. Suburban railways use

(A) 1500 V DC

(B) 440 V three phase AC

(C) 660 V three phase AC

(D) 3.3 kV three phase AC. Answer A

8. Long distance railways use

(A) 200 V DC

(B) 25 kV Single phase AC

(C) 25 kV Two phase AC

(D) 25 kV Three phase AC. Answer B

9. The range of horsepower for diesel locomotives is

(A) 100 to 500

(B) 500 to 1000

(C) 1500 to 2500

(D) 4000 to 5500. Answer C

10. Steam Engine provided on steam locomotives is

(A) Single acting condensing type

(B) double acting condensing type

(C) double acting non - condensing type

(D) single acting non condensing type. Answer C

11. A submarine while moving under water, is provided driving power through

(A) diesel engines

(B) steam turbine

(C) gas turbine

(D) batteries.

Answer D

12. Overload capacity of diesel engines is usually restricted to

(A) 1 %

(B) 10%

(C) 25%

(D) 50%.

13. Which locomotive has the highest operational availability

(A) Diesel

(B) Electric

(C) Steam

(D) All have same availability.

14. Which motor is used in tramways

(A) AC single phase capacitor start motor

(B) AC three phase motor

(C) DC series motor

(D) DC shunt motor.

15. A drive suitable for mines where explosive gas exist, is

(A) Diesel engine

(B) Steam engine

(C) Battery locomotive

(D) Any of the above.

16. The advantage of electric braking is

(A) is is instantaneous

(B) more heat is generated during braking

(C) it avoids wear of track

(D) motor continue to remain loaded during braking. Answer C

17. Which braking system on the locomotives is costly

(A) Vacuum braking on steam locomotives

(B) Vacuum braking on diesel locomotives

(C) Regenerative breaking on electric locomotives

(D) All breaking systems are equally costly. Answer C

18. The acceleration rate of trains on suburban services is

(A) 0.1 to 0.4 km phps

(B) 0.8 to 1 km phps

(C) 0.4 to 6.5 km phps

(D) 10 to 26 km phps. Answer C

19. The coasting retardation on trains is approximately

(A) 0.16 km phps

(B) 1.6 km phps

(C) 16 km phps

(D) 25 km phps. Answer A

20. The coefficient of adhesion is

(A) same on ac and dc traction systems

(B) high in case of dc traction and low in ac traction

(C) low in case of ac traction and high in dc traction. Answer C

21. Braking retardation on suburban trains is

(A) 0.3 to 0.5 km phps

(B) 0.5 to 1 km phps

(C) 3 to 5 km phps

(D) 30 to 40 km phps. Answer C

22. Power supply frequency for 25 kV single phase system is

(A) 161

(B) 25

(C) 50

(D) 60.

Answer C

23. For supply on 25 kV, 50 Hz single phase, suitable motor for electric traction is

(A) ac single phase split phase motor

(B) ac single phase universal motor

(C) dc shunt motor

(D) dc series motor.

Answer D

24. Method of speed control used on 25 kV, 50 Hz single phase traction is

(A) Tap changing control of transformer

(B) Reduced current method

(C) Series parallel operation of motors

(D) Any of the above.

25. The coefficient of adhesion is highest when

(A) the rails are dry

(B) the rails are oiled

(C) the rails ark wet with dew

(D) the rails are dusty.

26. When the speed of the train is estimated taking into account the time of stop at a station in addition to the actual running time between stops, is known as

(A) Average speed

(B) Schedule speed

(C) Notching speed

(D) Free running speed.

27. A schedule speed of 45 km, per hour is required between two stops 1.5 km apart. The duration of stop is 20 seconds. The acceleration is 2.4 km phps and retardation is 3.2 km phps. For a simplified trapezoidal curve the maximum speed over the mil will be

(A) 40 km per hour

(B) 48 km per hour

(C) 74 km per hour

(D) 90 km per hour.

Answer C

28. Speed of locomotive is controlled by

(A) gear box

(B) flywheel

(C) regulating steam to engine

(D)applying brakes.

Answer C

29. The specific energy consumption for suburban services is usually

(A) 18 to 25 watt-hours per tonne km

(B) 50 to 75 watt-hours per tonne km

(C) 125 to 150 watt-hours per tonne km

(D) 155 to 200 watt-hours per tonne km. Answer B

30. If the specific energy consumption for suburban services is 50 to 75 watts hours per tonne km, which of the following could be a representative figure for energy consumption on main line service

(A) 150 to 200 watt-hours per tonne km

(B) 100 to 125 watt-hours per tonne km

(C) 50 to 75 watt-hours per tonne km

(D) 20 to 30 watt-hours per tonne km. Answer D

UNIT-5

1. For 600 V dc line for tram cars

(A) track is connected to negative of the supply

(B) track is connected to positive of the supply

(C) track is connected to mid voltage of 300 V

(D) none of the above.

2. Over head lines for power supply to tramcars are at a minimum height of

(A) 2 m

(B) 5 m

(C) 10 m

(D) 15 m.

Answer C

3. Which of the following traction system is latest used in the world ?

(A) 3 phase 3.7 kV

(B) 20 kV, 50 Hz. single phase

(C) 600 V, DC

(D) 3 kV, DC.

4. Which of the following frequencies not common in low frequency traction system ?

(A) 161 Hz

(B) 25 Hz

(C) 40 Hz.

Answer C

5. In a long distance electric train, power for lighting in passenger coach is provided

(A)through locomotive

(B)directly through overhead electric line

(C)through individual generator of bogie and batteries

(D)through rails.

Answer C

6. In Kando system

(A) single phase supply is converted into three phase system

(B) single phase ac is converted into dc

(C) three phase ac is converted into dc

(D) dc supply is due to run dc motors.

7. Free running and coasting periods arc generally long in ease if

(A) urban service

(B) sub-urban service

(C) main-line service

(D) all of the above.

Answer C

8. Which of the following factor affects specific energy consumption ?

(A) Distance between stops

(B) Gradient

(C) retardation and acceleration values

(D) All of the

above. Answer D

9.A train runs at an average speed of 50 kmph between stations situated 2.5 km apart. The train accelerates at 2 kmph and retards at 3 kmph. Speed-time curve may be assumed to be trapezoidal. The maximum speed is

(A)27.75 kmph

(B)38.50 kmph

(C)44.25 kmph

(D)57.75 kmph.

