JEPPIAAR INSTITUTE OF TECHNOLOGY
“Self-Belief | Self Discipline | Self Respect”

QUESTION BANK

Regulation : 2017

Year/Semester : I / 02

Semester : 02

Batch : 2019-2023

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Vision of the Institution

Jeppiaar Institute of Technology aspires to provide technical education in futuristic technologies with the perspective of innovative, industrial and social application for the betterment of humanity

Mission of the Institution

M1: To produce competent and disciplined high-quality professionals with the practical skills necessary to excel as innovative professionals and entrepreneurs for the benefit of the society.

M2: To improve the quality of education through excellence in teaching and learning, research, leadership and by promoting the principles of scientific analysis, and creative thinking.

M3: To provide excellent infrastructure, serene and stimulating environment that is most conducive to learning.

M4: To strive for productive partnership between the Industry and the Institute for research and development in the emerging fields and creating opportunities for employability.

M5: To serve the global community by instilling ethics, values and life skills among the students needed to enrich their lives.

DEPARTMENT VISION

To produce Engineers with visionary knowledge in the field of Computer Science and Engineering through scientific and practical education in stance of inventive, modern and communal purpose for the improvement of society.

DEPARTMENT MISSION

M1: Devise students for technical and operational excellence, upgrade them as competent engineers and entrepreneurs for country's development.

M2: Develop the standard for higher studies and perpetual learning through creative and critical thinking for the effective use of emerging technologies with a supportive infrastructure.

M3: Involve in a constructive, team-oriented environment and transfer knowledge to balance the industry-institute interaction.

M4: Enrich students with professional integrity and ethical standards that will make them deal social challenges successfully in their life.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1: To support students with substantial knowledge for developing and resolving mathematical, scientific and engineering problems.

PEO 2: To provide students with adequate training and opportunities to work as a collaborator with informative and administrative qualities.

PEO 3: To motivate students for extensive learning to prepare them for graduate studies, R&D and competitive exams.

PEO 4: To cater students with industrial exposure in an endeavour to succeed in the emerging cutting edge technologies.

PEO 5: To shape students with principled values and to follow the code of ethics in social and professional life.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO 1 : Students are able to analyse, design, implement and test any software with the programming and testing skills they have acquired.

PSO 2: Students are able to design and develop algorithms for real time problems, scientific and business applications through analytical, logical and problems solving skills.

PSO 3: Students are able to provide security solution for network components and data storage and management which will enable them to work efficiently in the industry.

BLOOM'S TAXONOMY

Definition:

- A theory to identify cognitive levels (Levels of thinking)
- Represents the full range of cognitive functions.

Objectives:

- To classify educational learning objectives into levels of complexity and specificity. The classification covers the learning objectives in cognitive, affective and sensory domains.
- To structure curriculum learning objectives, assessments and activities.

Levels in Bloom's Taxonomy:

- **BTL 1** – **Remember -** The learner is able to recall, restate and remember learned information.

- **BTL 2** – **Understand -** The learner grasps the meaning of information by interpreting and translating what has been learned.

- **BTL 3** – **Apply -** The learner makes use of information in a context similar to the one in which it was learned.

- **BTL 4** – **Analyze -** The learner breaks learned information into its parts to best understand that information.

- **BTL 5** – **Evaluate -** The learner makes decisions based on in-depth reflection, criticism and assessment.

- **BTL 6** – **Create -** The learner creates new ideas and information using what has been previously learned.

TABLE OF CONTENT

CS8251- PROGRAMMING IN C

BE8255- BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING

HS8251 **L T P C**
4 0 0 4

TECHNICAL ENGLISH

Objectives:

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I INTRODUCTION TECHNICAL ENGLISH 12

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing**- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development**- technical vocabulary **Language Development** –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 12

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting charts, graphs- **Vocabulary Development-**vocabulary used in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12

Listening- Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

UNIT IV REPORT WRITING 12

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-**Vocabulary Development**- finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12

Listening- TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- accident and survey **Vocabulary Development- verbal analogies** Language **Development-** reported speech

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Black swan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication**. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. **Engineering English**. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana**, Project Work,** Oxford University Press**,** Oxford: 2014.
4. Grussendorf, Marion, **English for Presentations,** Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

UNIT 1: Sharing Information Related To Oneself/Family& Friends

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing-** purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development**- technical vocabulary **Language Development** –subject verb agreement - compound words.

PART*A

1. **Technical Vocabulary 2M BTL1**

a. contaminated	i. make easy
b. facilitate	ii. unclean
c. renowned	iii. Calculate
d. estimate	iv. Famous (a.- ii, b- i, c- iv, d- iii)

a. narrate	i. requirement
b. necessity	ii. cover
c. muffle	iii. envious
d. jealous	iv. Tell (a-iv ,b- i, c- ii, d- iii.)

a. identical	i. joyous
b. illegible	ii. complex
c. intricate	iii. unreadable
d. jubilant	iv. Alike (a-iv ,b- iii, c- ii, d- i)

a. gather	i. swoon
b. guilty	ii. Accumulate
c. faint	iii. flaw
d. defect	iv. Ashamed (a-ii ,b- iv, c- i, d- iii.)

a. wage	i. definitely
b. undoubtedly	ii. pay
c. tolerate	iii. Amusement
d. recreation	iv. Endure (a-ii ,b- i, c- iv, d- iii.)

Match the words in Column A with their antonyms in Column B

A	B
a. whole	i. common
b. various	ii.harmful
c. useful	iii. part

d. rare	iv. Identical	(a-iii, b- i, c- ii, d- iv.)

a. assist	i. detest	
b. assent	ii. Proud	
c. ashamed	iii. hinder	
d. admire	iv. Dissent	(a-iii ,b- iv, c- ii, d- i.)

a. cautious	i. welcome	
b. banish	ii. Forgetful	
c. barren	iii. polite	
d. impudent	iv. Fertile	(a-iv ,b- i, c- ii, d- iii.)

a. moderation	i. conceal	
b. rapid	ii. Disapprove	
c. reveal	iii. slow	
d. recommend	iv. Greed	(a-iv ,b- iii, c- i, d- ii.)

3. **Subject-Verb Agreement 2M BTL1**

Fill in the blanks with the correct verb that agrees with the subject. [BTL3]

1. Some of the amazing pictures taken by the contestants ____________ (is/**are)** displayed in the hall.
2. He is one of the successful business men who ______________ (**is**/are) sincere and hard working.
3. The committee ____________ (**have**/has) carefully studied the proposal for providing loan for the needy.
4. The official United Nations website for Peacekeeping_____________
   a. (Contain/**contains)** information on operations around the world.
5. Twenty five kilometers ____________ (**is**/are) a long distance to run every day.
6. The number of unemployed citizens _______________ (**are**/is) more in developing counties.
7. There ____________ (are/**is**) several reasons for implementing the new policy
8. The boy who won the two medals___________________ (are/**is**) a friend of mine
9. The person who is responsible for planning and implementing aims and objectives of the company __________________ (**is**/are) the manager.
10. According to a recent survey, the number of people who opt for purchasing Online.

II. **Choose the correct form of the verb that agrees with the subject.**

(is, are, am, was, were, has, have)

1. The price of the jeans **is** reasonable.
2. The books borrowed from the library **are** on my desk.
3. Bread and butter **is** our daily food.
4. The quality of the candies **was/is** poor.
5. There **were** ten books in the box.
6. Many a student **were** made the same mistakes.
7. One of the books **has** been missing.
8. Fifty miles is a long distance.
9. The poor **are** suffering.
10. One of the most intelligent students **is** John.
11. She and her friends **are** at the fair.
12. The book or the pen **is** in the drawer.
13. The boy or his friends **run** (run) everyday.
14. His friends or the boy **runs** (run) everyday.
15. The committee **decides** (decide) how to proceed.

4 **IV Compound Words 2M BTL1**

Expand the following Compound Noun

1. Animal behavior - The behavior of an animal
2. Aluminum extraction - The extraction of aluminum
3. Battery valve - Valve of a battery
4. Boat house - Boat used as a house

5. Butterfly valve - Valve which is in the shape of a butterfly
6. Calculator memory - Memory of a calculator
7. Carbon dioxide - Dioxide of carbon
8. Coal gas - Gas obtained from coal
9. Computer language - Language used for computer operation
10. Computer manual - Manual for operating the computer
11. Computer technology - Technology used in computers
12. Data input - Input of data
13. Disk drive - Drive of a disk
14. Flood damage - Damage caused by flood
15. Gear mechanism - Mechanism for operating the gear

Compound Nouns:

1. Inflation rate	Rate of inflation
2. Information centre	Centre for giving information
3. Box top	Top of the box
4. Carbon steel rod	Rod made of carbon steel
5. Component location	Location of the component
6. Computer fuel testing	Testing the fuel using the computer
7. Cylinder walls	Walls of the cylinder
8. Drinking water	Water for drinking purpose
9. Engine repair	Repair works related to engine
10. Engine housing	Housing to protect the engine
11. Ferrous oxide	Oxide of ferrous
12. Gear pump	Pump operates by means of gears
13. Language code	Code which specifies the language
14. Pare industry	Industry manufacturing paper
15. Passenger ship	Ship for the purpose of carrying passengers

16. Radar scan	Scan performed by radar
17. Turret lathe	Lathe having a turret
18. Toy factory	Factory for making toys

5 **Purpose Statement: 2M BTL2**

1. A barometer **is used to** measure atmospheric pressure.
2. Another way of expressing purpose is shown in the following sentences.
3. **The purpose of** painting iron parts **is to protect** them from rust.
4. **The purpose of** a thermostat **is to maintain** temperature at a constant level
5. **The aim of the** test **is to predict** the rise in pressure.

Use the hint below to make sentences expressing purpose (Use any of the patterns illustrated above)

1. **An aerial: receives broadcast signals**.
   An aerial is used to receive broadcast Signals
2. **A feasibility report: makes recommendations on the practicality of a project**
   A feasibility reports is used to make recommendation on the practicality of a project
3. **Sending telegrams: ensures that the message reaches the address quickly**.
   Sending telegrams are used to ensure that the messages reached the address quikly.
4. **An experiment: demonstrates a principle**
   An experiment is used to demonstrate a principle
5. **Constructing a bypass road: reduces traffic congestion in a city.**
   Constructing a bye-pass road is used to reduce traffic congestion in a city.
6. **A sheet of carbon paper: makes copies while one types.**
   A sheet of carbon paper is used for making copies while one types
7. **A litmus test: identifies acids an alkalies.**
   A litmus test is used for identifying alkalies.
8. **A flow chart: represents a process as a series of steps.**
   A flowchart is used for representing a process as a series of step.
9. **A calculator: calculates with numbers**
   A calculator is used for calculating numbers
10. **A life Boat: rescues people who are in danger at Sea**
    ALife boat is used for rescuing people who are in danger at Sea
11. **A Compass: Finds direction**
    A compass is used for finding direction
12. **Robot: do Heavy and dangerous jobs**.

Robot is used for doing heavy and dangerous jobs.

13. **A Satellite: Collects information for communication**
    A satellite is used for collecting information for communication.
14. **A glass bottle : stores acid.**
    A Glass bottles is used for storing acids.
15. **A moderator: slows down the speed of free neutrons**
    A moderator is used to slow down the speed of free neutron.

Extended Definition: 2M BTL2

Example : 1

(Sentence definition) We can define an **SUV** as a vehicle which is usually driven on rough terrain. ***(Illustration)***SUV is an acronym which stands for **s**ports **u**tility **v**ehicle. ***(Description)***The engines of the SUV vehicles supply power to all four wheels, so they are better for cruising sand dunes. ***(Classification)*** SUV vehicles vary in size; some of them can seat 5 passengers, while others can seat 7 passengers. ***(causal analysis)*** SUV vehicles are quite common in Saudi Arabia due to the low cost of petrol and their fantastic performance in the desert.

Example : 2

(Sentence definition)**The periodic table** can be defined as an organized array of all the chemical elements in order of the atomic weight. ***(Illustration)***The elements show a periodic recurrence of certain properties. ***(Chronology)***It was first discovered in 1869 by Dmitry I. Mendeleyev. ***(Description)***Those in the same column or group of the table as usually arranged have similar properties. ***(Chronology)***In the 20th century, when the structure of atoms was understood, the table was seen to precisely reflect increasing order of atomic number. ***(Description)*** Members of the same group in the table have the same number of electrons in the outermost shells of their atoms and form bonds of the same type.

Example : 3

(Sentence definition) Glass is a hard transparent material which is used to make windows, bottles and other objects. ***(Etymology)*** glass is an English word and was first used before the twelfth century. ***(Chronology)***Glass has been used as a decorative object indoors since ancient times. Today, glass is widely used in the construction and telecommunication sectors. ***(Description)*** It is made by cooling molten ingredients such as silica sand with sufficient rapidity to prevent the formation of visible crystals.

Example :4

Appropriate technology is that technology which is affordable within the resources available, is culturally acceptable and is environmentally harmless.

PART *B

1.

INSTRUCTION 16M BTL3

1. To control noise pollution: (May/Jun 2011)

1. Prohibit noise producing vehicles
2. Avoid using high sounding crackers
3. Don’t use loud speakers near schools and hospitals.
4. Use a silencer to absorb noise of the vehicle
5. Establish industrial units away from residential areas
6. Plant trees to absorb noise.
7. Live away from the airport
8. Avoid using high sounding pressure horns
9. Be aware of noise pollution

2. ***To reduce unemployment problem:***

1. Ensure employment to at least one person in a family
2. Increase the number of technical training institutes
3. Give loans to encourage self-employment
4. Give subsidies to encourage the entrepreneurs
5. Employ unemployed graduates for additional government duties like election duties
6. Encourage private sectors to generate employment.
7. Establish more industries in rural areas
8. Train the graduates to start small scale industries

3. ***To keep the college campus clean:***

1. Keep the environment always clean
2. Plant trees in the college campus
3. Conduct awareness classes to make the students to realise the importance of cleanliness.
4. Place more number of dust bins in the campus
5. Impose punishment on these who violate the rules
6. Maintain the vehicles properly
7. Avoid cutting of trees in the name of development
8. Always maintain strict discipline

4. To maintain a computer / a laptop in good working condition (Jan 2006; May/Jun 2007; Jan 2010)

1. Don’t touch the cables
2. Avoid touching the open sockets
3. Avoid touching the monitor
4. Always shut down the system when it is not in use.
5. Shut down the system properly.
6. Don’t misplace and replace the equipment.
7. Don’t handle the equipment roughly.
8. Don’t keep your legs on the UPS.

5. ***Safety instructions in a chemical engineering lab (Jan 2010)***

1. Don’t work in the laboratory barefoot.
2. Don’t handle the instruments roughly.

3. Don't wear gold ornaments.
4. Keep all the doors and windows open.
5. Keep your working place neat and tidy.
6. Don't wear loose clothes.
7. Wear apron and gloves while handling the chemicals.
8. Handle all glassware items carefully.
9. Don't drink or eat in lab.
10. Don't taste or sniff chemicals.
11. Identify the safety equipment.
12. Read the chemical safety instructions.

6. *Instructions must be followed by all pedestrians (Road safety)*

1. Walk on the pavement always.
2. Use subways; though it is long.
3. Avoid crossing suddenly.
4. Don't walk on road dividers.
5. Don't ignore traffic signals.
6. Cross the road only at zebra crossing.
7. Make sure that the road is clear, before crossing the road.
8. Avoid using the cell phone while walking along the road.
9. Be familiar with the traffic rules.