Answer D

10. The distance traveled before the brakes are applied is

(A)0.75 km

(B)1.35 km

(C)2.0 km

(D)2.35 km.

Answer D

11. At an average the coal consumption per km in case of steam engine is nearly

(A)28 to 30 kg

(B)80 to 100 kg

(C)150 to 160 kg

(D)200 to 250 kg.

Answer A

12. Unbalanced forces are maximum in case of

(A)electric locomotive

(B)diesel locomotives

(C)Petrol locomotives

(D)steam locomotives.

Answer D

13. Maintenance requirements are least in case of

(A)electric locomotives

(B)diesel locomotives

(C)steam locomotives.

Answer A

14. If the resistance to electric train is given by

$F_r = a + bv + cv^2$

In this equation constant c is likely to cover

(A)air resistance

(B) frictional

resistance

(C)flange

resistance

(D) track resistance.

Answer A

15.A train is required to run between two stations 16 km apart at an average speed of 43 kmph. The run is to be made to a simplified quadrilateral speed-time curve. The maximum speed is to be limited to 64 kmph, acceleration to 2 kmph and coasting and braking retardations to .16 and 3.2 kmph respectively. The duration of acceleration is

(A) 32 sec

(B) 24 sec

(C) 16 sec

(D) 1

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16.A train is required to run between two stations 16 km apart at an average speed of 43 kmph. The run is to be made to a simplified quadrilateral speed-time curve. The maximum speed is to be limited to 64 kmph, acceleration to 2 kmph and coasting and braking retardations to .16 and 3.2 kmph respectively. The duration of costing is

(A) 48.4 sec

(B) 96.8 sec

(C) 12.35 sec

(D) 1

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17. The braking period is

(A) 1.5 sec

(B) 5.15 sec

(C) 12.35 sec

(D) 1

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D

18.When a locomotive for Railways is designated as WAM_1, in this the letter W indicates that

(A) the locomotive is to run on broad guage track

(B) the locomotive is to run on meter guage track

(C) the locomotive is for shunting duty

(D) the locomotive is for good train only

Answer A

19. An ideal traction system should have

(A) high starting tractive effort

(B) equipment capable of withstanding large temporary overloads

(C) easy speed control

(D) all of the above.

Answer D

20.A train runs at an average speed of 45 kmph between stations 2.5 km apart. The train accelerates at 2 kmph and retards at 3 kmph speed-time curve may be assumed to be trapezoidal. The maximum speed attained will be nearly

(A)80 kmph

(B) 60

km

ph

(C)

50

km

ph

(D)1.535 kmph.

Answer C

21. The distance traveled before the brakes are applied is

(A) 2.383 km

(B) 2.103 km

(C) 1.887 km

(D) 35 kmph.

22. The main difference between speed-time curves of mainline service as compared to suburban services lies in

(A) longer free running periods

(B) longer coasting periods

(C) shorter acceleration gand braking periods

(D) all of the above.

23.An electric train is to have a braking retardation of 3.2 kmph. The ratio of maximum speed to average speed is 1.3, the time for stop is 26 seconds and acceleration is 0.8 kmph. The run is 1.5 km.

Actual time of run is

(A) 77 seconds

(B) 101 seconds

(C) 154 seconds

(D) 2
31
secon
ds.

Answ
er C

24. The schedule time is

(A)154 kmph

(B)180 kmph

(C)210 seconds

(D)240
second
s.

Answer
B

25. The schedule speed is

(A)25 kmph

(B)30 kmph

(C)45 kmph

(D)60 kmph.

Answer B

26. Energy consumption in propelling the train is required for

(A)acceleration

(B) work against gravity while moving up the gradient

(C) work against the resistance to motion

(D)all of the above.

27. Quadrilateral speed-time curve is the closer approximation for

(A) main line service

(B) suburban service

(C) urban service

(D) urban and suburban service.

28. Distance between the rails for meter gauge track is

(A) 2

' -

6

3/

8"

(B

)3'

-4

3/

4"

(C) 4' - 6 1/2"

(D) O

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29.An electric train has quadrilateral speed time curve as follows:

(i) Uniform acceleration from rest at 2 kmph for 30

seconds (ii) Coasting for 50 seconds

(iii) Uniform braking to rest for 20 seconds The train is moving a uniform up gradient of 1 in 100, train resistance is 40 N/tonne, rotational inertia effect 10% of dead weight and duration of stop 30 seconds.

30. Braking retardations is

(A) 0.87 kmphps

(B) 1.27 kmphs

(C) 1.87 kmphs

(D) 2 kmphps.

Answer C

QUESTION BANK:

GROUP-I (SHORT ANSWER TYPE QUESTIONS)

S.No	QUESTION	BLOOMS TAXONOMY	COURSE OUTCOME
UNIT-I **ELECTRIC DRIVES**			
1	What are different methods of modes of heat transfer?	Remember	1
2	State different types of drives and give three advantages and disadvantages of any one of the drive?	Remember	1
3	Why electrical drives produce noise? How it is reduces?	Analyze	1
4	What is load equalization? Why it is necessary?	Understand	1
5	Compare the slip ring and squirrel cage induction motors from the applications?	Analyze	1
6	Why and where is an individual drive recommended?	Analyze	1
7	Discuss the various factors that govern the choice of a motor ?	Understand	1
8	Explain the starting characteristics of synchronous motor?	Remember	1
9	Explain the starting characteristics of d.c. motors?	Remember	1
10	Derive the equations of heat time curve and cool time curve?	evaluate	1
UNIT-II			

ELECTRIC HEATING

1	State causes of failure of heating element at least four.	Remember	2
2	State four applications of dielectrically heating.	Remember	2
3	Explain the principal of dielectric heating and its applications?	Remember	2
4	What are the characteristics of heating element?	Remember	2
5	Give relative advantages and disadvantages of direct and indirect electric Arc furnace?	Understand	2
6	What is high-frequency eddy current heating?	Remember	2

7	What is the Stefan's formula for heat dissipation?	Analyze	2
8	a) What is pinch effect? b) What are the types of arc furnaces?	Understand	2
9	What are the various methods of controlling the temperature of resistance	Understand	2
10	The power required for dielectric heating of a slab of resin 150 cm^2 in area and 2-cm thick is 200 W, at a frequency of 30 MHz. The material has a relative permittivity of 5 and power factor 0.05. Find the voltage necessary and the current flowing through the material. If the voltage is limited to 700 V, what will be the frequency to obtain the same heating?	evaluate	2
	UNIT-II **ELECTRIC WELDING**		
1	Why only D.C. supply is used in case of carbon arc welding?	Analyze	3
2	What are the various methods of welding? What are the types of butt welding?	Remember	3
3	What are the applications of the electrical welding?	Remember	3
4	What are the advantages of coated electrodes in welding process?	Remember	3
5	a)What is resistance welding?	Remember	3
6	Enlist the advantages of A.C arc welding process?	Remember	3
7	Name and describe various resistances welding process?	Understand	3
8	Describe: i) carbon Arc welding process ii) shielded metal Arc welding Process?	Understand	3

9	a) What is meant by electrical welding? b) What are the advantages of electrical welding?	Remember	3
10	What is meant by spot welding? What is meant by seam welding?	Remember	3
UNIT-1II ILLUMINATION FUNDAMENTALS			
1	a) Define following terms i)MSCP ii)MHCP	Understand	4
2	State Inverse square law and Lambert's cosine law of illumination?	Analyze	4
3	Explain how you will measure the candle power of a source of light	Analyze	4
4	Prove the relationship between the plane angle and solid angle?	evaluate	4
5	A 200V lamp takes a current of 1.2amp, it produces a total flux of 2,860lumens.calculate a) the MSCP of the lamp b) efficiency of the lamp?	evaluate	4
6	What is photometry?	Remember	4
7	Define: (a) Mean spherical candle power,(b) Mean horizontal candle power(c)	Understand	4
8	Write short notes on Bunsen photometer head.	Remember	4
9	Write the expression that shows the relation between solid angle and plane angle?	Analyze	4
10	What is the need of polar curves?	Understand	4
UNIT-III **VARIOUS ILLUMINATION METHODS**			

1	State at least four differences between Incandescent Lamp and Fluorescent lamp?	Understand	4
2	State four advantages of graphite electrode over carbon electrode in case of arc heating furnace.	Remember	4

3	Write the principle of electric incandescent lamp.	Understand	4
4	Compare the merits and demerits of filament lamp and fluorescent lamps?	Analyze	4
5	List out the properties should be possessed by the filament material.	Remember	4
6	Discuss about street lighting?	Understand	4
7	Compare the various features of industrial lighting and domestic lighting?	Analyze	4
8	Mention any two reasons why tungsten is preferred to carbon as filament	Remember	4
9	a) What is meant by aging effect? b) What is stroboscopic effect?	Understand	4
10	a) What is meant by floodlighting? b) What is the empirical formula for calculating the number of lamps	Understand	4
UNIT-IV **ELECTRIC TRACTION-I**			
1	State advantages and disadvantages of electrical braking system over	Remember	5
2	Explain the electric braking by plugging?	Understand	5
3	Explain briefly the a.c motors used in traction.	Understand	5
4	Compare the various types of braking methods.	Analyze	5
5	Explain why a series motor is preferred for the electric traction.	Understand	5
6	Explain the methods of rheostatic bracking.	Understand	5

7	What are the requirements of good electric braking?	Remember	5
8	Briefly explain the a.c motors used in traction.	Remember	5
9	Explain why a DC series motor is ideally suited for traction purpose.	Analyze	5
10	What are the advantages and disadvantages of track electrification?	Remember	5
	UNIT-IV **ELECTRIC TRACTION-I**		
1	What are the various types of services?	Remember	6
2	What is meant by main line services?	Understand	6
3	Define crest speed	Remember	6
4	Define schedule speed	Remember	6
5	What is meant by urban services?	Understand	6
6	What is meant by suburban services?	Understand	6
7	Draw speed-Time curve of a main line service	Remember	6
8	Draw speed-Time curve of sub-urban service	Remember	6
9	Draw the trapezoidal speed-Time curve	Remember	6
10	What do you understand by speed-Time curve? What is its use in practice?	Analyze	6
	UNIT-V ELECTRIC TRACTION-II		
1	Define adhesive weight Define coefficient of adhesion	Understand	6
2	Define dead weight	Understand	6
3	Define tractive effort	Understand	6

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4	Define specific energy consumption.	Understand	6
5	Define Acceleration and Retardation	Understand	6
6	Define Crest speed or Maximum speed	Understand	6
7	Explain tractive effort for propulsion of train	Remember	6
8	What are factors affecting specific consumption.	Remember	6
9	What are factors affecting schedule speed of a train?	Remember	6
10	Derive expression for the tractive effort for a train on a level track?	evaluate	6

GROUP-II (LONG ANSWER QUESTIONS)

S.No	QUESTION	BLOOMS TAXONOMY LEVEL	COURSE OUTCOME
	UNIT-I **ELECTRIC DRIVES**		
1	Describe the selection of various types of motors for the following services. i)Rolling mills ii)cranes and lifts iii)Textile machinery iv) Printing machine and v) Household applications.	Understand	1
2	a) Compare the characteristics of DC series and shunt motor. b) Explain the different types of drives?	Analyze	1

3	a) Discuss advantages and disadvantages of electric drive over other drives and also explain different types of drives. b) Explain the various methods of speed control of AC motors.	understand	1
4	What is an electric drive? What are its advantages? Compare a group drive and an individual drive.	Remember	1
5	Explain what is mean by ―individual drive‖ and Group drive‖ discuss their relative merits and demerits?	Understand	1
6	Through a.c is superior to d.c for electric drives, sometimes d.c. is preferred. Give the reasons and mention some of the applications	Analyze	1
7	Discuss how different parameters of speed-Time curve will vary with the type of train service.	Remember	1
8	Explain what is mean by Load Equalization and how it is accomplished?	Understand	1
9	a) Discuss the various factors governing the choice of motors b) Explain the various factors that affect the final temperature rise of a motor on load?	Analyze	1
10	a) Discuss the running characteristics of any two electric motors b) Discuss the selection criterion of a motor for a drive application.	Analyze	1
	UNIT-II **ELECTRIC HEATING**		
1	a) Discuss the various modes of heat dissipation b) Briefly explain the different methods of electric heating?	Understand	2

2	a) Discuss the various modes of heat dissipation b) Briefly explain the different methods of electric heating?	Understand	2