7. *Instructions to save petrol (May / Jun 2012)*

1. Keep the engine in good condition
2. Fit the vehicle with an engine that gives high mileage.
3. Don't keep the engine running while the vehicle is not in motion.
4. Inflate the tyres at an optimum level of air pressure.
5. Use the correct engine oil for the proper functioning.
6. Service the vehicle regularly.
7. Avoid clutch driving.
8. Avoid frequent change of gear to save petrol.

8. *Instructions to maintain two/four wheelers in good working condition (May/Jun 2005/2006)*

1. Always maintain the air pressure in the tyre to the recommended levels.
2. Drive only at optimum level of speed depending on the roads.
3. Clean the air-filter regularly since clogged air filters increase fuel consumption.
4. Do not idle the engine not more than 30 seconds to warm it up when starting.
5. Avoid sudden breaks and frequent gear changing.
6. Handle the gear, brake and clutch softly.
7. Service the vehicles regularly for better performance as well as fuel saving
8. Always maintain the lubricants at the required level to ensure running of the engine.
9. Avoid pressure horns.
10. Avoid faulty silencers.

9. *Write eight instructions to preserve environment. (May 2004/2005)*

1. Reduce the usage of plastic

2. Use the eco-friendly papers made out of alternative sources.
3. Use rechargeable batteries for frequent usages to reduce the number of dead batteries
4. Use natural fertilizers and pesticides for agriculture.
5. Don't cut trees.
6. Plant native and adaptive trees.
7. Turn light off at office as well as at home whenever it is not needed.
8. Treat sewage and industrial effluents before discharging into the water bodies.
9. Conduct awareness programmes for preserving the environment.
10. Encourage rain water harvesting.

10. ***Instructions for giving first aid to a victim of a road accident***

1. Check the victim thoroughly whether the victim is breathing or not
2. Take the victim to the side of the road.
3. Try to stop the bleeding by applying pressure on the bleeding side.
4. Give artificial respiration if the victim is struggling for breathe.
5. Don't crowd round the victim and prevent airflow.
6. Handle the victim carefully.
7. Examine the head, eyes, nose, ears, chest, and abdomen to detect wounds.
8. Ask the victim to move the toes, and fingers to check their movements or function.
9. Take the victim to the hospital

9 **II Checklists 16M BTL2**

1.Checklist for an Interview

	Yes	No
1. Have I taken the ticket?	☐	☐
2. Have I taken the certificates?	☐	☐
3. Have I taken the call letter?	☐	☐
4. Have I taken money?	☐	☐
5. Have I arranged the certificates properly?	☐	☐
6. Have I taken my project report?	☐	☐
7. Have I taken my friends' contact number?	☐	☐
8. Have I packed the formal wear?	☐	☐

2. Checklist for an Industrial Visit

	Yes	No
1. Have I taken the ticket?	☐	☐
2. Have I taken money?	☐	☐
3. Have I taken the conformation letter?	☐	☐
4. Have I taken all the documents?	☐	☐

5. Have I taken my Identity Card? ☐ ☐
6. Have I taken my cell phone and charger? ☐ ☐
7. Have I packed the formal wear? ☐ ☐
8. Have I taken my friends' contact number ☐ ☐

3. Checklist for conducting a two day conference Yes No

1. Have I sent the invitations? ☐ ☐
2. Have I invited the chief guest? ☐ ☐
3. Have I invited the Principal and staffs? ☐ ☐
4. Have I prepared the welcome address? ☐ ☐
5. Have I prepared the agenda? ☐ ☐
6. Have I arranged the conference hall? ☐ ☐
7. Have I arranged enough refreshments? ☐ ☐
8. Have I made the stage ready? ☐ ☐

4. Checklist for organizing a Paper Presentation session Yes No

1. Have I arranged the venue? ☐ ☐
2. Have I finalized the papers? ☐ ☐
3. Have I fixed the judges? ☐ ☐
4. Have I arranged for refreshment and lunch for delegates? ☐ ☐
5. Have I purchased the kits? ☐ ☐
6. Have I prepared the certificates? ☐ ☐
7. Have I prepared the agenda? ☐ ☐
8. Have I prepared the welcome address? ☐ ☐
9. Have I informed the participants? ☐ ☐

5. Checklist for one day Training Programme in Delhi Yes No

1. Have I reserved the tickets? ☐ ☐
2. Have I taken the money? ☐ ☐
3. Have I taken the dresses? ☐ ☐
4. Have I taken the Laptop? ☐ ☐
5. Have I taken the documents? ☐ ☐
6. Have I taken the notes for training? ☐ ☐
7. Have I taken the confirmation letter? ☐ ☐

☐ ☐

8. Have I taken the venue address?

Recommendations 16M BTL3

I. Recommendations to preserve our water resources:-

1. It is recommended to observe rain water harvesting by all.
2. It is important to control sand smuggling.
3. It is necessary to construct rain water storage tanks.
4. It is recommended to encourage the people for afforestation.
5. It is essential to conduct awareness programmes.
6. It is advised to plant native and adaptive plants.
7. It is recommended to water gardens and fields early in the morning to avoid evaporation.
8. It is highly recommended to recycle the water.

II. RECOMMENDATIONS

1. Write a set of eight recommendations to preserve our water resources.

Ans: Title : Recommendations to preserve our water resources:-

9. It is recommended to observe rain water harvesting by all.
10. It is important to control sand smuggling.
11. It is necessary to construct rain water storage tanks.
12. It is recommended to encourage the people for a forestation.
13. It is essential to conduct awareness programmes.
14. It is advised to plant native and adaptive plants.
15. It is recommended to water gardens and fields early in the morning to avoid evaporation.
16. It is highly recommended to recycle the water.

2. Power cut is a major problem in southern parts of India and it badly affects small scale industries. Write a set of eight recommendations to ensure continuous power supply to the small scale industries. **(AUC DEC-JAN 2016)**

Ans: Title : Recommendation to ensure continuous power supply to small scale industries

1. It is recommended that UPS may be installed.
2. It is recommended to create general awareness among public and educate them to save energy resources.
3. It is recommended to introduce feasible solar systems as an alternative source of energy.
4. It is recommended to take adequate measures to implement plants to generate power through pedal power.
5. It is recommended to learn to conserve electricity.
6. It is recommended to use net metering technology which is eco-friendly and economical.
7. It is recommended to tap more alternative sources.
8. It is recommended to generate bio mass power.

3.Write a set of eight recommendations to reduce unemployment problem.

Ans: Title : Eight recommendations to reduce unemployment problem.

1. It is recommended that the government can increase the number of technical training institutes.
2. It is recommended to give loans to encourage self-employment.
3. It is recommended to introduce entrepreneurship courses in the school and college curriculum.
4. It is recommended to give subsidies to encourage the entrepreneurs.
5. It is recommended to start more industries in rural and suburban areas.
6. It is recommended to encourage private sectors to generate employment.
7. It is recommended that the government can ensure employment to at least one person in a family.
8. It is recommended to employ the unemployed graduates for additional government duties like elections duties etc.

4.There are many social problems such as poverty and hunger in India, which need to be solved. Write a set of eight recommendations to solve these problems.
Ans : Title : Eight recommendations to solve social problems such as poverty and hunger in India

1. It is recommended that the government can measures to increase exports.
2. It is recommended to concentrate on the development of the small scale industries.
3. It is recommended to provide loans for small business in rural areas.
4. It is recommended to create livelihood opportunities for the poor and the needy by the state government.
5. It is recommended that the charitable institutions can support the government to eradicate hunger and poverty.
6. It is recommended that the multinational companies can be encouraged to start business for the increase of job opportunities and income.
7. It is recommended that the children suffering from malnutrition can be adopted by social organizations.
8. It is recommended to take necessary steps to monitor whether the deserving people are benefitted of the services provided for them.

5.Write a set of eight Recommendations to make environment clean and less polluted.

Ans : Title : Eight recommendations to make environment clean and less polluted.

1. It is recommended to use renewable resources which can be replenished.
2. It is recommended to start replenish forests for producing raw materials and increasing the area under forest.
3. It is recommended to ban killing or poaching of animals.

4. It is recommended to preserve natural habitat for animals.
5. It is recommended to monitor and survey the maintenance of greenery around by the concerned officials.
6. It is recommended to encourage growing of more trees.
7. It is recommended to stop using plastics and burning of it.
8. It is recommended to use eco-friendly appliances and gadgets.

6.Write a set of eight recommendations for selecting a proper fuel.

Ans : Title : Eight recommendations for selecting a proper fuel.

1. It is recommended to select such a fuel which can burn easily.
2. It is recommended to select the fuel which produces sufficient energy.
3. It is recommended to select the fuel which is available in plenty.
4. It is recommended to select the fuel for which the storage is easy and safe.
5. It is recommended to select such a fuel which does not pollute the air on burning.
6. It is recommended to select a fuel which does not leave behind much residue.
7. It is recommended to select a fuel for which the transportation is easy and safe.
8. It is recommended to select an inexpensive fuel.

UNIT II READING AND STUDY SKILLS 12

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting charts, graphs- **Vocabulary Development-**vocabulary used in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

PART*A

Impersonal Passive 2M BTL1

1. **The company had manufactured high powered engines.**

   High powered Engines had been manufactured

2. **One can easily solve this problem.**

   This problem can be solved

3. **Users have maintained this pump themselves.**

   This pump has been maintained

4. **The men are laying roads in many parts of the city.**

   Roads have been laid in many parts of the city.

5. **The Cricket Board men offer to give 1400 transmitters.**

   1400 transmitters have been offered.

6. **They will start production on the new type of reactor soon**.

   New type of reactors production with soon be started.

7. **We pass an electric current across the electrodes**

   An electric current will be passed across the electrode.

8. **The workers are repairing the bridge.**

   The bridge is being repaired .

9. **We can cast this metal into very complicated shapes**.

   This metal can been casted into very complicated shapes

Write the sentence into Passive form 2M BTL1

1. I can answer the question- The question can be answered by me.
2. She would carry the box. – The box would be carried by her.
3. You should open the window – The window should be opened by you.
4. We might play cards. - Cards might be played by us.

5. You ought to wash the car. – The car ought to be washed by you.
6. He must fill in the form. – The form must be filled in by him.
7. They need not buy bread. – Bread need not be bought by them.
8. He could not read the sentence. - The sentence could not be read by him.
9. Will the teacher test our English? - will our English be tested by the teacher?
10. Could jenny lock the door? – Could the door be locked by jenny?

II Numerical Adjectives. 2M BTL1

Rewrite the following as numerical expressions

1. A flask with a capacity of 10 liters- A 10 liter flask
2. A journey of 20 miles- A 20 mile journey
3. A squad of 1000 men- A 1000 men squad
4. A civilization which in 2000 years old- 2000 year old civilization
5. A project of 10 years- A 10 year project.
6. A match lasting five days- A five day Lasting match.
7. At intervals of 10 minutes- A 10 minute interval
8. A DC supply of 240 volts- A 240 volt DC supply
9. A lamp of a power of 60 watts- A 60watts power Lamp.
10. An investment of Rs. 3, 50,000- A 3, 50,000 investment.
11. A book in six volume – a 6 volume book
12. An engine with 100 cc power – a 100 cc power engine
13. A walk of five kilometers – A 5 kilometer walk
14. A drive for 8 hours – A 8 hour drive
15. A committee of 6 members – A 6 member committee
16. A rope with a length of 5 meters – A 5 meter rope
17. A can with a capacity of 25 liters – A 25 liter tank
18. A training programme for 25 days - A 25 day training programme
19. An auditorium of 1000 capacity – A 1000 capacity auditorium
20. A pen drive with 16 GB storage. – A 16 GB pen drive
21. A lab with 30 computers – A 30 computer lab
22. The pipe is 3 feet long – A 3 foot pipe

23. A colony with 200 houses – A 200 house colony
24. A road measuring 100 feet – A 100 foot road
25. A video running for 40 seconds – A 40 second video.

Interpreting charts and graphs.16M BTL-4

Look at the following information and graph about the pass percentage of the students in the plus two examination. Analyze the given data and write a short review of the pass percentage of the student in a paragraph of not more than 120 words:

About John Higher Secondary School

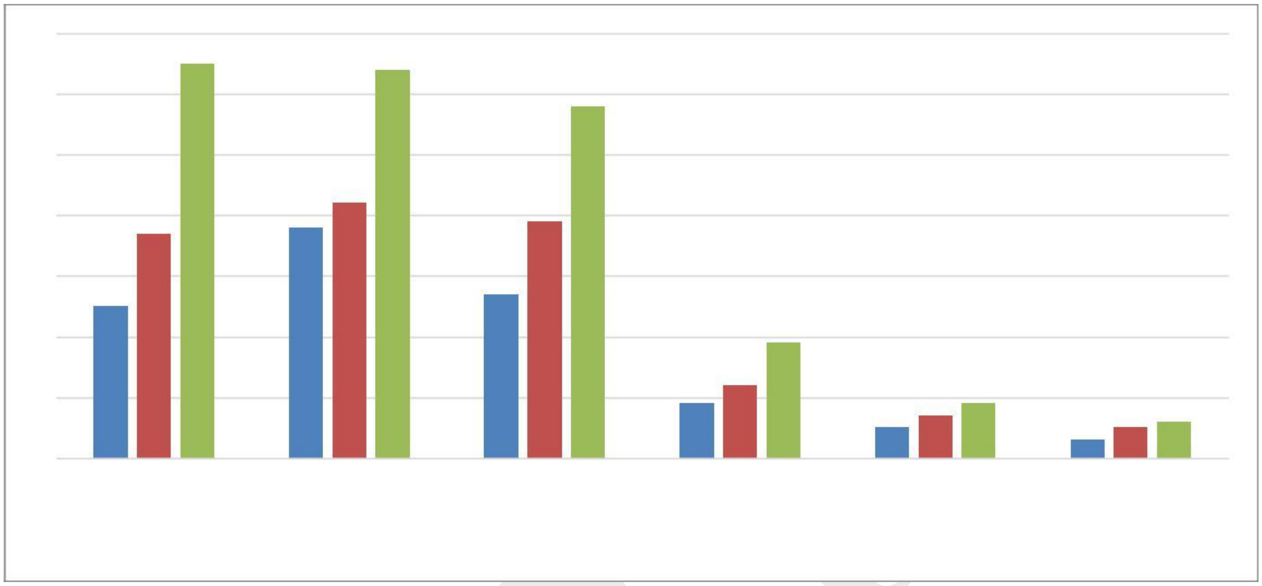
This school was started in a village to cater to the needs of the poor people.

In 2011, many experienced teachers left the school .

After reviewing the low performance of the students in the plus-two examination, the infrastructure facilities were improved and teachers were given adequate training to teach their subjects effectively

Besides, the management has started giving special incentives to the teachers who give cent percent results in the examination.

II. The following chart represents the arrival of tourists from different regions. Analyze the given data and write a paragraph:

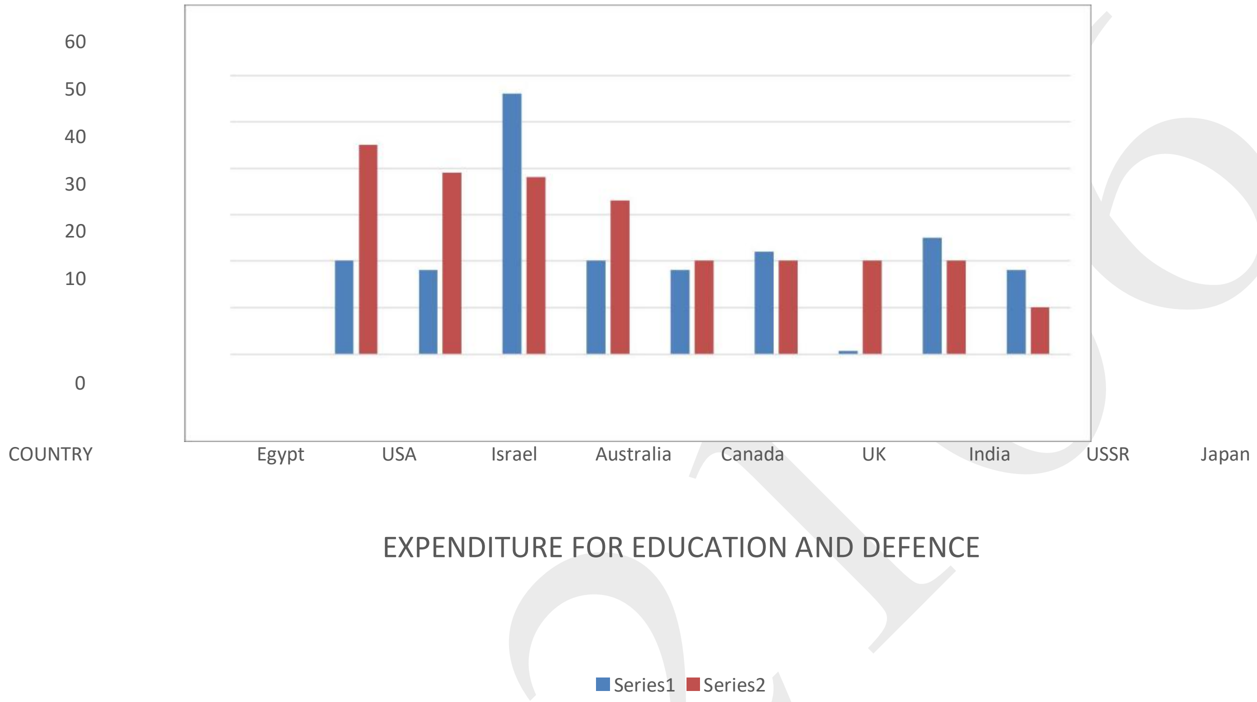


X- axis – Tourists arrival from region of origin

□		2012	2.5	3.8	2.7	0.9	0.5	0.3
□		2013	3.7	4.2	3.9	1.2	0.7	0.5
□		2014	6.5	6.4	5.8	1.9	0.9	0.6

Y-axis- Tourists who visited India in millions

Look at the following bar chart which describes the expenditure on education and defense of the total expenditure incurred by different countries. Write a paragraph presenting the information contain in it using expressions of comparison.


60
50
40
30
20
10
0
COUNTRY
Egypt
USA
Israel
Australia
Canada
UK
India
USSR
Japan
EXPENDITURE FOR EDUCATION AND DEFENCE
Series1
Series2

Unit-III

TECHNICAL WRITING AND GRAMMAR 12

Listening- Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

PART*A

1. I**. Sequence Words** 2M BTL1

Fill in the blanks with appropriate sequence words.

1. Half an hour passed, but there was no sign of bus. -------------, we decided to go home.
2. The documents will be scrutinized by the bank officials. ------------ they will sanction th loan.
3. To reduce weight, ----------- create rigorous exercise.
4. When air conditioner is used reversed. ---------reverse mechanism, hot air is propelled towar indoor and cool air towards outdoor.
5. How can you lay two audio tracks --------- in Windows Live Movie Maker?
6. ---------- you buy a new lay out you should decide on what you really need.
7. In the process of making chocolates, firstly the cocoa beans are finely ground. ----------, it mixed with cocoa butter and sugar and then smoothened.
8. Cheese is a concentrated source of many of the nutrients in milk. -----the usual cheese making process, the amount of various nutrients retained depends on the

(a)Then press the "Send" option.

(b) Next type your message and add "smileys" or images, if you want.

(c) To begin with, go to "messages"

(d) After that "Add" the contact number of the recipient.

(a) Then, the tea water is filtered and is served with sugar cubes.

(b) First, water is taken in a kettle and is allowed to boil.

(c) After that, the decoction is allowed to settle down.

(d) Next, tea leaves are added to the boiling water.

(a) First, the clothes and soap powder are put in the respective slots.

(b) Water is drawn repeatedly as per requirement to wash and rinse.

(c) When the start button is pressed the machine starts to draw water from the tap and the operation starts after the tank is full.

(d) Finally clothes are dried.

(a) The image is charged with electricity.

(b) The document for taking photocopy is kept in the machine.

(c) Then, an ink powder called toner sticks to the charged parts of the image and is transferred on to paper.

(d) Secondly, a bright light reflects the image of the document on to a plate or drum.

(a) After you enter your information, click "Sign Up"

(b) On here you will need to enter your information.

(c) Towards the right side of the screen you will see a "sign up" screen.

(d) Go to www.facebook.com.

3. **Misspelt word 2M BTL3**

Correct the spelling of the misspelt words.

1. Occasion- occasion
2. Committee- Committee.
3. Tomorrow- tomorrow
4. Charactar- Character.
5. Greatful- Grateful
6. Neessary- Necessary
7. Sychology- Psychology
8. recieve -receive
9. leisue- Leisure.
10. Apetite- Appetite
11. Careulness-Carefulness
12. Exceled- Exceled
13. Prohiited- Prohibited
14. Groupped- grouped
15. Earnned – Earned.
16. Transmited- Transmitted.
17. Aloted – Allotted
18. Refering- Referring

19. Traping – Trapping
20. Stimuleted- Stimulated

4.

Embedded Sentences [BTL2]

Complete the following sentences with appropriate Embedded Clauses

1. The music, ________________________ gave me a headache.
2. The old lady, _______________________ waited for a taxi.
3. The bus, _________________________ sped down the street.
4. The loaf of bread, ___________________ was spoilt.
5. The singer, _________________________ was the chief guest on our College Day.
6. The child, __________________________ was crying in the super market
7. The airplane,____________________ finally landed at the airport
8. The elderly man, _________struggled to cross the road
9. The astronaut,_______________ was received warmly at the airport.
10. The boy, ___________________________ is from our college

PART *B

I. Describing a process 16 BMTL-4

1. Describe the process involved in opening a bank account.
2. Describe the process of mending the puncture tube of your two-wheeler.
3. Describe the process involved in making a cup of tea.
4. Describe the process involved in sending an email attachment to your friend.
5. Describe the process involved in becoming successful orator.
6. Describe the process involved in m king a glass of lemon juice

Process:
Explanation in a paragraph or two-
Presentation -4
Content – 8
Sentence format- 4

Reading Comprehension

(a) Read the following passage carefully and answer the questions below it:

The latest buzz word in the continuing debate about the environment is “sustainable management”- that means using plants and animals for our benefit, but ensuring that enough is left alive to guarantee the survival of the species. This sounds good, but is it practical in reality? In spite of years of scientific research, no one really knows how much damage human beings are doing to their environment. We know that, they are responsible for many problems ranging from global warming to ozone depletion, and there is no doubt that they have a devastating effect on animal and plant life on earth. About 50,000 animal and plant species are becoming extinct every year. All species depend on some way on one another for survival. If you remove one species from this complex web of inter relationships, we have little idea of the repercussions on the ecosystem in general. What makes things more complicated is the fact that unlike global warming - which, if the political will was there, could be reduced by cutting gas emissions -preserving bio diversity- remains a difficult dilemma. There are also questions about whether sustainable management is practical as far as protecting areas of great bio-diversity such as the world's tropical forest are concerned. In theory, the principle should be to cut a number of trees, but not so many as to completely destroy the forest.

Sustainable Management of trees requires controls on the number of trees which are cut down as well as investment replacing them. Most tropical forests exist in poor countries which depend on logging to make money. Foremost loggers in these countries, making money means cutting down as many trees as Possible in the shortest time. The price of trees remains stable, varying by 4-5% annually, whereas the interest rates in most developing countries can create 15% or more in returns. It therefore makes little sense, and certainly no economic sense, to Delay tree felling. One solution could be to insist that wood comes from sustainable managed forests. In theory, consumers would buy only this wood and force logging companies to go "green" or else out of business. Unfortunately, unrestricted logging is more profitable than wood from sustainable managed forests which would cost unto 5 times more to control. Consumers would not be prepared to pay the extra sum just to protect the environment. The sad fact is that there is no practical solution to protect vegetation and wildlife of tropical forests in the future. It is estimated that these forests contain anything form 50-90 percent of all animal and plant species of the earth. In one study of kilometer square area of rain forest in Peru, for example, scientists counted 1300 species of butterfly and 600 species of birds. In the entire USA only 400 species of butterfly and 700 species of birds have been recorded. Sustainable Management represents gigantic experiment. If this doesn't work, we cant move to another planet to escape. It is a case of one planet, one experiment!

Complete the following statements choosing from one of the given alternatives

(i) The extent of the damage being inflicted on our environment.......

	1. can be estimated by years of scientific research. 2. is being calculated by scientific research exactly. 3. is impossible to assess despite years of scientific research. 4. is thanks to years of scientific research, on the decrease. (ii) The term “Sustainable Management” means using plants and animals for our own benefit, but....... 1. assuring none are left alive to guarantee the survival of the species. 2. making sure that enough are left alive to guarantee survival of the species.
	The newlyweds agreed to be very ***frugal*** in their shopping because they wanted to save enough money to buy a house. **1. economical** 2. wasteful 3. interested
	Although Alex usually looks ***unkempt,*** he had a very neat appearance at his job interview. 1. orderly 2. handsome **3. messy**
5.	Paragraph writing 16M BTL3
	1. Write two paragraphs comparing the newspaper and the television as media of mass communication. Each of the paragraphs should not exceed 200 words. 2. Write two paragraphs, one describing the benefits of technology the other describing the drawbacks of technology. Each paragraph should not exceed 200 words.

	3. Imagine yourself to be in the year 2050 and you are in your early 70's. The fuel position is very bad. Describe how life was fifty years ago when fuel was easily available. Write this in about 170-200 words. 4. Describe in about 170-200 words the utility, function with advantages and disadvantages of a washing machine. 5. Imagine yourself to be living in the year 2050 and you are in your early 70's. The fuel position is very bad. Describe how life was fifty years ago when fuel was easily available. Write this for about 170- 200 words. 6. Write two paragraphs, one describing the advantages and disadvantages of Mass media. 7. Write a paragraph on Population explosion. 8. Write a paragraph on Information Technology in India. Content- 6 Sentence completion 2 Grammar/ spellings 4 Presentation 4 a. The importance of social media in today's world. b. Donate blood and save lives. c. Student's approach to library in the current scenario. d. Going away from nature is happening naturally- Discuss. e. Outdoor and Indoor Games.
6.	
	1. Objective/ Multiple type: 1 per question 2. True or False: 1m/ Question 3. Short note: 2m if any

UNIT IV	**REPORT WRITING** **12**
Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-**Vocabulary Development**-finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.	
Sr.No	**PART* A**
1	**Clauses- If conditional** 2M BTL2 1. If he communicates effectively, **he will get selected**.

2. If he had performed well, **he would have passed**
3. If I got up earlier, **I would catch the train**.
4. If the new material had come in time, **we would have transferred the goods**.
5. If you planned well, **you could finish the project**.
6. If I had a net connection, **I would send the email**.
7. If I were you, **I would enjoy the trip**.
8. If you went for a walk every day, **you would maintain your health well**.
9. If people follow traffic rules, **the city can avoid traffic congestion**.
10. If you practised hard, you **would pass** (pass) the exam easily.
11. If the traffic rules are followed, there ---------**will be**---------- (be) very less accidents.
12. If I drop this, it **_______will explode_________** (explode).
13. If I had seen you, I **__would have invited_** (invite) you.
14. If the child goes out in the rain, it ______ (catch) cold. **Ans : will catch**
15. If I were an astronaut, I ______ (visit) the space station. **Ans : would visit**
16. If the boys do not practice, they ______ (lose) in the finals. **Ans : will lose**
17. If there had been good rains, the corps ______ (grow) well. **Ans : would have grown**
18. If I get a new job, _____________________ **Ans : If I get a new job, I will take my family to a holy place for prayer.**
19. _________________ , she would have completed her journey.
Ans : If Rita has joined the crew, she would have completed her journey.

3 PART* B

Ten Quick Tips on Writing a Professional Email 16M BTL3

1. Always fill in the subject line with a topic that means something to your reader. Not "Decals" or "Important!" but "Deadline for New Parking Decals."
2. Put your main point in the opening sentence. Most readers won't stick around for a surprise ending.
3. Never begin a message with a vague "This." ("This needs to be done by 5:00.") Always specify what you're writing about.
4. Don't use ALL CAPITALS (no shouting!), or all lower-case letters either (unless you're e. e. cummings).
5. As a general rule, PLZ avoid textspeak (abbreviations and acronyms): *you* may be ROFLOL (rolling on the floor laughing out loud), but your reader may be left wondering WUWT (what's up with that).
6. Be brief *and* polite. If your message runs longer than two or three short paragraphs, consider (a) reducing the message, or (b) providing an attachment. But in any case, don't snap, growl, or bark.
7. Remember to say "please" and "thank you." And mean it. "Thank you for understanding why afternoon breaks have been eliminated" is prissy and petty. It's *not* polite.
8. Add a signature block with appropriate contact information (in most cases, your name, business address, and phone number, along with a legal disclaimer if required by your company). Do you *need* to clutter the signature block with a clever quotation and artwork? Probably not.

9. Edit and proofread before hitting "send." You may think you're too busy to sweat the small stuff, but unfortunately your reader may think you're a careless dolt.
10. Finally, reply promptly to serious messages. If you need more than 24 hours to collect information or make a decision, send a brief response explaining the delay.

1. **Start with a salutation**

Your email should open by addressing the person you're writing to. Sure, you can get away with leaving out the salutation when you're dashing off an email to your friend, but business-like messages should begin with:

- *Dear Mr Jones,* or *Dear Professor Smith,* (for someone you don't know well, especially if they're a superior)
- *Dear Joe,* or *Dear Mandy,* (if you have a working relationship with the person)

It's fine to use "Hi Joe", "Hello Joe" or just the name followed by a comma ("Joe,") if you know the person well – writing "Dear Joe" to one of your team-mates will look odd!

2. Write in short paragraphs

Get straight to the point – don't waste time waffling. Split your email into two to four short paragraphs, each one dealing with a single idea. Consider using bullet-points for extra clarity, perhaps if you are:

- Listing several questions for the recipient to answer
- Suggesting a number of alternative options
- Explaining the steps that you'll be carrying out

Put a double line break, rather than an indent (tab), between paragraphs.

3. Stick to one topic

If you need to write to someone about several different issues (for example, if you're giving your boss an update on Project X, asking him for a review meeting to discuss a payrise, and telling him that you've got a doctor's appointment on Friday), then don't put them all in the same email. It's hard for people to keep track of different email threads and conversations if topics are jumbled up.

4. Use capitals appropriately

Emails should follow the same rules of punctuation as other writing. Capitals are often misused. In particular, you should:

- Never write a whole sentence (or worse, a whole email) in capitals
- Always capitalise "I" and the first letter of proper nouns (names)
- Capitalise acronymns *(USA, BBC, RSPCA)*
- Always start sentences with a capital letter.