3	What is electric heating? What are the advantages over other methods of heating?	Remember	2
4	a) Explain the theory of dielectric heating and state its applications. what are the advantages of dielectric heating? b) Explain the principal of operation of induction heating and state and explain different type's induction heating methods?	Understand	2
5	Describe briefly the methods of direct and indirect resistance heating and list the applications of these two methods?	Understand	2
6	a) What are the various types of induction furnace? b) A high-frequency induction furnace that takes 20 min to melt 1.9 kg of aluminum, the input to the furnace being 3 kW, and the initial temperature is 25°C. Then, determine the efficiency of the furnace.	evaluate	2
7	a) How will you control most efficiently the heat of resistance furnace? b) What advantages does graphite electrode process over carbon electrode?	Analyze	2
8	A 4.5-kW, 200-V, and 1-φ resistance oven is to have nichrome wire heating elements. If the wire temperature is to be 1,000°C and that of the charge 500°C. Estimate the diameter and length of the wire. The resistivy of the nichrome alloy is 42.5 μΩ-m. Assume the radiating efficiency and the emissivity of the	evaluate	2

	element as 1.0 and 0.9, respectively.		
9	Explain in brief how heating is done in the following cases? i)Resistance heating, ii)Induction heating iii) Dielectric heating.	Understand	2
10	A 100-kW Ajax Wyatt furnace works at a secondary voltage of 12 V at power factor 0.6 when fully charged. If the reactance presented by the charge remains constant but the resistance varies invert as the charge depth in the furnace; calculate the charge depth that produces maximum heating effect when the furnace is fully charged.	evaluate	2
UNIT-II **ELECTRIC WELDING**			
1	a) Define the following terms i) squeeze time ii)weld time iii)Hold time b) Define the following resistance welding process i)spot welding ii) seam welding iii) butt welding iv)projection welding	Understand	3
2	Compare between Resistances welding and are welding on following points. i) Types of supply used. ii) External filler material required. iii) External pressure required. iv) Temperature obtained	Analyze	3
3	Explain the difference between carbon and metallic arc weldings. Give their relative merits and demerits.	Understand	3

4	Explain the different methods of electric welding and their relative advantages?	Understand	3
5	a) What is the fundamental difference between the electric arc welding and the resistance welding?	Understand	3

	b) What is meant by electron beam welding? c) What is meant by laser beam welding?		
6	a) Compare flash and upset butt welding? b) Compare resistance and arc welding?	Analyze	3
7	a) Describe the various types of electric Arc welding process? b) Why AC is more suitable for the resistance welding?	Understand	3
8	b) What advantages does graphite electrode process over carbon electrode? c) Write a note on A.C welding set & D.C. welding set?	Remember	3
9	a) Describe the various methods of current flow control in welding transformers b) Describe butt welding and its various applications.	Understand	3
10	What are the types of electrodes used for welding operation? Give the advantages of coated electrodes.	Remember	3
	UNIT-III **ILLUMINATION FUNDAMENTALS**		
1	Define the following :i)solid angle ii)candela iii)Luminous efficiency iv) M.S.C.P V) M.H.C.P	evaluate	4
2	Define the terms: i)Illumination ii) Glare iii)Luminance	evaluate	4

	iv) Luminous efficiency.		
3	What are polar curves as applied to light sources/ show how these curves are used for finding in MHCP and MSCP.	Remember	4
4	a) Explain why it is economical to use few large sources of light mounted high for industrial use than many sources of low output? b) What are drawbacks of direct lighting systems and how these are over come?	Remember	4
5	Define: i)Space to height ratio ii)Specific output iii)Coefficient of utilization iv)coefficient of reflection	Understand	4
6	Two similar lamps having uniform intensity 500 CP in all directions below the horizontal are mounted at a height of 4 m. What must be the maximum spacing between the lamps so that the illumination on the ground midway between the lamps shall be at least one-half the illuminations directly under the lamps?	Understand	4
7	What do you understand by polar curves as applicable to light source Explain?	Remember	4
8	State the laws of illumination. Explain the laws with the help of suitable diagrams, and derive an equation of the same.	Understand	4
9	Define i) Luminous flux ii)Illumination	Remember	4

	iii) Luminance iv) Luminous intensity		
10	Explain how the determination of mean horizontal luminous intensity and polar curve is made.	Understand	4

UNIT-III **VARIOUS ILLUMINATION METHODS**			
1	With a neat diagram, explain the construction and working of Mercury vapour lamp.	Remember	4
2	With the help of a neat diagram, explain the principal of operation of Incandescent lamp?	Understand	4
3	What are the various types of lighting schemes? Explain with a neat sketch?	Remember	4
4	Explain with connection diagram the operation of the low pressure fluorescent lamp and state its advantages?	Understand	4
5	Write short notes on: a) High pressure mercury vapour lamp i) M.A Type ii) M.T.Type b) Mercury fluorescent lamp	Remember	4
6	State and describe various types of lighting schemes	Understand	4
7	Discuss the flood lighting with suitable diagrams.	Remember	4
8	Compare a tungsten filament lamp with fluorescent lamp in detail.	Analyze	4

9	Explain with a neat diagram the principle of operation of a sodium vapour lamp. Mention its applications.	Understand	4
10	Why is tungsten selected as the filament material and on what factors does its life depend?	Understand	4

UNIT-IV

ELECTRIC TRACTION-I

1	Discuss various factors which are taken into account while deciding the changeover from existing system of electrification to a new system of electrification.	Understand	5
2	a) What are the requirements of good electric braking? b) What are the various electric traction systems in India? Compare them.	Remember	5
3	Explain the different methods of the electric braking of the three-phase induction motor.	Understand	5
4	Describe how plugging, rheostat braking, and regenerative braking are employed with DC series motor.	Understand	5
5	a) Explain how rheostat braking is done in DC shunt motors and series motors. b) Briefly explain the AC motors used in traction	Understand	5

6	Why DC series motor is ideally suited for traction services? Review the existing electric traction systems in India.	Analyze	5
7	Derive expression for: a) The tractive effort for propulsion of train on level track. b) The tractive effort for propulsion of train up and down a gradient.	Analyze	5

8	a) What is electric traction? b) Mention a few advantages of electric traction c) What are the disadvantages of electric braking? d) What are the advantages of self-contained locomotives?	Remember	5
9	State the condition under which regenerative bracking with d.c series motor is possible and explain with the help of circuit diagram. Also explain the various methods of providing regeneration.	Remember	5
10	Explain the following electric bracking methods. i) Plugging ii) Rheostatic bracking iii) Regenerative bracking.	Remember	5
UNIT-IV **ELECTRIC TRACTION-I**			
1	With the help of a complete Speed-Time curve, discuss how different parameters. Of this curve change with the type of train service.	Understand	6
2	Derive an expression for the distance traveled by an electric train using trapezoidal speed-time curve.	Analyze	6
3	Draw the speed-time curves for different services and explain them in detail.	Understand	6
4	Assuming a quadrilateral speed-time curve, develop a method of determining the specific energy consumption of a train.	Analyze	6