This makes your email easier to read: try retyping one of the emails you've received in ALL CAPS or all lower case, and see how much harder it is to follow!

5. Sign off the email

For short internal company emails, you can get away with just putting a double space after your last paragraph then typing your name. If you're writing a more formal email, though, it's essential to close it appropriately.

- Use *Yours sincerely,* (when you know the name of your addressee) and *Yours faithfully,* (when you've addressed it to "Dear Sir/Madam") for very formal emails such as job applications.
- Use *Best regards,* or *Kind regards,* in most other situations.
- Even when writing to people you know well, it's polite to sign off with something such as "All the best," "Take care," or "Have a nice day," before typing your name.

6. Use a sensible email signature

Hopefully this is common sense – but don't cram your email signature with quotes from your favourite TV show, motivational speaker or witty friend. Do include your name, email address, telephone number and postal address (where appropriate) – obviously, your company may have some guidelines on these.

It makes it easy for your correspondents to find your contact details: they don't need to root through for the first message you sent them, but can just look in the footer of any of your emails.

Putting it all together

Compare the following two job applications. The content of the emails are identical – but who would you give the job to?

i've attached my resume i would be grateful if you could read it and get back to me at your earliest convenience. i have all the experience you are looking for – i've worked in a customer-facing environment for three years, i am competent with ms office and i enjoy working as part of a team. thanks for your time

Or

Dear Sir/Madam,

I've attached my resume. I would be grateful if you could read it and get back to me at your earliest convenience. I have all the experience you are looking for:

- *I've worked in a customer-facing environment for three years*
- *I am competent with MS office*
- *I enjoy working as part of a team*

Thanks for your time.

Yours faithfully,

Joe Bloggs

E-Mail Writing 16M BTL3

1. Send an email to your friend sharing your experience about your College.
2. Send an email to your mother sharing your first weekend experience with your friends.
3. Imagine yourself to be the Team Leader in TCS and send a mail to your team appreciating successful completion of the Project.

Scheme of Marks :

Format – 6M
Key Words – 4M
Presentation- 2M
Content - 4M

4. **Letter of Job Application** 16M BTL 4

From

M. Raja,
45, Ragav Apartments,
Rajaji Nagar,

Chennai – 73

To

The Executive Director,
Godrej Company Limited,
455, Greams Road,
Chennai – 600 035

Sir,

Sub: Application for the post of Production Manager – Reg.

Ref: With reference to the advertisement in “The Hindu” dated 18.02.2012

I am a Mechanical Engineering graduate. I have been working in “Prakash Furniture Ltd” as Production Manager for three years. I have managerial skills and inter-personal skills. I have enclosed my resume for your perusal.

Expecting your intimation letter

Thanking you,

Yours faithfully,

(M.Raja)

RESUME

M. Raja
45, Ragav Apartments,
Rajaji Nagar, Mobile: 9944488077
Chennai – 73 E-mail:
raja.m@gmail.com

—

OBJECTIVE

To pursue a challenging position in whatever I do and to contribute towards the growth of the organization.

EDUCATIONAL QUALIFICATION:

B.E - Mechanical Engineering – 90%
ABC Engineering College, Chennai – 13
May 2008

HSC - Govt. Higher Secondary School - 85%
Chennai – 73
May 2004

EXPERIENCE:

July 2009 – till date - Production Manager,
Prakash Furniture Ltd,
Trichy.

July 2008 – July 2009 - Junior Production Manager,
Rahul Furniture Ltd.,
Rasipuram, Namakkal. (Dt)

ACHIEVEMENTS:

- University gold medalist at UG Level.
- Won the best project award.
- Presented many papers in conferences and seminars.

RESPONSIBILITIES:

- Sports secretary in 12th std.
- Class representative from 10th std.
- Captain of college football team.

REFERENCES:

1. Dr. V. M. Periasamy,
   Principal,
   BSA Engineering College,
   Nagarkoil.

2. Mr. Ashok Kumar,
   The General Manager,
   Prakash Furniture Ltd.,
   Trichy.

PERSONAL PROFILE:

Name : M. Raja
Date of Birth : 12.08.1987
Age : 29
Gender : Male
Father's Name : R. Manikkavasagam

Nationality : Indian
Religion : Hindu
Languages Known : Tamil, English.

DECLARATION

I hereby solemnly declare that all the information made is true to the best of my knowledge and belief.

Thank you,

Yours faithfully,

Place: Chennai
Date: 20.02.12

(M. Raja)

1 .Write a letter of application for the post of an Assistant Engineer to The Human Resource Manager, HRC Communication Ltd., 390, Lake View Road, Santhome, Chennai – 600 004. Attach a separate resume with your letter. **(AU, May/June 2014)**

2.Write a letter of application for the post of Team Leader to The Human Resource Manager, Mayday Motors Ltd., 327, G.T. Naidu Road, Coimbatore. Write the details of your qualification and experience within the application letter. **(AU, May/June 2014)**

3.Write a letter of application for the post of a Junior Engineer to the Divisional Engineer, Mambalam Division, Chennai Telephones, 786, Anna Salai, Chennai – 35. Attach a suitable bio-data with the application.

4. The Chief Engineer of Public Works Department, Kancheepuram, wants to make you a member of the technical committee on Road Developments in Kancheepuram. Write a letter of thanks to him and also enclose your resume with your letter. **(AU, May/June 2013)**

5. Draft a letter of Job Application in response to the following advertisement. Candidates holding a bachelor's / master's degree with a background in engineering are required for work on company for the post of engineer. Applicants' must also possess excellent writing skills and the ability to effectively and CV to Mr.Promod Tiwari, Human Resources Dept., Exclusive software, North Main Street, Chennai – 67. **(AU, May/June2012)**

6.You have come across the following advertisement in the newspaper on 12th June 2014. Write a letter of application and detailed CV to one of the posts selected:

A leading private sector company in India needs the following engineers for the various projects in India **(AU, May/June2015)**

1. CIVIL/MECHANICAL ENGINEERS
2. ELECTRICAL / MANUFACTURING ENGINEERS
3. CHEMICAL ENGINEERS
4. COMPUTER SCIENCE ENGINEERS

1 to 3 years of experience
Should be able to work in a team
Good communication skills

Apply to
The Managing Director,
L and T Ltd.,
Bangalore – 5
Email ID : landtl4@gmail.com

7. You come across the following advertisement

(AU, May/June2015)

Company Name : Way Staffing
Location : Thane, Pune
Nationality : India
Salary : 6.50 – 8.50 lacs
Experience : 3 – 8 yrs
Education : B.E. / B.Tech

- IT
- Manufacturing/ Engineering / R&D

Posted on : 30th August 2018

Role : Technical Support Engineer
Civil Engineer
Electrical Engineer
Industry : Engineering,
Procurement
Construction

8. Prepare a detailed CV to be uploaded in the website.

8. Read the following advertisement published in "The Times of India" and write a letter of application. Enclose your resume with the letter of application. **(AU, Nov/Dec, 2014)**

Job : Software Engineer
Company : Kamal Info Systems Private Limited
Location: Hyderabad
Eligibility : B.E. / B.Tech
Skills: Capital Markets, Object Oriented Project Planning, Design Patterns in Java, C++
Send your application with the resume to: The HR Manager, Kamal Info Systems Private Limited, No.14, Greams Road, Hyderabad – 500 002.

Scheme of Marks :
Format – 6M
Presentation- 4M
Content - 6M

	UNIT V **GROUP DISCUSSION AND JOB APPLICATIONS** 12
	Listening- TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting-accident and survey **Vocabulary Development- verbal analogies Language Development-** reported speech
	PART* A
1	**Reported Speech** 2M BTL 3 1. "I will work hard to get first class" said Lazar (D.S.) Lazar said he would work hard to get first class. (I.S.)

2. "You can do this work" said Nelson to Johnsi (D.S.)
Nelson told Johnsi that he could do that work. (I.S.)

3. He says, "I am glad to be here this evening"(D.S.)
He says that he is glad to be there that evening. (I.S.)

4. "I'm going to the library now" said David (D.S.)
David said that he was going to the library then. (I.S.)

5. "Don't talk in the class" said the teacher to the boys. (D.S.)
The teacher advised the boys not to talk in the class. (I.S.)

6. "Please give me something to eat. I am hungry" the old man said to them. (D.S.)
The old man requested them to give him something to eat and said that he was hungry (I.S.)

7. Mohan said to Stalin, "Why did you not attend the meeting yesterday"? (D.S.)
Mohan asked Stalin why he had not attended the meeting the day before. (I.S.)

8. "How often do you go to the theatre?" said David to John. (D.S.)
David asked John how often he went to the theatre. (I.S.)

9. Alas! I have broken my brother's watch" said he.
He exclaimed sorrowfully that he had broken his brother's watch. (I.S.)

10. "How beautiful the flower is!" said Kumar. (D.S.)
Kumar exclaimed joyfully that the flower was very beautiful. (I.S.)

11. "Won't you help me to caary this box?" said I to my friend. (D.S.)
I asked my friend if he would not help me to carry that box. (I.S.)

12. Mohan said to Stalin, "Why did not you attend the meeting yesterday"? (D.S.)
Mohan asked Stalin why he had not attended the meeting the day before. (I.S.)

13. "How often do you go to the theatre?" said David to John. (D.S.)
David asked John how often he went to the theatre. (I.S.)

14. Mohamed said to Sultan, "Do you like mangoes?" (D.S.)

Mohamed asked Sultan if he liked mangoes. (I.S.)

15. The teacher has said to the pupils, "Sea-water is different from the river water.".

The teacher has told the pupils that sea-water is different from river water.

16. David answered, "The Mines are under the ground".

David answered that the Mines are under the ground.

17. John said to his brother, "The U.N.O. is a world organization".

John told his brother that the U.N.O. is a world organisaiton.

18. The Science teacher told the class, "Ice floats on water.".

The Science teacher told the class that ice floats on water.

19. "I don't know the way. Do you?" he asked.

He said that he didn't know the way and asked her if she did.

20. She said, "Oh! It's a snake. Don't go near it, children."

She exclaimed with disgust that it was a snake and told the children not to go near it.

21. "I the floods get any worse we must leave the house", he said.

(must = will have to)

He said that if the floods got any worse they would have to leave the house.

22. "I have just received a letter", he said; "I must go home at once".

He said that he had jus treceived a letter and would have to go home at once.

23. Angel said, "I brought a pen yesterday". (D.S)

Angel said that she had bought a pen the day before. (I.S)

24. John said, "I am going to church". (D.S)

John said that he was going to church. (I.S)

25. He said, "I have been reading a novel". (D.S)

He said that he had been reading a novel. (I.S)

2 **Verbal Analogies: 2M BTL3**

1. **Sing : hum :: Talk : ______**
   a. murmur b. whisper c. **mumble** d. shout
2. **Liquid : liter**
   a**. Weight : kilogram** b. Land : seismometer c. Bushel : corn d. Fame : television
3. **If Dawn: Morning, then Dusk: ________**

   a. **Evening :** b. Night : c. Darkness : d. Fog

4. If Parson lives in Parsonage, then Pioneer lives in _________

a. Cottage : b.**Wagon :** c.Monastery : d. Barracks

5. If Ravens: Croak, then Ducks: __________

a. Talk : b. Gobble : c. Squeak : d. **Quack**

6. If Bears: Growl, then Asses: ______

a. Growl : b. **Bray** : c. Purr : d. Bleat

7. ______ : trail:: grain : grail

a. train : b. path : c. wheat : d. holy

8. particular : fussy :: ______ : subservient

a. meek : b. above : c. cranky : d. uptight

9. ______ : horse :: board : train

a. stable : b. shoe : c. ride : d. mount

10. tureen : ______ :: goblet : wine

a. napkin : b. soup : c. spoon : d. pilsner

11. son : nuclear :: ______ : extended

a. father : b. mother : c. cousin : d. daughters

12. coif : hair :: ______ : musical

a. Shower : b. close : c. praise : d. score

13. feta : Greek :: provolone : ______

a. salad : b. Swiss : c. blue : d. Italian

14. moccasin : snake :: ______ : shoe

a. alligator : b. w**aders** : c. asp : d. loafer

15. ______ : zenith :: fear : composure

a. apex : b. **heaven :** c. heights : d. nadir

16. pill : bore :: core : ______

a. **center** : b. mug : c. bar : d. placebo

17. pilfer : steal :: ______ : equip

a. return : b. damage : c. exercise : d. furnish

18. **native : aboriginal :: naïve : ______**

a. learned : b. **arid** : c. unsophisticated : d. tribe

19. junket : ______ :: junk : trash

a. trounce : b. trip : c. refuse : d. trinket

20. _____ : festive :: funeral : somber

a. tension : b. soiree : c. eulogy : d. **sari**

21. fetish : fixation :: slight : ______

a. flirt : b. sloth : c. insult : d. confuse

22. hovel : dirty :: hub : ______

a. unseen : b. prideful : c. **busy** : d. shove

23. bog : ______ :: slumber : sleep

a. dream : b. **foray** : c. marsh : d. night

24. ______: segue :: throng : mass

a. **subway :** b. church : c. transition : d. line

PART * B

3. **Minutes of a Meeting 16M BTL 3**

	1. Write the minutes of the meeting of organizing a cultural event in the college. Discuss about the budget, responsibilities for organizing functions, Programme, guests and honor, food, stage decoration, logistics, food, publicity. As the secretary, write the minutes of meeting. **2.** Write Minutes of meeting for the class committee meeting held on 19th January 2019. **3.** Write Minutes of meeting for the research meeting over the project with the panel members held on 20th January 2019. **4.** Write Minutes of meeting for the celebration of College day on 24th of march 2018. **5.** Write Minutes of meeting for the meeting between the officer in the Environment Pollution Authority and the Transport Department authority regarding air pollution. **Scheme of Marks :** **Format** – 6M **Presentation-** 4M **Content** - 6M
4.	**Report Writing 16M BTL 4** 1. You are working as a Technical Manager in a Software Company, Hidalco Inc. There was a fire accident in your warehouse which resulted in the damage of goods stored there. Your MD asks you to investigate the cause of the accident and send a report. (2018) 2. Your college administration wants to find what students feel about your college's environment and facilities. As student advisor you have been asked to conduct a survey among students about college infrastructure and environment. Conduct a survey on these topics and submit a report to your Dean.(2018) 3. A company is planning to set up a small shoe unit in a small village 20km from Ranipet. You are asked to prepare a suitable report about the feasibility of starting the factory. Mention the availability of raw materials and labour in your area. 4. Write a survey report on the reading habits of engineering students for submission to your college principal. Also give a set of recommendations for enhancing the reading habits of technical students. 5. You are the Works Manager in Industrial Gases Limited where LPG Cylinders are filled for utilization by the consumers. Write a report about an accident that happened in the LPG section in which three workers were seriously injured. **Scheme of Marks :** **Format** – 6M **Presentation-** 4M **Content** - 6M formal report may include the following points 1. Title Page 2. Executive Summary 3. Abstract

4. Objective
5. Technical details
6. Cost estimation
7. Management Plan
8. Conclusion
9. Recommendations

Title Page

Imagine that you are going to start a language lab in your Institution. Write a detailed proposal about the need for establishing the lab to the General Manager.

A PROPOSAL TO ESTABLISH THE LANGUAGE LAB

SUBMITTED TO
Mr. R. Ravichandran
The General Manager
ABC Group of Institutions
Chennai-28

SUBMITTED BY
Mr. G. Sathiaraj
Department of English
ABC Engineering College
Chennai- 28

DATE
10th April 2013

A. Executive Summary

1. Project Title : Establishing Computer Assisted Language Lab
2. Name & Designation of the Department : Mr. G. Sathiaraj., Asst. Prof
   Department of English
   ABC Engineering College
   Chennai- 28
3. Duration of the Project : 3 Months
4. Amount Required : 20 lakhs

B. Abstract

Communication skills become inevitable in today's survival. Communication skill is expected by every IT firms. Everyone must have a good proficiency in English Language. To meet these expectations, it is proposed to establish a computer assisted language lab in our institution. So, the student could have been provided an independent learning opportunity and acquire the language proficiency.

C. Objective

To establish Computer Assisted language lab to improve and impart the language proficiency of the learning community.

D. Technical plan

It is planned to install 60 students systems with one Teacher control server. 15 different softwares for practice.

E. Cost Estimation

Product	Cost per Unit	Required Unit	Total Cost	Remarks
P-IV computer with 360 GB HD	35000	1	35000	
P-IV computer with 180 GB HD	30000	60	1800000	
Head Phones with Mike	500	61	30500	
Language Learning Softwares	15	1 each	300000	
Split A/C 1.5 ton	25000	2	50000	
Total	1946000			

F. Management Plan

1. The lab may be taken care by Department of English
2. Lab hours may be included in the Regular Time Table
3. One Technical Assistant may be appointed to assist.
4. One staff may be given in-charge.

	G. Recommendations So, It is recommended to establish a Computer Assisted Language Lab at our institution.

JEPPIAAR INSTITUTE OF TECHNOLOGY

QUESTION BANK
FIRST YEAR – 2nd SEMESTER
DEPARTMENT OF SCIENCE AND HUMANITIES

SYLLABUS

MA8251 ` MATHEMATICS – II L T P C
3 1 0 4

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix - Characteristic equation - Properties of eigenvalues and eigenvectors - Statement and applications of Cayley-Hamilton Theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation –Nature of quadratic forms.

UNIT II VECTOR CALCULUS 9+3

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem(excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT III ANALYTIC FUNCTIONS 9+3

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues –

Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

UNIT V LAPLACE TRANSFORM 9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,(2011).
2. Grewal. B.S, "Higher Engineering Mathematics", 41 st Edition, Khanna Publications, Delhi, (2011).

REFERENCES:

1. Dass, H.K., and Er. RajnishVerma," Higher Engineering Mathematics", S. Chand Private Ltd., (2011)
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, (2012).
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2008).

TABLE OF CONTENT

Subject Code: MA8251 **Year/Semester:** I /II
Subject Name: MATHEMATICS-II **Subject Handler:**

	UNIT-I MATRICES
	Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.
Q.No.	**PART-A**
1	**State Cayley Hamilton theorem and give its two uses.** **(NOV/DEC 2015)(MAY/JUNE 2012)** BTL1 Every square matrix satisfies its own characteristic equation. It is used to calculate i. The positive integral powers ii. The inverse of a square matrix.
2	**If λ_1, λ_2, …λ_n are Eigen values of a matrix A then show that $\frac{1}{\lambda_1},\frac{1}{\lambda_2},\ldots\frac{1}{\lambda_n}$ are Eigen values of A^{-1}.** BTL2 If λ_i and X_i are corresponding Eigen value and Eigen vector of A where i=1,2...,n. $AX_i =_i X_i A^{-1}\left(AX_i\right) = A^{-1}\left(\lambda_i X_i\right)$ $\Rightarrow IX_i = \lambda_i A^{-1} X_i$ $\Rightarrow X_i = \lambda_i A^{-1} X_i$ $\Rightarrow A^{-1}Xi = 1/\lambda_i X_i$ $\Rightarrow A^{-1} = 1/\lambda_i$ $\therefore 1/\lambda_i$ is an Eigen values of A^{-1}
3	**If $\lambda_1,\lambda_2,\ldots \lambda n$ are Eigen values of an n x n matrix A then show that λ_1^3, $\lambda_2^3\ldots$ λ_n^3 are Eigen values of A^3.** BTL2 Let λ be Eigen value of A and let X be Eigen vector of A. $\therefore$ AX = λ X $A^2X = A\lambda X= \lambda (AX) = \lambda (\lambda X) = \lambda^2X$

	$\therefore A^2 = \lambda$ Similarly, $A^3X = \lambda^3X \Rightarrow A^3 = \lambda^3$ $\therefore \lambda^3$ is an Eigen value of A^3.	
4	**If λ is the eigenvalue of the matrix *A*, then prove that λ^2 is the eigenvalue of A^2.** (APR/MAY 2019) Let λ be Eigen value of A and let X be Eigen vector of A. $\therefore \quad AX = \lambda X$ $A^2X = A\lambda X = \lambda(AX) = \lambda(\lambda X) = \lambda^2X$ $\therefore A^2 = \lambda$.	
5	**Two Eigen values of $A=\begin{pmatrix}2&2&1\\1&3&1\\1&2&2\end{pmatrix}$ are equal and are $\frac{1}{5}$ times to the third. Find them.** **(NOV/DEC 2014)** BTL1 Let $\lambda_1, \lambda_2, \lambda_3$ be Eigen values of A. Given $\lambda_1 = \lambda_2 = \frac{1}{5}\lambda_3$ We know sum of Eigen values = sum of diagonal elements $\lambda_1 + \lambda_2 + \lambda_3 = 7$ $\frac{1}{5}\lambda_3 + \frac{1}{5}\lambda_3 + \lambda_3 = 7$ $\frac{7}{5}\lambda_3 = 7$ $\therefore \lambda_3 = 5$ $\therefore \lambda_1 = \lambda_2 = 1$.	
5	**Find the Eigen values of A^2 given $A=\begin{pmatrix}1&2&3\\0&2&-7\\0&0&3\end{pmatrix}$.Also find A^3, A^{-1}, $2A^2$.** BTL1 We know the Eigen values of a triangular matrix are just the diagonal elements. Here given matrix is a upper triangular matrix $\therefore$ Eigen values of A are 1,2,3. We know that "if $\lambda_1, \lambda_2, \ldots\lambda_n$ are Eigen values of a matrix A,then $\lambda_1^m, \lambda_2^m, \ldots\lambda_n^m$ are Eigen values of A^m." $\therefore$ Eigen values of A^2 are 1,4,9.	

	$\therefore$ Eigen values of A^3 are 1,8,27. We know that if $\lambda_1, \lambda_2, \ldots\lambda_n$ are Eigen values of A then $k\lambda_1, k\lambda_2, \ldots k\lambda_n$ are Eigen values of KA $\therefore$ Eigen values of $2A^2$ are 2,8,18	
6	**If A is an orthogonal matrix Show that A^{-1} is also orthogonal.** BTL2 Let A be orthogonal matrix i.e. $A^T = A^{-1}$ Let $A^T = A^{-1} = B$ $B^T = (A^{-1})^T = (A^T)^{-1} = B^{-1}$ Therefore B is orthogonal. i.e. A^{-1} is an orthogonal matrix.	
7	**Prove that the product of 2 orthogonal matrices is an orthogonal matrix.** BTL5 Let A be an n^{th} order orthogonal matrix. $\therefore \quad AA' = A'A = I$ Let B be an n^{th} order orthogonal matrix. $BB' = B'B = I$ Now $(AB)(AB)' = AB\,B'A'$ $= AIA'$ $= AA'$ $= I$ Now $(AB)'(AB) = B'A'AB$ $= B'IB$ $= B'B$ $= I$ Since $(AB)(AB)' = (AB)'(AB) = I$. AB is orthogonal matrix.	
8	**If 1 and 2 are Eigen values of a 2 x2 matrix A, what are the Eigen values of A^2 and A^{-1}.** BTL1 Eigen values of A^2 are 1 and 4 Eigen values of A^{-1} are 1 and $\frac{1}{2}$.	
9	**If 2, 3 are the Eigen value of** $A = \begin{pmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ b & 0 & 2 \end{pmatrix}$ **then find the value of b?** **(NOV/DEC 2013)** BTL1	

	Given Eigen values are $\lambda_1 = 2, \lambda_3 = 3$ Sum of the Eigen values = Sum of the main diagonal elements $\lambda_1 + \lambda_2 + \lambda_3 = 6$ $2 + 3 + \lambda_3 = 6$ $5 + \lambda_3 = 6$ $\lambda_3 = 1$ Product of the Eigen value = $\lvert A \rvert$ $(2)(3)(1) = 8 - 2b$ $6 = 8 - 2b$ $b = 1$	
10	**If the sum of two Eigen values and trace of a 3 x 3 matrix A are equal, find the value of |A|.** BTL1 Let $\lambda_1, \lambda_2, \lambda_3$ be the Eigen values of A. Then we have $\lambda_1 + \lambda_2$ = trace of A $\Rightarrow \lambda_1 + \lambda_2 = \lambda_1 + \lambda_2 + \lambda_3 \Rightarrow \lambda_3 = 0$. Hence |A| = product of Eigen values = $\lambda_1 \lambda_2 \lambda_3 = 0$	
11	**For a given matrix A of order 3, |A| = 32 and two of its Eigen values are 8 and 2. Find the sum of the Eigen values.** BTL1 Given Eigen value be $\lambda_1 = 8, \lambda_2 = 2$. Then (8)(2)($\lambda_3$) = |A| = 32 $\Rightarrow \lambda_3$ = 2 Let the third Eigen value be λ_3 = 2 Hence the sum of the Eigen values = $\lambda_1 + \lambda_2 + \lambda_3 = 8 + 2 + 2 = 12$	
12	**Find the sum and product of the Eigen values of the square matrix** $A = \begin{pmatrix} 8 & 1 & 6 \\ 3 & 5 & 7 \\ 4 & 9 & 2 \end{pmatrix}$**.** **(NOV/DEC 2010)** BTL1 Sum of the Eigen values = sum of the main diagonal elements = 8+5+2=15 Product of the Eigen values = $\lvert A \rvert = 8(10 - 63) - 1(6 - 28) + 6(27 - 20) = -360$	
13	**Find the sum of the Eigen values of 2A if** $A = \begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$. BTL1 If λ_1, λ_2, λ_3 are the Eigen values of A, then $\lambda_1 + \lambda_2 + \lambda_3 = 18$. We know that $2\lambda_1$, $2\lambda_2$, $2\lambda_3$ are the Eigen values of 2A.	

	Therefore the sum of Eigen values of 2A = 2 ($\lambda_1 + \lambda_2 + \lambda_3$) = 2 (18) = 36
14	**If the Eigen value of A are 3x3 are 2,3 and 1, then find the Eigen values of adjA. (NOV/DEC 2003)** BTL1 The Eigen values of are 2,3,1 The Eigen value of A^{-1} are $\frac{1}{2},\frac{1}{3},1$ The product of Eigen values are $(2)(3)(1)=\lvert A\rvert$ $\therefore \lvert A\rvert = 6$ We know that $A^{-1}=\frac{1}{\lvert A\rvert}adjA$ $adjA=\lvert A\rvert A^{-1}$ The Eigen value of adjA are $(6)\left(\frac{1}{2}\right),\ (6)\left(\frac{1}{3}\right),(6)1$ $\Rightarrow 3,2,6$
	If the eigenvalue of the matrix *A* of the order 3x3 are 2, 3 and 1, then find the determinant of *A*. (APR/ MAY 2019) The Eigen values of are 2,3,1 The product of Eigen values are $(2)(3)(1)=\lvert A\rvert$ $\therefore \lvert A\rvert = 6.$
15	**Find the sum of the squares of the Eigen values of $A=\begin{pmatrix}3&1&4\\0&2&6\\0&0&5\end{pmatrix}$.** **(NOV/DEC 2016)** BTL1 A is a triangular matrix. Therefore the Eigen values of A are 3, 2 and 5. The sum of squares of the Eigen values of $A^2 = 3^2 + 2^2 + 5^2 = 9 + 4 + 25 = 38$
16	**Find the Eigen values of 2A – I, given $A=\begin{pmatrix}-4&1\\3&-2\end{pmatrix}$.** BTL1

	$2\boldsymbol{A}-\boldsymbol{I} = \begin{pmatrix}-8 & 2\\ 6 & -4\end{pmatrix} - \begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix} = \begin{pmatrix}-9 & 2\\ 6 & -5\end{pmatrix}$ The Characteristic equation of 2A - I is given by $\vert 2\boldsymbol{A}-\boldsymbol{I}-\lambda\boldsymbol{I}\vert = 0 \Rightarrow \begin{vmatrix}-9-\lambda & 2\\ 6 & -5-\lambda\end{vmatrix} = 0$ $\Rightarrow \lambda^2+14\lambda+33 = (\lambda+11)(\lambda+3) = 0$ $\Rightarrow \lambda = -3, -11$	
17	**Prove that A and A^T have the same Eigen values.** BTL5 $\vert \boldsymbol{A^T} - \lambda\boldsymbol{I} \vert = \vert \boldsymbol{A}^{\mathrm{T}} - (\lambda\boldsymbol{I})^{\boldsymbol{T}} \vert = \vert (\boldsymbol{A}-\lambda\boldsymbol{I})^{\boldsymbol{T}} \vert = \vert \boldsymbol{A}-\lambda\boldsymbol{I} \vert.$ $\Rightarrow$A and A^T have the same characteristic equation and hence they have the same Eigen values.	
18	**Prove that Similar matrices have the same characteristic roots.** BTL5 LetA and Bbe two similar matrices, then there exists a matrix P such that $B = P^{-1}AP$. Hence $\vert \boldsymbol{B}-\lambda\boldsymbol{I} \vert = \vert \boldsymbol{P}^{-1}\boldsymbol{AP} - \boldsymbol{P}^{-1}\lambda\boldsymbol{IP} \vert = \vert \boldsymbol{P}^{-1} \vert \vert \boldsymbol{A}-\lambda\boldsymbol{I} \vert \vert \boldsymbol{P} \vert = \vert \boldsymbol{A}-\lambda\boldsymbol{I} \vert \vert \boldsymbol{PP}^{-1} \vert$ $= \vert \boldsymbol{A}-\lambda\boldsymbol{I} \vert$ i.e., A and B have the same characteristic equation. Therefore, they have the same Characteristic roots.	
19	**Is the matrix** $B = \begin{pmatrix}\cos\theta & \sin\theta & 0\\ -\sin\theta & \cos\theta` & 0\\ 0 & 0 & 1\end{pmatrix}$ **orthogonal? Justify.** BTL5 $\mathbf{BB^T} = \begin{bmatrix}\cos\theta & \sin\theta & 0\\ -\sin\theta & \cos\theta & 0\\ 0 & 0 & 1\end{bmatrix}\begin{bmatrix}\cos\theta & -\sin\theta & 0\\ \sin\theta & \cos\theta & 0\\ 0 & 0 & 1\end{bmatrix} = \begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix} = \mathbf{I}$ Similarly, $B^TB = I$. Hence B is orthogonal.	
20	**Use Cayley-Hamilton theorem to find** $A^4\text{-}4A^3\text{-}5A^2\text{+}A\text{+}2I$ **where** $A = \begin{pmatrix}1 & 2\\ 4 & 3\end{pmatrix}$**.** BTL3 $\vert \mathbf{A}-\lambda\boldsymbol{I} \vert = 0 \Rightarrow \begin{vmatrix}1-\lambda & 2\\ 4 & 3-\lambda\end{vmatrix} = 0 \Rightarrow \lambda^2-4\lambda-5 = 0 \Rightarrow \boldsymbol{A}^2-4\boldsymbol{A}-5\boldsymbol{I} = 0$ **(**By Cayley-Hamilton Theorem) $\Rightarrow \boldsymbol{A}^2(\boldsymbol{A}^2-4\boldsymbol{A}-5\boldsymbol{I}) = 0 \Rightarrow \boldsymbol{A}^4-4\boldsymbol{A}^3-5\boldsymbol{A}^2 = 0$ $\Rightarrow A^4-4A^3-5A^2+A+2I = 0 + A + 2I = \begin{bmatrix}1 & 2\\ 4 & 3\end{bmatrix} + \begin{bmatrix}2 & 0\\ 0 & 2\end{bmatrix} = \begin{bmatrix}3 & 2\\ 4 & 5\end{bmatrix}.$	