5	Discuss how different parameters of speed-time curve will vary with the type of train service.	Remember	6
6	With the help of trapezoidal speed-time curve, derive an expression for the maximum speed and hence estimate the values of acceleration and retardation.	Analyze	6
7	Derive the expressions for the speed-Torque characteristics of dc shunt motor under the following conditions: a) Without control b) External resistance in the armature circuit c) External resistance in the field circuit d) Armature shunted with resistance R Draw the typical characteristics for all the conditions.	evaluate	6
8	Derive an expression for specific energy output on level track using a simplified speed–time curve.	evaluate	6
9	Derive the relationship between acceleration, retardation, maximum speed, running time and distance between two stops assuming a trapezoidal Speed- Time curve.	evaluate	6
10	What are the different methods of approximation of speed-Time curves? Derive expression for distance travelled using quadrilateral approximation method of V (t) curve.	Understand	6

UNIT-V ELECTRIC TRACTION-II

1	Derive expression for: (a) The tractive effort for propulsion of a train on level track (b) The tractive effort for propulsion of a train up and down a gradient.	evaluate	6

2	An electric train has quadrilateral speed–time curve as follows: i) Uniform acceleration from rest at 1.5 kmphps for 25 s. ii)Coasting for 45 s. iii)The duration of braking 20 s.	evaluate	6
3	(a) Explain characteristics of d.c series motors and why these are used in traction. (b) Describe the d.c series motor control with details of components used.	Understand	6
4	Explain dead weight, accelerating weight, and train resistant referred to traction	Understand	6
5	A train has schedule speed of 32 kmph over a level track distance between two stations being 2 km. The duration of stop is 25 s. Assuming the braking retardation of 3.2 kmphps and the maximum speed is 20% grater than the average speed. Determine the acceleration required to run the service.	evaluate	6
6	Explain briefly the tractive effort required, while the train is moving up the gradient and down the gradient.	Understand	6
7	How does the value of acceleration and retardation affect the specific energy consumption for a given schedule speed?	Analyze	6
8	Write short notes on the following i) Factors affecting energy consumption in propelling a train ii) Mechanism of train movement iii) Tractive efforts for propulsion of train	Remember	6

9	What is tractive effort of train and what are its functions? Derive an expression for the tractive effort developed by a train unit	Analyze	6
10	Describe the procedure of calculating the specific energy consumption of an electric train	Analyze	6

GROUP-III (ANALYTICAL QUESTIONS)

S.No	QUESTIONS	BLOOMS TAXONOMY LEVEL	PROGRAM OUTCOME
	UNIT-I **ELECTRIC DRIVES**		
1	A 200V shunt motor has an armature resistance of 05 ohm it takes a current of 16A on full load and runs at 600 rpm if a resistance of 05ohm is placed in the armature circuit Find the ratio of the starting torque to the full load torque.	Evaluate	1
2	A 250V DC shunt motor with constant field excitation drives a load, the torque of which varies as the square of the speed. The armature current is 20A , when the motor is running at 500 rpm find the percentage reduction in the speed of the motor when a resistance of 20ohms is connected in series with the armature. Neglect the losses in the motor.	Evaluate	1
3		Evaluate	1

	A 50-kVA, 400-V, 3-φ, and 50-Hz squires cage induction motor has full- load slip of 6%. Its standstill impedance is 0.866 Ω/phase. It is started using a tapped autotransformer. Calculate the tap position and the ratio of starting torque to full load. The maximum allowable supply current at the time of starting is 100 A.		
4	The rotor of four-pole and 50-Hz slip ring induction motor has a resistance of 0.25 Ω per phase and runs at 1,440 rpm at full load. Determine the	Evaluate	1

	external resistance per phase that must be added to lower the speed to 1,300 rpm.		
5	Determine the new value of stator current if a 3-φ, 440-V and 1,200-rpm slip ring induction motor is operating with 3% slip and taking a stator current of 50-A speed of the motor is reduced at constant torque to 600 rpm using stator voltage control.	Evaluate	1
6	A 9.5-kW, 240-V, three-phase, star-connected, 50-Hz, and four-pole squirrel cage induction has its full-load internal torque at a slip of 0.05. The parameters of the motor are $R_1 = 0.4\Omega$/phase, $R_2 = 0.3\Omega$/phase $X_1 = X_2 = 0.5\Omega$/phase, $X_m = 16\Omega$/phase. Assume that the shunt branch is connected across the supply terminals. Determine (a) maximum internal torque at rated voltage and frequency, (b) slip at maximum torque, and (c) internal starting torque at rated, voltage, and frequency.	Evaluate	1
7	A 30-HP, six-pole, 50-Hz, and three-phase induction motor has stator/rotor phase voltage ratio of 7/5. The stator and rotor impedances per phase are (0.35 + j0.65) Ω and (0.15 + j0.65) Ω, respectively. Find the starting torque exerted by the motor when an external resistance of 1.5 Ω is inserted in each phase; the motor being started directly on the 440-V supply system. Assume *Y/Y*	Evaluate	1

connection.

8	A motor operates continuously on the following load cycle. 20 kW for 10 sec,10 kW for 15 sec, 30 kW for 5 sec, 50 kW for 20 sec, 40 kW for 10 sec, and idle for 5 sec.	Evaluate	1
9	A series motor with series field and armature resistance of 0.06 Ω and 0.02 Ω, respectively, is connected across 440-V mains. The armature takes 60 A and its speed is 850 rpm. Determine its speed when it takes 85 A from this very and the excitation is increased by 20%.	Evaluate	1
10	A motor has the following load cycle. Load raising uniformly from 100 to 200 kW in 5s. Continuous load 50 kW for 10 s regenerative braking kW returned to the supply 50 kW to 0 kW for 3 s and idle for 2 s. Draw the load diagram neatly for one cycle. Find the size of continuously rated motor for the above duty. The load cycle is repeated indefinitely.	Evaluate	1

UNIT-II

ELECTRIC HEATING

1	A 4.5-kW, 200-V, and 1-φ resistance oven is to have nichrome wire heating elements. If the wire temperature is to be 1,000°C and that of the charge 500°C. Estimate the diameter and length of the wire. The resistivy of the nichrome alloy is 42.5 μΩ-m. Assume the radiating efficiency and the	Evaluate	2

	emissivity of the element as 1.0 and 0.9, respectively		
2	Determine the diameter and length of the wire, if a 17-kW, 220-V, and 1- *φ*resistance oven employs nickel-chrome wire for its heating elements. The temperature is not exceeding to 1,100°C and the temperature of the charge is to be 500°C. Assume the radiating efficiency as 0.5 and the emissivity as 0.9, respectively.	Evaluate	2

3	A20-kW, 230-V, and single-phase resistance oven employs nickel—chrome strip 25-mm thick is used, for its heating elements. If the wire temperature is not to exceed 1,200°C and the temperature of the charge is to be 700°C. Calculate the width and length of the wire. Assume the radiating efficiency as 0.6 and emissivity as 0.9. Determine also the temperature of the wire when the charge is cold	Evaluate	2
4	Six resistances, each of 60 ohms, are used in a resistance; how much power is drawn for the following connections. (a) Supply is 400 V, AC, and single phase and the connections are: i) Three groups in parallel, each of two resistance units in series. ii) Six groups are in parallel, each of one resistance unit. (b) With the same three-phase supply, they are connected in delta fashion. i) Two resistance units in parallel in each branch. ii) Two resistance units in series in each branch. (c) Supply is 400 V and three-phase while the connection is a star combination of: i) Two resistance elements in series in each phase. ii) Two resistance elements in parallel in each phase.	Evaluate	2
5	A 100-kW Ajax Wyatt furnace works at a secondary voltage of 12 V at power factor 0.6 when fully charged. If the reactance presented by the charge remains constant but the resistance varies invert as the charge depth in the furnace; calculate the charge depth that produces maximum	Evaluate	2

	heating effect when the furnace is fully charged.		
6	Determine the amount of energy required to melt 2 ton of zinc in 1 hr, if it operates at an efficiency of 70% specific heat of zinc is equals to 0.1. The latent heat of zinc = 26.67 kcal/kg, the melting point is 480°C, and the initial temperature is 25°C.	Evaluate	2
7	A high-frequency induction furnace that takes 20 min to melt 1.9 kg of aluminum, the input to the furnace being 3 kW, and the initial temperature is 25°C. Then, determine the efficiency of the furnace.	Evaluate	2
8	A low-frequency induction furnace has a secondary voltage of 20 V and takes 600 kW at 0.5 pf when the hearth is full. If the secondary voltage is maintained at 20 V, determine the power absorbed and the power factor when the hearth is half-full. Assume the resistance of the secondary circuit to be doubled and the reactance to remain the same.	Evaluate	2
9	A piece of insulating material is to be heated by dielectric heating. The size of the piece is 10 × 10 × 3 cm^3. A frequency of 30 mega cycles is used and the power absorbed is 400 W. Determine the voltage necessary for heating and the current that flows in the material. The material has a permittivity of 5 and a power factor of 0.05.	Evaluate	2
10	An electric arc furnace consuming 5KW takes 15 minutes to just melt 15kgs of aluminum, the initial temperature being $15^{o}C$ Find the efficiency	Evaluate	2

	of the furnace Specific heat of aluminum is 0.212, melting point 658 ^{o}C and latent heat of fusion is 76.8 cal per gram.		

UNIT-III

ILLUMINATION FUNDAMENTALS

1	A 200-V lamp takes a current of 1.2 A, it produces a total flux of 2,860 lumens. Calculate: 1. MSCP of the lamp and 2. Efficiency of the lamp.	Evaluate	4
2	A room with an area of 6 × 9 m is illustrated by ten 80-W lamps. The luminous efficiency of the lamp is 80 lumens/W and the coefficient of utilization is 0.65. Find the average illumination	Evaluate	4
3	The luminous intensity of a lamp is 600 CP. Find the flux given out. Also find the flux in the hemisphere containing the source of light and zero above the horizontal.	Evaluate	4
4	A surface inclined at an angle 40° to the rays is kept 6 m away from 150 candle power lamp. Find the average intensity of illumination on the surface .	Evaluate	4
5	The illumination at a point on a working plane directly below the lamp is to be 60 lumens/m^2. The lamp gives 130 CP uniformly below the horizontal plane. Determine: i) The height at which lamp is suspended. ii) The illumination at a point on the working plane 2.8 m away from the	Evaluate	4

	vertical axis of the lamp.		
6	A lamp having a candle power of 300 in all directions is provided with a reflector that directs 70% of total light uniformly on a circular area 40-m diameter. The lamp is hung at 15 m above the area. 1. Calculate the illumination. 2. Also calculate the illumination at the center. 3. The illumination at the edge of the surface without reflector.	Evaluate	4
7	Two sources of candle power or luminous intensity 200 candela and 250 candela are mounted at 8 and 10 m, respectively. The horizontal distance between the lamps posts is 40 m, calculate the illumination in the middle of the posts.	Evaluate	4
8	Two sources of having luminous intensity 400 candela are hung at a height of 10 m. The distance between the two lamp posts is 20 m. Find the illumination (i) beneath the lamp and (ii) in the middle of the posts	Evaluate	4
9	A light source with an intensity uniform in all direction is mounted at a height of 20 ms above a horizontal surface. Two points *'A'* and _*B*‘ both lie on the surface with point *A* directly beneath the source. How far is *B* from *A* if the illumination at _*B*‘ is only 1/15th as great as *A*?	Evaluate	4
10	In a street lighting, two lamps are having luminous intensity of 300 candela, which are mounted at a height of 6 and 10 m. The distance between lamp	Evaluate	4