21	**Can** $A=\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}$ **be diagonalised? Why?(MAY/JUNE 2016)** BTL1 Yes. Even if the Eigen values of A are equal, namely 1, 1, it is possible to find two linearly independent Eigen vectors corresponding to the Eigen value 1.	
22	**Find the matrix of the quadratic from** $2x^2+2y^2+3z^2+2xy-4xz-4yz$**.** BTL1 The required matrix $A=\begin{bmatrix} coeff\ x^2 & \frac{1}{2}coeff\ \ xy & \frac{1}{2}coeff\ xz\\ \frac{1}{2}coeff\ \ yx & coeff\ \ y^2 & \frac{1}{2}coeff\ yz\\ \frac{1}{2}coeff\ zx & \frac{1}{2}coeff\ \ zy & coeff\ z^2\end{bmatrix}$ $A=\begin{pmatrix}2 & 1 & -2\\ 1 & 2 & -2\\ -2 & -2 & 3\end{pmatrix}$	
23	**Find the nature of the quadratic form** $x_1^2+2x_2^2+x_3^2-2x_1x_2+2x_2x_3$. **(MAY/JUNE 2010)** BTL1 $A=\begin{bmatrix} coeffx_1^2 & \frac{1}{2}coeffx_1x_2 & \frac{1}{2}coeffx_1x_3\\ \frac{1}{2}coeffx_2x_1 & coeffx_2^2 & \frac{1}{2}coeffx_2x_3\\ \frac{1}{2}coeffx_3x_1 & \frac{1}{2}coeffx_3x_2 & coeffx_3^2\end{bmatrix}$ $D_1=\begin{vmatrix}1 & -1 & 0\\ -1 & 2 & 1\\ 0 & 1 & 1\end{vmatrix}=\lvert a_{11}\rvert=1$ $D_2=\begin{vmatrix}1 & -1 & 0\\ -1 & 2 & 1\\ 0 & 1 & 1\end{vmatrix}=\begin{vmatrix}1 & -1\\ -1 & 2\end{vmatrix}=2-1=1$ $D_3=\lvert A\rvert=1$ The nature positive definite since all are positive values.	
24	**Write down the matrix corresponding to the quadratic form** $x^2+y^2+z^2+2zx+4\sqrt{2}yz$	

	BTL1 The required matrix $A=\begin{bmatrix} coeff\ x^2 & \frac{1}{2}coeff\ \ xy & \frac{1}{2}coeff\ xz \\ \frac{1}{2}coeff\ \ yx & coeff\ \ y^2 & \frac{1}{2}coeff\ yz \\ \frac{1}{2}coeff\ zx & \frac{1}{2}coeff\ \ zy & coeff\ z^2 \end{bmatrix}$ $A=\begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 2\sqrt{2} \\ 1 & 2\sqrt{2} & 1 \end{pmatrix}$	
25	**Write down the Quadratic Form corresponding to the matrix** $A=\begin{pmatrix} 2 & 1 & -2 \\ 1 & 2 & -2 \\ -2 & -2 & 3 \end{pmatrix}$**.** BTL1 The Quadratic Form of the matrix is $2x^2+2y^2+3z^2+2xy-4yz-4zx$	
26	**Define index and signature of a quadratic form. Find the index and signature of the quadratic form** $x_1^2+2x_2^2-3x_3^2$**.** BTL1 The number (p) of positive terms in the canonical form of a QF is called the index of the QF. The number of positive terms minus the number of negative terms is called the signature of the QF Index = 2 , Signature = 1	
27	**Find the constant 'a' and 'b' such that the matrix** $A=\begin{pmatrix} a & 4 \\ 1 & b \end{pmatrix}$ has 3 and -2 as eigen values. BTL1 Give the Eigen values are 3 and -2 Sum of the Eigen value of A are 'a' and 'b' Sum of the Eigen value $a+b=3-2=1$ $\therefore a+b=1$ …………………….(1) Product of the Eigen value $3(-2)=-6$	

	Product of the Eigen value of A are $\lvert A\rvert = ab-4$ $\therefore ab-4=-6$ $ab=-2$.....................(2) $(1)\Rightarrow \quad b=1-a$ $(2)\Rightarrow \quad ab=-2$ $a(1-a)=-2$ $a^2-a-2=0$ $(a-2)(a+1)=0 \quad \therefore a=2\,\&\,a=-1$ $when\;\; a=2\;then\;b=-1$ $when\;\; a=-1\;then\;b=2$ $\therefore a=2, b=-1\;or\;\;a=-1, b=2$	
28	**Find the Eigen values of 3A+2I , where** $A=\begin{pmatrix}5 & 4\\ 0 & 3\end{pmatrix}$ **.(MAY/JUNE 2007)** BTL1 The Eigen values of A are 5 and 2, The Eigen values of 3A+2I are 3(5)+2 and 3(2)+2 The Eigen values of 3A+2I are 17 and 8	
29	**If 3 and 5 are two Eigen values of the matrix** $A=\begin{pmatrix}8 & -6 & 2\\ -6 & 7 & -4\\ 2 & -4 & 3\end{pmatrix}$ **then find its third Eigen value and hence** $\lvert A\rvert$**. (MAY/JUNE 2018 R-17)** BTL1 Given Eigen value be $\lambda_1=3, \lambda_2=5$. Sum of the Eigen values= Trace of A $\lambda_1+\lambda_2+\lambda_3=8+7+3=18$ $\therefore \lambda_3=18-8=10$ Product of the Eigen value $\lvert A\rvert=150$	
30	**Show that Eigen values of a null matrix are zero (MAY/JUNE 2018 R-17)** BTL1 Let $A=\begin{pmatrix}0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}$	

The Characteristic Equation is $\lambda^3 = 0$

$\therefore \lambda_1 = 0, \lambda_2 = 0, \lambda_3 = 0$

PART-B

1.

Find the Eigen values and Eigen vectors of $\begin{pmatrix} 2 & 2 & 0 \\ 2 & 1 & 1 \\ -7 & 2 & -3 \end{pmatrix}$. **(8M)** BTL1

Answer : Refer Page No.1.8-Dr.M.CHANDRASEKAR

- The Eigen values are $\lambda = -4, 1, 3$. **(2 M)**
- Eigen vectors $X_1 = \begin{bmatrix} 1 \\ -3 \\ 13 \end{bmatrix}; X_2 = \begin{bmatrix} 2 \\ -1 \\ -4 \end{bmatrix}; X_3 = \begin{bmatrix} 2 \\ 1 \\ 4 \end{bmatrix}$ **(6M)**

2.

Find the Eigen values and Eigen vectors of $\begin{pmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{pmatrix}$ **(May/June-2018 R-17) (8M)**

BTL1

Answer : Refer Page No.1.21-Dr.M.CHANDRASEKAR

- The Eigen values are $\lambda = 0, 1, 2$ **(2 M)**
- Eigen vectors $X_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}; X_2 = \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}; X_3 = \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix}$ **(6M)**

3.

Find the Eigen values and Eigen vectors of $\begin{pmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{pmatrix}$ **(DEC/JAN-2016 R-13) (8M)**

BTL1

Answer : Refer Page No.1.10-Dr.M.CHANDRASEKAR

- The Eigen values are $\lambda = 1, 2, 3$ **(2 M)**
- Eigen vectors $X_1 = \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix}; X_2 = \begin{bmatrix} 2 \\ -1 \\ -2 \end{bmatrix}; X_3 = \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}$ **(6M)**

4.	**Find the Eigen values and Eigen vectors of** $\begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$ **(DEC/JAN-2014 R-13) (8M)** BTL1 **Answer : Refer Page No.1.15-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda = 1,1,5$ **(2 M)** • Eigen vectors $X_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}; X_2 = \begin{bmatrix} 0 \\ 1 \\ -2 \end{bmatrix}; X_3 = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$ **(6M)**	
5.	**Find the Eigen values and Eigen vectors of** $\begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ **(APR/MAY-2015 R-13)** **(8M)** BTL1 **Answer : Refer Page No.1.17-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda = 2,2,8$ **(2 M)** • Eigen vectors $X_1 = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}; X_2 = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}; X_3 = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}$ **(6M)**	
6.	**Find the eigenvalues and the eigenvectors of the matrix** $A = \begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$ **.(APR/MAY 2019)(8M)** BTL3 • The Eigen values are $\lambda = 0,3,15$ **(4 M)** • Eigen vectors $X_1 = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}; X_2 = \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix}; X_3 = \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}$ **(4M)**	
7.	**Verify Cayley-Hamilton theorem and hence find the inverse of the matrix** $\begin{pmatrix} 1 & 2 & -1 \\ 3 & -3 & 1 \\ 2 & 1 & -2 \end{pmatrix}$ **(DEC/JAN-2014 R-13) (8M)** BTL3	

	Answer : Refer Page No.1.45-Dr.M.CHANDRASEKAR • The Characteristic Equation is $\lambda^3+4\lambda^2-4\lambda-12=0$ **(2 M)** • For Proving $A^3+4A^2-4A-12I=0$ **(3 M)** • $A^{-1}=\frac{1}{12}\begin{pmatrix}5&3&-1\\8&0&-4\\9&3&-9\end{pmatrix}$ **(3 M)**	
8.	**Verify Cayley-Hamilton theorem and hence find the inverse of the matrix** $\begin{pmatrix}1&0&3\\2&1&-1\\1&-1&1\end{pmatrix}$ **(DEC/JAN-2015 R-13) (8M)** BTL3 **Answer : Refer Page No.1.47-Dr.M.CHANDRASEKAR** • The Characteristic Equation is $\lambda^3-3\lambda^2-\lambda+9=0$ **(2 M)** • For Proving $A^3-3A^2-A+9I=0$. **(3 M)** • $A^{-1}=\frac{-1}{9}\begin{pmatrix}0&-3&-3\\-3&-2&7\\-3&1&1\end{pmatrix}$. **(3 M)**	
9.	**Using Cayley-Hamilton theorem to find the inverse of the matrix** $\begin{pmatrix}1&2&1\\2&2&1\\1&1&3\end{pmatrix}$ **(May/June-2018 R-17) (8M)** BTL3 **Answer : Refer Page No.1.56-Dr.M.CHANDRASEKAR** • The Characteristic Equation is $\lambda^3-6\lambda^2+5\lambda+5=0$ **(2 M)** • For Proving $A^3-6A^2+5A+5I=0$ **(3 M)** • $A^{-1}=\frac{-1}{5}\begin{pmatrix}-5&5&0\\5&-2&-1\\0&-1&2\end{pmatrix}$ **(3 M)**	

10.

Use Cayley-Hamilton theorem to find the A^4 **of the matrix** $\begin{pmatrix} 2 & -1 & 1 \\ 0 & 1 & 2 \\ 1 & 0 & 1 \end{pmatrix}$

(DEC/JAN-2016 R-13) (8M) BTL3

Answer : Refer Page No.1.48-Dr.M.CHANDRASEKAR

- The Characteristic Equation is $\lambda^3 - 4\lambda^2 + 4\lambda + 1 = 0$ **(2 M)**
- $\mathrm{A}^4 = \begin{pmatrix} 22 & -19 & -5 \\ 24 & -9 & 14 \\ 19 & -12 & 3 \end{pmatrix}$ **(6 M)**

11.

Use Cayley-Hamilton theorem to find $\mathrm{A}^8 - 5\mathrm{A}^7 + 7\mathrm{A}^6 - 3\mathrm{A}^5 + \mathrm{A}^4 - 5\mathrm{A}^3 + 8\mathrm{A}^2 - 2\mathrm{A} + \mathrm{I}$ **of** $\mathrm{A} = \begin{pmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$ **(DEC/JAN-2006,APR/MAY 2005) (8M)** BTL3

Answer : Refer Page No.1.51-Dr.M.CHANDRASEKAR

- The Characteristic Equation is $\lambda^3 - 5\lambda^2 + 7\lambda - 3 = 0$ **(2 M)**
- For Proving $\mathrm{A}^8 - 5\mathrm{A}^7 + 7\mathrm{A}^6 - 3\mathrm{A}^5 + \mathrm{A}^4 - 5\mathrm{A}^3 + 8\mathrm{A}^2 - 2\mathrm{A} + \mathrm{I} = \mathrm{A}^2 + \mathrm{A} + \mathrm{I}$ **(3 M)**
- $\mathrm{A}^8 - 5\mathrm{A}^7 + 7\mathrm{A}^6 - 3\mathrm{A}^5 + \mathrm{A}^4 - 5\mathrm{A}^3 + 8\mathrm{A}^2 - 2\mathrm{A} + \mathrm{I} = \begin{pmatrix} 8 & 5 & 5 \\ 0 & 3 & 0 \\ 5 & 5 & 8 \end{pmatrix}$ **(3 M)**

12.

Reduce the quadratic form *2xy-2yz+2xz* into a canonical form by an orthogonal reduction. (APR/MAY 2019)(16M) BTL3

Answer : Refer Page No.1.119-Dr.G. BALAJI

- The Eigen values are $\lambda = 1, 1, -2$ **(4M)**
- Eigen vectors $X_1 = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}, \; X_2 = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \; X_3 = \begin{bmatrix} -1 \\ 1 \\ 1 \end{bmatrix},$ **(4M)**
- $D = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$ **(6M)**
- Canonical form = $-2y_1^2 + y_2^2 + y_3^2$. **(2M)**

13.	**Diagonalize** $A=\begin{pmatrix}8&-6&2\\-6&7&-4\\2&-4&3\end{pmatrix}$ **by means of orthogonal transformation.(12M)** BTL1 **Answer : Refer Page No.1.72-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda=0,3,15$ **(2 M)** • Eigen vectors $X_1=\begin{bmatrix}1\\2\\2\end{bmatrix};X_2=\begin{bmatrix}2\\1\\-2\end{bmatrix};X_3=\begin{bmatrix}2\\-2\\1\end{bmatrix}$ **(4M)** • $D=N^TAN=\begin{pmatrix}0&0&0\\0&3&0\\0&0&15\end{pmatrix}$ **(6M)**	
14.	**Diagonalize** $A=\begin{pmatrix}3&1&1\\1&3&-1\\1&-1&3\end{pmatrix}$ **by means of orthogonal transformation. (12M)** BTL1 **Answer : Refer Page No.1.77-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda=1,4,4$ **(2 M)** • Eigen vectors $X_1=\begin{bmatrix}-1\\1\\1\end{bmatrix};X_2=\begin{bmatrix}1\\1\\0\end{bmatrix};X_3=\begin{bmatrix}-1\\1\\-2\end{bmatrix}$ **(4M)** • $D=N^TAN=\begin{pmatrix}1&0&0\\0&4&0\\0&0&4\end{pmatrix}$ **(6M)**	
15.	**Diagonalize** $A=\begin{pmatrix}6&-2&2\\-2&3&-1\\2&-1&3\end{pmatrix}$ **by means of orthogonal transformation.** BTL1 **(DEC/JAN-2015 R-13) (12M)** **Answer : Refer Page No.1.87-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda=2,2,8$ **(2 M)**	

- Eigen vectors $X_1=\begin{bmatrix}2\\-1\\1\end{bmatrix};X_2=\begin{bmatrix}1\\1\\-1\end{bmatrix};X_3=\begin{bmatrix}0\\1\\1\end{bmatrix}$ **(4M)**
- $D=N^TAN=\begin{pmatrix}8&0&0\\0&2&0\\0&0&2\end{pmatrix}$ **(6M)**

16.