	posts is 12 m. Find the illumination, just below the two lamps			

	UNIT-III **VARIOUS ILLUMINATION METHODS**		
1	A room 20 × 10 m is illuminated by 60 W incandescent lamps of lumen output of 1,600 lumens. The average illumination required at the workplace is 300 lux. Calculate the number of lamps required to be fitted in the room. Assume utilization and depreciation factors as 0.5 and 1, respectively.	Evaluate	4
2	The front of a building 35 × 18 m is illuminated by 15 lamps; the wattage of each lamp is 80 W. The lamps are arranged so that uniform illumination on the surface is obtained. Assuming a luminous efficiency of 20 lumens/W, the coefficient of utilization is 0.8, the waste light factor is 1.25, DF = 0.9. Determine the illumination on the surface.	Evaluate	4
3	A room of size 10 × 4 m is to be illuminated by ten 150-W lamps. The MSCP of each lamp is 300. Assuming a depreciation factor of 0.8 and a utilization factor of 0.5. Find the average illumination produced on the floor	Evaluate	4
4	The front of a building 25 × 12 m is illuminated by 20 1,200-W lamps arranged so that uniform illumination on the surface is obtained. Assuming a luminous efficiency of 30 lumens/W and a coefficient of utilization of 0.75. Determine the illumination on the surface. Assume DF = 1.3 and waste light factor 1.2.	Evaluate	4
5	An illumination of 40 lux is to be produced on the floor of a room 16 × 12	Evaluate	4

	m. 15 lamps are required to produce this illumination in the room; 40% of the emitted light falls on the floor. Determine the power of the lamp in candela. Assume maintenance factor as unity.		
6	A drawing, with an area of 18 × 12 m, is to be illuminated with an average illumination of about 150 lux. The lamps are to be fitted at 6 m height. Find out the number and size of incandescent lamps required for an efficiency of 20 lumens/W. UF = 0.6, MF = 0.75.	Evaluate	4
7	A hall 40-m long and 16-m wide is to be illuminated and illumination required is 70-m candles. Five types of lamps having lumen outputs, as given below are available. Taking a depreciation factor of 1.5 and a utilization coefficient of 0.7, calculate the number of lamps required in each case to produce required illumination. Out of above five types of lamps, select most suitable type and design, a suitable scheme, and make a sketch showing location of lamps. Assume a suitable mounting height and calculate space to height ratio of lamps.	Evaluate	4
8	An illumination on the working plane of 100 lux is required in a room 45 × 25 m in size. The lamps are required to be hung 3 m above the plane. Assuming a suitable space–height ratio, a utilization factor of 0.8, a lamp efficiency of 18 lumens/W, and a candle power depreciation of 30%,	Evaluate	4

	estimate the number, rating, and disposition of lamps. Watts: 50 100 150 200 250 Lumens: 1,500 1,830 2,500 3,200 4,000		
9	A lamp of 50 W operates at 220 V and power factor 0.8. Its power factor is to be corrected to be unity. Determine the capacitance required for the condenser	Evaluate	4
10	A room 40 × 24 m is illuminated by indirect lighting. An average illumination of 50 lux is required to illuminate the working plane. Eighty- watt filament lamps having luminous efficiency of 16 lumens/W are to be used. The coefficient of utilization is 0.75 and depreciation factor is 0.85. Calculate the following:	Evaluate	4

	1. Gross lumens required. 2. Power required for illumination. 3. Number of lamps.		

4. Find the saving in power if instead of 80-W filament lamps, 30-W fluorescent tubes are used having efficiency of 40 lumens/W. Also

find the number of tube lights required.

UNIT-IV

ELECTRIC TRACTION-I

1	A 230-V DC shunt motor takes a current of 20 A on a certain load. The armature resistance is 0.8 Ω and the field circuit resistance is 250 Ω. Find the resistance to be inserted in series with the armature to have the speed is half if the load torque is constant.	Evaluate	5
2	A series motor having a resistance of 0.8 Ω between its terminal drives. The torque of a fan is proportional to the square of the speed. At 220 V, its speed is 350 rpm and takes 12 A. The speed of the fan is to be raised to 400 rpm by supply voltage control. Estimate the supply voltage required	Evaluate	5
3	A 230-V, 10-HP, and DC shunt motor with $R_a = 0.2\ \Omega$ and $R_{sh} = 80\ \Omega$, runs at 1000 rpm on full load. The efficiency on the full load is 80%. If the speed is to be raised to 1200 rpm keeping load constant, determine extra resistance to be added in the field ckt. Assume 1 HP = 736 W	Evaluate	5
4	Two DC traction motors, each takes a current of 45 from 450 V mains and runs at the speed of 600 and 625 rpm, respectively. Each motor has an	Evaluate	5

	effective resistance of 0.4 Ω. Calculate the speed and voltage across each machine when mechanically coupled and electrically connected in series and taking a current of 45 A from 450 V mains the resistance of each motor being unchanged		
5	A DC series motor drives a load. The motor takes a current of 13 A and the speed is 620 rpm. The torque of the motor varies as the square of speed. The field winding is shunted by a diverter of the same resistance as that of the field winding, then determine the motor speed and current. Neglect all motor losses and assume that the magnetic circuit is unsaturated	Evaluate	5
6	A 230-V, and 12-HP motor has shunt and armature resistance of 120 and 0.3 Ω, respectively. Calculate the resistance to be inserted in the armature circuit to reduce the speed by 20%, assuming the torque remains constant. The efficiency of the motor is 90%.	Evaluate	5
7	A 40H.P, 400V,3-phase, 4 pole, 50Hz 1m has full load slip of 5s. If ratio of standstill reactance resistance per rotor phase is 4. Estimate the plugging torque at full speed.	Evaluate	5
8	A200V, 500 rpm d.c shunt motor with an armature resistance of 0.08ohm and full load armature current of 150A is to be braked by plugging. Estimate the value of resistance which is to be placed in series with the armature to limit the initial braking current to 200A what would be the speed at which	Evaluate	5

	the electric braking torque is 75% of its initial value?		
9	An electric train has an average speed of 42 km/hr on a level track between stops1400 m apart. It is accelerated at 1.7 km/hr/sec and it is braked at 3.3km/hr/sec.Draw the speed-Time curve and estimate the specific energy consumption. Assume tractive resistance as 50 NW/tonnes and allow 10% rotational inertia	Evaluate	5
10	A train weighing 500 tonnes is going down a gradient of 20 in 1000. It is desired to maintain train speed out 40 KMP by regenerative braking calculate the power fed into the line. Tractive resistance is 40 N/tone and allow rotational intertia of 10% and efficiency of conversion of 75%.	Evaluate	5