Reduce the quadratic form $10x_1^2+2x_2^2+5x_3^2+6x_2x_3-10x_3x_1-4x_1x_2$ to a canonical form. Discuss its nature.(16M) BTL1

Answer : Refer Page No.1.99-Dr.M.CHANDRASEKAR

- The Eigen values are $\lambda=0,3,14$ **(2 M)**
- Eigen vectors $X_1=\begin{bmatrix}1\\-5\\4\end{bmatrix};X_2=\begin{bmatrix}1\\1\\1\end{bmatrix};X_3=\begin{bmatrix}3\\-1\\-2\end{bmatrix}$ **(4M)**
- $D=N^TAN=\begin{pmatrix}0&0&0\\0&3&0\\0&0&14\end{pmatrix}$ **(6M)**
- Canonical form= $0y_1^2+3y_2^2+14y_3^2$ **.** **(2 M)**
- Rank=2, Index=2, Signature=2; Nature = Positive Semi definite. **(2 M)**

17.

Reduce the quadratic form $6x_1^2+3x_2^2+3x_3^2-2x_2x_3+4x_3x_1-4x_1x_2$ to a canonical form. Discuss its nature.(DEC/JAN-2016, JAN-2014 R-13) (16M) BTL1

Answer : Refer Page No.1.102-Dr.M.CHANDRASEKAR

- The Eigen values are $\lambda=2,2,8$ **(2 M)**
- Eigen vectors $X_1=\begin{bmatrix}2\\-1\\1\end{bmatrix};X_2=\begin{bmatrix}1\\2\\0\end{bmatrix};X_3=\begin{bmatrix}2\\-1\\-5\end{bmatrix}$ **(4M)**
- $D=N^TAN=\begin{pmatrix}2&0&0\\0&2&0\\0&0&8\end{pmatrix}$ **(6M)**

	• Canonical form= $2y_1^2+2y_2^2+8y_3^2$ **(2 M)** • Rank=3, Index=3, Signature=3; Nature = Positive definite **(2 M)**	
18.	**Reduce the quadratic form** $6x_1^2+3x_2^2+3x_3^2-2x_2x_3+4x_3x_1-4x_1x_2$ **to a canonical form by orthogonal reduction. (16M)** BTL1 **Answer : Refer Page No.1.104-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda=2,3,6$ **(2 M)** • Eigen vectors $X_1=\begin{bmatrix}1\\0\\-1\end{bmatrix};X_2=\begin{bmatrix}1\\1\\1\end{bmatrix};X_3=\begin{bmatrix}1\\-2\\1\end{bmatrix}$ **(4M)** • $D=N^TAN=\begin{pmatrix}2&0&0\\0&3&0\\0&0&6\end{pmatrix}$ **(8M)** • Canonical form= $2y_1^2+3y_2^2+6y_3^2$ **(2 M)**	
19.	**Reduce the quadratic form** $x^2+5y^2+z^2+2xy+2yz+6zx$ **to a canonical form through an orthogonal transformation. (DEC/JAN-2015 R-13) (16M)** BTL1 **Answer : Refer Page No.1.109-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda=-2,3,6$ **(2 M)** • Eigen vectors $X_1=\begin{bmatrix}-1\\0\\1\end{bmatrix};X_2=\begin{bmatrix}-1\\1\\-1\end{bmatrix};X_3=\begin{bmatrix}1\\2\\1\end{bmatrix}$ **(4M)** • $D=N^TAN=\begin{pmatrix}-2&0&0\\0&3&0\\0&0&6\end{pmatrix}$ **(8M)** • Canonical form= $-2y_1^2+3y_2^2+6y_3^2$ **(2 M)**	
20.	**Reduce the quadratic form** $8x_1^2+7x_2^2+3x_3^2-8x_2x_3+4x_3x_1-12x_1x_2$ **to a canonical form by orthogonal reduction. (16M)** BTL1 **Answer : Refer Page No.1.111-Dr.M.CHANDRASEKAR**	

	• The Eigen values are $\lambda = 0,3,15$ **(2 M)** • Eigen vectors $X_1 = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}; X_2 = \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix}; X_3 = \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}$ **(4M)** • $D = N^T AN = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 15 \end{pmatrix}$ **(8M)** • Canonical form= $0{y_1}^2 + 3{y_2}^2 + 15{y_3}^2$ **(2 M)**	
21.	**Reduce the quadratic form $2{x_1}^2 + 5{x_2}^2 + 3{x_3}^2 + 4x_1x_2$ to a canonical form by orthogonal reduction. (May/June-2018 R-17) (16M)** BTL1 **Answer : Refer Page No.1.113-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda = 1,3,6$ **(2 M)** • Eigen vectors $X_1 = \begin{bmatrix} 2 \\ -1 \\ 0 \end{bmatrix}; X_2 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}; X_3 = \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}$ **(4M)** • $D = N^T AN = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 6 \end{pmatrix}$ **(8M)** • Canonical form= $1{y_1}^2 + 3{y_2}^2 + 6{y_3}^2$ **(2 M)**	
22.	**Reduce the quadratic form ${x_1}^2 + 2{x_2}^2 + {x_3}^2 + 2x_2x_3 - 2x_1x_2$ to a canonical form through orthogonal transformation and hence show that it is positive semi-definite. Also give a non-zero set of values (x_1, x_2, x_3) which makes this quadratic form zero (16M)** BTL1 **Answer : Refer Page No.1.121-Dr.M.CHANDRASEKAR** • The Eigen values are $\lambda = 0,1,3$ **(2 M)** • Eigen vectors $X_1 = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}; X_2 = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} X_3 = \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}$ **(4M)**	

	• $D=N^TAN=\begin{pmatrix}0&0&0\\0&1&0\\0&0&3\end{pmatrix}$ **(6M)** • Canonical form= $0y_1^2+1y_2^2+3y_3^2$ **(2 M)** • $x_1=1, x_2=1, x_3=-1$ which makes Q.F is zero **(1 M)** • For proving Positive Semi definite **(1 M)**

UNIT-II VECTOR CALCULUS

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral – Area of a curved surface – Volume integral – Green's, Gauss divergence and Stokes theorems – Verification and application in evaluating line, surface and volume integrals.

PART-A

1	**State Stokes theorem. (DEC/JAN-2015)** BTL1 The surface integral of the normal component of the curl of a vector point function $\vec{F}$ over an open surface 'S' is equal to the line integral of the tangential component of $\vec{F}$ around the closed curve 'C' bounding 'S' $\int_C \overrightarrow{F}.\overrightarrow{dr}=\iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds$
2	**State Gauss divergence theorem**. **(DEC/JAN-2013) (NOV/DEC-2015)** BTL1 The surface integral of the normal component of a vector function $\vec{F}$ over a closed surface S enclosing volume V is equal to the volume integral of the divergence of $\vec{F}$ taken throughout the volume V $\iint_S \overrightarrow{F}.\hat{n}\,ds=\iiint_V \nabla.\overrightarrow{F}dv$
3	**State Green's theorem**. **(DEC/JAN-2009) (NOV/DEC-2010)** BTL1 If $u, v, \frac{\partial u}{\partial y}, \frac{\partial v}{\partial x}$ are continuous and single valued functions in the region R enclosed by the curve C, then $\int_C udx+vdy=\iint_R\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dxdy$
4	**Find curl $\vec{F}$ if $\overrightarrow{F}=xy\vec{i}+yz\vec{j}+zx\vec{k}$.** BTL1 $curl\ \vec{F}=\nabla\times\vec{F}$

	$= \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/_{\partial x} & \partial/_{\partial y} & \partial/_{\partial z} \\ xy & yz & zx \end{vmatrix} =$ $\vec{i}(0-y) - \vec{j}(z-0) + \vec{k}(0-x)$ $= -y\vec{i} - z\vec{j} - x\vec{k} = -(y\vec{i} + z\vec{j} + x\vec{k})$	
5	**Prove that $\vec{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$ is irrotational.** BTL5 $\nabla \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/_{\partial x} & \partial/_{\partial y} & \partial/_{\partial z} \\ yz & zx & xy \end{vmatrix} = \sum \vec{i}\left[\frac{\partial}{\partial y}(xy) - \frac{\partial}{\partial z}(zx)\right]$ $= \sum \vec{i}\,[x - x] = 0\vec{i} + 0\vec{j} + 0\vec{k} = \vec{0}$. Hence, $\vec{F}$ is irrotational.	
6	**Is the position vector $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ irrotational? Justify. (DEC/JAN-2016)** BTL5 $\nabla \times \vec{r} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/_{\partial x} & \partial/_{\partial y} & \partial/_{\partial z} \\ x & y & z \end{vmatrix}$ $= \vec{i}\left[\frac{\partial}{\partial y}(z) - \frac{\partial}{\partial z}(y)\right] - \vec{j}\left[\frac{\partial}{\partial x}(z) - \frac{\partial}{\partial z}(x)\right] + \vec{k}\left[\frac{\partial}{\partial x}(y) - \frac{\partial}{\partial y}(x)\right]$ $= 0\vec{i} + 0\vec{j} + 0\vec{k} = \vec{0}$. Hence, $\vec{r}$ is irrotational.	
7	**Prove that $3x^2y\vec{i} + (yz - 3xy^2)\vec{j} - \frac{z^2}{2}\vec{k}$ is a solenoidal.** BTL5 $\nabla.\vec{F} = \frac{\partial}{\partial x}(3x^2y) + \frac{\partial}{\partial y}(yz - 3xy^2) + \frac{\partial}{\partial z}\left(-\frac{z^2}{2}\right)$ $= (6xy) + (z - 6xy) + (\frac{-2z}{2}) = 0$ $\therefore$ $\vec{F}$is Solenoidal.	
8	**Show that $\vec{F} = (y^2 - z^2 + 3yz - 2x)\vec{i} + (3xz + 2xy)\vec{j} + (3xy - 2xz + 2z)\vec{k}$ is both solenoidal and irrotational.** BTL2 $\nabla.\vec{F} = \frac{\partial}{\partial x}(y^2 - z^2 + 3yz - 2x) + \frac{\partial}{\partial y}(3xz + 2xy) + \frac{\partial}{\partial z}(3xy - 2xz + 2z)$ $= (-2) + (2x) + (-2x + 2)$ $= 0$ $\therefore$ $\vec{F}$is Solenoidal.	

	$\nabla \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ y^2 - z^2 + 3yz - 2x & 3xz + 2xy & 3xy - 2xz + 2z \end{vmatrix}$ $= \vec{i}\left[\frac{\partial}{\partial y}(3xy - 2xz + 2z) - \frac{\partial}{\partial z}(3xz + 2xy)\right]$ $-\vec{j}\left[\frac{\partial}{\partial x}(3xy - 2xz + 2z) - \frac{\partial}{\partial z}(y^2 - z^2 + 3yz - 2x)\right]$ $+\vec{k}\left[\frac{\partial}{\partial x}(3xz + 2xy) - \frac{\partial}{\partial y}(y^2 - z^2 + 3yz - 2x)\right]$ $= [3x - 3x]\vec{i} - [(3y - 2z) - (-2z + 3y)]\vec{j} + [(3z + 2y) - (2y + 3z)]\vec{k}$ $\nabla \times \vec{F} = 0\vec{i} + 0\vec{j} + 0\vec{k} = \vec{0}$ Hence, $\vec{F}$ is irrotational.	
9	**Find α such that $\vec{F} = (3x - 2y + z)\vec{i} + (4x + \alpha y - z)\vec{j} + (x - y + 2z)\vec{k}$ is solenoidal.** BTL1 Given $\nabla . \vec{F} = 0$ $\frac{\partial}{\partial x}(3x - 2y + z) + \frac{\partial}{\partial y}(4x + \alpha y - z) + \frac{\partial}{\partial z}(x - y + 2z) = 0$ $3 + \alpha + 2 = 0$ $\alpha + 5 = 0 \therefore \alpha = -5$	
10	**Find the constants a, b, c so that $\vec{F} = (x + 2y + az)\vec{i} + (bx - 3y - z)\vec{j} + (4x + cy + 2z)\vec{k}$ is irrotational. (DEC/JAN-2012) (May/June-2018 R-17)** BTL1 $\nabla \times \vec{F} = \vec{0}$ $\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ x + 2y + az & bx - 3y - z & 4x + cy + 2z \end{vmatrix} = \vec{0}$ $\vec{i}[c + 1] - \vec{j}[4 - a] + \vec{k}[b - 2] = 0\vec{i} - 0\vec{j} + 0\vec{k}$ i.e., $c + 1 = 0, 4 - a = 0, b - 2 = 0$ $\therefore \boldsymbol{c = -1, a = 4, b = 2}$	
11	**Prove that div $\vec{r} = 3$ and curl $\vec{r} = \vec{0}$.(DEC/JAN-2016) (NOV/DEC-2010)** BTL5 $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ $\nabla . \vec{r} = \frac{\partial}{\partial x}(x) + \frac{\partial}{\partial y}(y) + \frac{\partial}{\partial z}(z) = 1 + 1 + 1 = 3$	