UNIT-IV **ELECTRIC TRACTION-I**			
1	The distance between two stops is 1.2 km. A schedule speed of 40 kmph is required to cover that distance. The stop is of 18-s duration. The values of the acceleration and retardation are 2 kmphp and 3 kmphp, respectively. Then, determine the maximum speed over the run. Assume a simplified trapezoidal speed–time curve.	Evaluate	6
2	The speed–time curve of train carries of the following parameters: 1. Free running for 12 min. 2. Uniform acceleration of 6.5 kmphp for 20 s. 3. Uniform deceleration of 6.5 kmphp to stop the train. 4. A stop of 7 min. Then, determine the distance between two stations, the average, and the schedule speeds.	Evaluate	6
3	The distance between two stops is 5 km. A train has schedule speed of 50 kmph. The train accelerates at 2.5 kmphps and retards 3.5 kmphps and the duration of stop is 55 s. Determine the crest speed over the run assuming trapezoidal speed–time curve.	Evaluate	6
4	An electric train has an average speed of 40 kmph on a level track between stops 1,500 m apart. It is accelerated at 2 kmphps and is braked at 3 kmphps. Draw the speed–time curve for the run.	Evaluate	6

5	A train has a schedule speed of 40 km/hr between two stops which are 4kmps apart Determine the crest speed over the run, if the duration of stops is 60 sec and acceleration and retardation both are 2km/hr eachAssume trapezoidal speed-time curve.	Evaluate	6
6	The maximum speed of sub-urban electric train is 60km/hr and its schedule speed is 40km/hr and duration of stop is 30 sec. If acceleration is 2km/hr and distance between two stops is 2kms. Determine the retardation.	Evaluate	6
7	A train has a schedule speed of 30kmph over a level track. Distance between stations being 1km. Station stopping time is 20 seconds. Assuming braking retardation of 3 kmphps and maximum speed 25% greater than average speed calculate acceleration required to run the service.	Evaluate	6
8	A section of tramway ABC is 6km long and earthed at A. Its resistance is 001ohm/km and loading of 200 A/Km uniformly distributed. Negative feeder with booster is taken off from point B, 4km from A. If potential of B is 4 volts above earth, calculate the rating of booster, negative feeder resistance being 0.02 ohm.	Evaluate	6
9	A mail is to be run between two stations 5kms apart at an average speed of 50 km/hr If maximum speed is to be limited to 70 km/hr acceleration to 2 kmphps, breaking retardation to 4 kmphps and coasting retardation to 01 kmphps Determine the speed at the end of coasting duration of coasting period and braking period.	Evaluate	6
	A train is required to run between stations 1.6kms apart at an average speed of 40 kmph. The run is to be made from a quadrilateral speed-time	Evaluate	6

10	curve. The acceleration is 2km/hr. The coasting and braking retardations are 0.16km/hr and 3.2 km/hr respectively. Determine the duration of acceleration, coasting and braking and distance covered in the each period.		

UNIT-V

ELECTRIC TRACTION-II

1	An electric train is to have the acceleration and braking retardation of 0.6 km/hr/sec and 3 km/hr/sec, respectively. If the ratio of the maximum speed to the average speed is 1.3 and time for stop is 25 s. Then determine the schedule speed for a run of 1.6 km. Assume the simplified trapezoidal speed–time curve.	Evaluate	7
2	A train is required to run between two stations 1.5 km apart at an average speed of 42 kmph. The run is to be made to a simplified quadrilateral speed–time curve. If the maximum speed is limited to 65 kmph, the acceleration to 2.5, kmphps, and the casting and braking retardation to 0.15 kmphs and 3 kmphs, respectively. Determine the duration of acceleration, costing, and braking periods	Evaluate	7
3	A train has schedule speed of 32 kmph over a level track distance between two stations being 2 km. The duration of stop is 25 s. Assuming the braking retardation of 3.2 kmphps and the maximum speed is 20% grater than the average speed. Determine the acceleration required to run the service	Evaluate	7
	A suburban electric train has a maximum speed of 75 kmph. The schedule	Evaluate	7

4	speed including a station stop of 25 s is 48 kmph. If the acceleration is 2 kmphps, the average distance between two stops is 4 km. Determine the value of retardation.		
5	An electric train is accelerated at 2 kmphps and is braked at 3 kmphps. The train has an average speed of 50 kmph on a level track of 2,000 min between the two stations. Determine the following: 1. Actual time of run. 2. Maximum speed. 3. The distance travelled before applying brakes 4. Schedule speed. Assume time for stop as 12 s. And, run according to trapezoidal	Evaluate	7
6	An electric train has quadrilateral speed–time curve as follows: 1. Uniform acceleration from rest at 1.5 kmphps for 25 s. 2. Coasting for 45 s. 3. The duration of braking 20 s. If the train is moving a uniform up gradient of 1.5%, the reactive resistance is 45 N/ton, the rotational inertia effect is 10% of dead weight, the duration of stop is 15 s, and the overall efficiency of transmission gear and motor is 80%. Find schedule speed.	Evaluate	7
7	A 250-ton motor coach having four motors each developing 6,000 N-m torque during acceleration, starts from rest. If the gradient is 40 in 1,000, gear ration is 4, gear transmission efficiency is 87%, wheel radius is 40 cm, train resistance is 50 N/ton, the addition of rotational inertia is 12%.	Evaluate	7

	Calculate the time taken to attain a speed of 50 kmph. If the line voltage is 3,000-V DC and the efficiency of motors is 85%. Find the current during notching period.		
8	An electric train of weight 250 ton has eight motors geared to driving wheels, each is 85 cm diameter. The tractive resistance is of 50/ton. The effect of rotational inertia is 8% of the train weight, the gear ratio is 4–1, and the gearing efficiency is 85% determine. The torque developed by each motor to accelerate the train to a speed of 50 kmph in 30 s up a gradient of 1 in 200.	Evaluate	7
9	A train weighing 450 ton is going down a gradient of 20 in 1,000, it is desired to maintain train speed at 50 kmph by regenerative braking. Calculate the power fed into the line and allow rotational inertia of 12% and the efficiency of conversion is 80%. Traction resistance is 50 N/ton.	Evaluate	7

10	The speed–time curve of an electric train on a uniform raising gradient of 10 in 1,000 comprise of: 1. Uniform acceleration from rest at 2.2 kmphps for 30 s. 2. Wasting with power off for 30 s. 3. Braking at 3.2 kmphps to standstill the weight of the train is 200 ton. The tractive resistance of level track being 4 kg/ton and the allowance for rotary inertia 10%. Calculate the maximum power developed by traction motors and the total distance travelled by the train. Assume the transmission efficiency as 85%.	Evaluate	7