	$\nabla \times \vec{r} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/_{\partial x} & \partial/_{\partial y} & \partial/_{\partial z} \\ x & y & z \end{vmatrix}$ $= \vec{i}\left[\frac{\partial}{\partial y}(z) - \frac{\partial}{\partial z}(y)\right] - \vec{j}\left[\frac{\partial}{\partial x}(z) - \frac{\partial}{\partial z}(x)\right] + \vec{k}\left[\frac{\partial}{\partial x}(y) - \frac{\partial}{\partial y}(x)\right]$ $= \mathbf{0}\vec{\boldsymbol{i}} + \mathbf{0}\vec{\boldsymbol{j}} + \mathbf{0}\vec{\boldsymbol{k}} = \vec{\mathbf{0}}$	
12	**Prove that curl $(\mathbf{grad}\ \emptyset) = \vec{\mathbf{0}}$. (NOV/DEC-2008)** BTL5 $grad\ \emptyset = \nabla\emptyset$ $= \vec{i}\frac{\partial\emptyset}{\partial x} + \vec{j}\frac{\partial\emptyset}{\partial y} + \vec{k}\frac{\partial\emptyset}{\partial z}$ $curl\ (grad\ \emptyset) = \nabla \times (\nabla\emptyset)$ $= \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/_{\partial x} & \partial/_{\partial y} & \partial/_{\partial z} \\ \frac{\partial\emptyset}{\partial x} & \frac{\partial\emptyset}{\partial y} & \frac{\partial\emptyset}{\partial z} \end{vmatrix}$ $= \sum \vec{i}\left[\frac{\partial^2\emptyset}{\partial y\partial z} - \frac{\partial^2\emptyset}{\partial z\partial y}\right]$ $= \sum \overrightarrow{\vec{i}[0]}\ (Since\ mixed\ partial\ derivatives\ are\ equal)$ $= 0\vec{i} + 0\vec{j} + 0\vec{k} = \vec{0}$	
13	**In what direction from $(\mathbf{3}, \mathbf{1}, -\mathbf{2})$ is the directional derivative of $\emptyset = \mathbf{x^2y^2z^4}$ maximum? Find also the magnitude of this maximum.** BTL1 $\nabla\emptyset = \vec{i}\frac{\partial\emptyset}{\partial x} + \vec{j}\frac{\partial\emptyset}{\partial y} + \vec{k}\frac{\partial\emptyset}{\partial z}$ $= \vec{i}[2xy^2z^4] + \vec{j}[2x^2yz^4] + \vec{k}[4x^2y^2z^3]$ $\nabla\varphi_{(3,1,-2)} = \vec{i}\left[2(3)(1)(16)\right] + \vec{j}\left[2(9)(1)(16)\right] + \vec{k}\left[4(9)(1)(-8)\right]$ $= 96\vec{i} + 288\vec{j} - 288\vec{k}$ $= 96\left(\vec{i} + 3\vec{j} - 3\vec{k}\right)$ The directional derivative is maximum in the direction of $96\left(\vec{i} + 3\vec{j} - 3\vec{k}\right)$ Maximum value is $\lvert\nabla\varphi\rvert = \left\lvert 96\left(\vec{i} + 3\vec{j} - 3\vec{k}\right)\right\rvert$ $= \sqrt{92^2\left(1+9+9\right)}$ $= 96\sqrt{19}$	
14	**Find the unit vector normal to the surface $\mathbf{x^2 + y^2 = z}$ at $(\mathbf{1}, -\mathbf{2}, \mathbf{5})$.** BTL1 Given $\phi = x^2 + y^2 - z$	

	Unit normal vector $\hat{n} = \frac{\nabla\phi}{\lvert\nabla\phi\rvert}$ ………… (1) $\nabla\phi = \vec{i}\,\frac{\partial\phi}{\partial x} + \vec{j}\,\frac{\partial\phi}{\partial y} + \vec{k}\,\frac{\partial\phi}{\partial z}$ $= \vec{\imath}[2x] + \vec{\jmath}[2y] + \vec{k}[-1]$ $\nabla\phi_{(1,-2,5)} = \vec{\imath}[2] + \vec{\jmath}[-4] + \vec{k}[-1]$ $= 2\vec{\imath} - 4\vec{\jmath} - \vec{k}$ $\lvert\nabla\phi\rvert = \sqrt{2^2 + (-4)^2 + (-1)^2}$ $= \sqrt{4 + 16 + 1} = \sqrt{21}$ $\therefore (1) \Rightarrow \hat{n} = \frac{2\vec{i} - 4\vec{j} - \vec{k}}{\sqrt{21}}$	
15	**Find the greatest rate of increase of $\emptyset = \mathbf{xyz^2}$ at $(\mathbf{1}, \mathbf{0}, \mathbf{3})$.** BTL1 $\nabla\emptyset = \vec{\imath}\frac{\partial\emptyset}{\partial x} + \vec{\jmath}\frac{\partial\emptyset}{\partial y} + \vec{k}\frac{\partial\emptyset}{\partial z}$ $= \vec{\imath}[yz^2] + \vec{\jmath}[xz^2] + \vec{k}[2xyz]$ $\nabla\emptyset_{(1,0,3)} = 0\vec{\imath} + 9\vec{\jmath} + 0\vec{k}$ $\therefore$ Greatest rate of increase= $\lvert\boldsymbol{\nabla\emptyset}\rvert = \sqrt{\mathbf{9^2}} = \mathbf{9}$	
16	**State the physical interpretation of the line integral.** $\int_A^B \vec{F}.\vec{dr}$. BTL1 Physically $\int_A^B \vec{F}.\overrightarrow{dr}$ denotes the total work done by the force$\vec{F}$, in displacing a particle from A to B along the curve C.	
17	**Define Solenoidal vector function. If** $\vec{V} = (x+3y)\vec{i} + (y-2z)\vec{j} + (x+2\lambda z)\vec{k}$ **is Solenoidal, find the value of** λ**.** BTL1 If div$\vec{F}$= 0, then $\vec{F}$ is said to be Solenoidal vector. $\nabla.\vec{F} = 0$. $\nabla.\vec{V} = \frac{\partial}{\partial x}(x+3y) + \frac{\partial}{\partial y}(y-2z) + \frac{\partial}{\partial z}(x+2\lambda z)$ $= 1 + 1 + 2\lambda$ $= 2 + 2\lambda$ $\nabla.\vec{V} = 0$ $2 + 2\lambda = 0$ $\lambda = -1$	
	Find grad$(\mathbf{r^n})$where $\vec{\mathbf{r}} = \mathbf{x}\vec{\mathbf{i}} + \mathbf{y}\vec{\mathbf{j}} + \mathbf{z}\vec{\mathbf{k}}$and $r = \lvert\vec{r}\rvert$. BTL1 We know that $\frac{\partial r}{\partial x} = \frac{x}{r}$, $\frac{\partial r}{\partial y} = \frac{y}{r}$, $\frac{\partial r}{\partial z} = \frac{z}{r}$	

18	$grad\left(r^n\right) = \sum \vec{i}\frac{\partial r^n}{\partial x}$ $= \sum \vec{i}(nr^{n-1})\frac{\partial r}{\partial x}$ $= (nr^{n-2})\vec{r}$	
19	**Find grad(r) and grad (** $\frac{\mathbf{1}}{\mathbf{r}}$ **) where** $\vec{r} = x\vec{i}+y\vec{j}+z\vec{k}$ **and** $\vec{r} = \lvert\vec{r}\rvert$. BTL1 $\nabla\phi = \Sigma\vec{i}\frac{\partial\phi}{\partial x} = \frac{\Sigma x\vec{i}}{r}$ $= \frac{\vec{r}}{r}$ $grad(\frac{1}{r}) = \Sigma\vec{i}\frac{\partial\left(\frac{1}{r}\right)}{\partial x} = \left(-\frac{1}{r^2}\right)\frac{\Sigma x\vec{i}}{r}$ $= \frac{-\vec{r}}{r^3}$	
20	**Find the unit normal to the surface** $x^2+xy+z^2 = 4\ at\ \ (1,-1,2)$**.** BTL1 $\hat{n} = \frac{\nabla\phi}{\lvert\nabla\phi\rvert}$ $\nabla\phi = \Sigma\vec{i}\frac{\partial\phi}{\partial x}$ $Given:$ $x^2+xy+z^2 = 4\ \ Point(1,-1,2)$ $\nabla\phi = \vec{i}+\vec{j}+4\vec{k}$ $\lvert\nabla\phi\rvert = \sqrt{1+1+16} = \sqrt{18}$ $\hat{n} = \frac{\vec{i}+\vec{j}+4\vec{k}}{3\sqrt{2}}$	
21	**Prove by Green's theorem that the area bounded by a simple closed curve is** $\frac{1}{2}\int_c (xdy - ydx)$ BTL5 By Green's theorem:	

	$\int_C udx+vdy=\iint_R\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dxdy$ $u=\frac{-y}{2},\text{v}=\frac{v}{2}\Rightarrow\frac{\partial u}{\partial y}=\frac{-1}{2},\frac{\partial v}{\partial x}=\frac{1}{2}$ Given that $\frac{1}{2}\int_C xdy-ydx=\iint_R\left(\frac{1}{2}+\frac{1}{2}\right)dxdy$ $=\iint_R dxdy.$ which a area bounded by a simple closed curve$'c'$	
22	**Find** $\nabla\left[\nabla.\left(\left(x^2-yz\right)\vec{i}+\left(y^2-xz\right)\vec{j}+\left(z^2-xy\right)\vec{k}\right)\right]$ **at the point (1,-1,2).** BTL1 $\nabla.\vec{F}=\frac{\partial}{\partial x}(x^2-yz)+\frac{\partial}{\partial y}(\text{y}^2-xz)+\frac{\partial}{\partial \text{z}}(\text{z}^2-xy)$ $=2x+2y+2z$ $\nabla.\vec{F}_{(1,-1,2)}=2-2+4$ $=4$ $Grad(\nabla.\vec{F})=\nabla(\nabla.\vec{F})$ $=\vec{i}\frac{\partial}{\partial x}(2x)+\vec{j}\frac{\partial}{\partial y}(2y)+\vec{k}\frac{\partial}{\partial \text{z}}(2z)$ $=2\vec{i}+2\vec{j}+2\vec{k}$	
23	**Find the directional directive of** $\phi(\text{x},\text{y},\text{z})=\text{xy}^2+yz^2$ **at the point (2,-1,1) in the direction of the vector** $\vec{i}+2\vec{j}+3\vec{k}$ **.(DEC/JAN-2014)** BTL1 Directional derivative(D.D)= $\nabla\phi.\frac{\vec{a}}{\lvert\vec{a}\rvert}$ $Given:$ $\phi(x,y,z)=xy^2+z^2y,\quad \vec{a}=\vec{i}+2\vec{j}+3\vec{k}$ $\nabla\phi_{(1,-1,2)}=\vec{i}+2\vec{j}+4\vec{k},\quad \lvert\vec{a}\rvert=\sqrt{14}$ $D.D=(\vec{i}+2\vec{j}+4\vec{k}).\frac{(\vec{i}+2\vec{j}+3\vec{k})}{\sqrt{14}}$ $=\frac{17}{\sqrt{14}}.$	
	If $\vec{\text{F}}$ **is irrotational and C is closed curve then find the value of** $\int_c\vec{\text{F}}.d\vec{r}$ **.** BTL1	

24	By Stokes theorem $\int_c \vec{F}.d\vec{r} = \iint_s \left(\nabla x\, \vec{F}\right).\hat{n}ds$ Since $\vec{F}$ is irrotational $\therefore \nabla x\, \vec{F} = 0$ $\int_c \vec{F}.d\vec{r} = \iint_s \left(\nabla x\, \vec{F}\right).\hat{n}ds$ $= \iint_s 0.\hat{n}ds$ $= 0$	
25	**Prove that** $\nabla(\log r) = \frac{\vec{r}}{r^2}$. **(NOV/DEC-2014)**. BTL5 $\text{we have } \vec{r} = x\vec{i} + y\vec{j} + z\vec{k} \;\; and \;\; r = \lvert\vec{r}\rvert = \sqrt{x^2+y^2+z^2}$ $r^2 = x^2+y^2+z^2,\ \frac{\partial r}{\partial x} = \frac{x}{r},\ \frac{\partial r}{\partial y} = \frac{y}{r},\ \frac{\partial r}{\partial z} = \frac{z}{r}$ $\nabla(\log r) = \vec{i}\,\frac{\partial(\log r)}{\partial x} + \vec{j}\,\frac{\partial(\log r)}{\partial y} + \vec{k}\,\frac{\partial(\log r)}{\partial z}$ $= \vec{i}\left(\frac{1}{r}\frac{\partial r}{\partial x}\right) + \vec{j}\left(\frac{1}{r}\frac{\partial r}{\partial y}\right) + \vec{k}\left(\frac{1}{r}\frac{\partial r}{\partial z}\right)$ $= \frac{1}{r}\left[\frac{x}{r}\vec{i} + \frac{y}{r}\vec{j} + \frac{z}{r}\vec{k}\right]$ $= \frac{1}{r^2}\left[x\vec{i} + y\vec{j} + z\vec{k}\right] = \frac{\vec{r}}{r^2}$	
26	**If** $\vec{F} = (x^3)\vec{i} + (y^3)\vec{j} + (z^3)\vec{k}$ **then find div curl** $\vec{F}$. **(May/June-2018 R-17)** BTL1 $\nabla \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ x^3 & y^3 & z^3 \end{vmatrix} = 0$ Therefore **div curl** $\vec{F} = 0$	
	PART-B	
1.	**Prove that** $\nabla(r^n) = \mathrm{n}r^{n-2}\,\vec{r}$. **(May/June 2003,2008)** **(8 M)** BTL5 **Answer : Refer Page No.2.5-Dr.M.CHANDRASEKAR** • $\frac{\partial r}{\partial x} = \frac{x}{r},\ \frac{\partial r}{\partial y} = \frac{y}{r},\ \frac{\partial r}{\partial z} = \frac{z}{r}$. **(2 M)** • $\nabla(r^n) = \vec{i}\left(nr^{n-1}\frac{\partial r}{\partial x}\right) + \vec{j}\left(nr^{n-1}\frac{\partial r}{\partial y}\right) + \vec{k}\left(nr^{n-1}\frac{\partial r}{\partial z}\right)$ **(2 M)**	

	• $\nabla(r^n) = \frac{nr^{n-1}}{r}\left[x\vec{i}+y\vec{j}+z\vec{k}\right] = nr^{n-2}\vec{r}$ **(4M)**	
2.	**Prove that** $\text{Curl}\,(\text{Curl}\,\vec{\text{F}}) = \nabla(div\,\vec{\text{F}}) - \nabla^2\,\vec{\text{F}}$. **(May/June 2003,2008) (8 M)** BTL5 **Answer : Refer Page No.2.36-Dr.M.CHANDRASEKAR** • $\nabla\times(\nabla\times\vec{F}) = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ \frac{\partial F_3}{\partial y}-\frac{\partial F_2}{\partial z} & \frac{\partial F_1}{\partial z}-\frac{\partial F_3}{\partial x} & \frac{\partial F_2}{\partial x}-\frac{\partial F_1}{\partial y} \end{vmatrix}$ **(3M)** • $\nabla\times(\nabla\times\vec{F}) = \sum\left\{\frac{\partial}{\partial x}(div\,\vec{\text{F}}) - \nabla^2\,\vec{\text{F}}_1\right\}\vec{i}$ **(3M)** • For proving $\text{Curl}\,(\text{Curl}\,\vec{\text{F}}) = \nabla(div\,\vec{\text{F}}) - \nabla^2\,\vec{\text{F}}$ **(2M)**	
3.	**Prove that** $\vec{\text{F}} = (y^2\cos x + \text{z}^3)\,\vec{\text{i}} + (2y\sin x - 4)\,\vec{j} + 3xz^2\,\vec{\text{k}}$ **is irrotational and find its scalar potential. (8 M)** BTL5 **Answer : Refer Page No.2.33-Dr.M.CHANDRASEKAR** • $\nabla\times\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ y^2\cos x+\text{z}^3 & 2y\sin x-4 & 3xz^2 \end{vmatrix} = 0$ **(2 M)** $\phi_1 = y^2\sin x + xz^3 + f(y,z)$ • $\phi_2 = y^2\sin x - 4y + f(x,z)$ **(4M)** $\phi_3 = xz^3 + f(x,y)$ • $\phi = y^2\sin x + xz^3 - 4y + c$. **(2M)**	
4.	**Prove that** $\vec{\text{F}} = (6xy + \text{z}^3)\,\vec{\text{i}} + (3x^2 - z)\,\vec{j} + (3xz^2 - \text{y})\,\vec{\text{k}}$ **is irrotational and find its scalar potential.(NOV/DEC 2015,R-13)(8 M)** BTL5 **Answer : Refer Page No.2.32-Dr.M.CHANDRASEKAR**	

	• $\nabla\times\vec{F}=\begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\ \partial/\partial x&\partial/\partial y&\partial/\partial z\\ (6xy+z^3)&(3x^2-z)&(3xz^2-y)\end{vmatrix}=0$ **(2 M)** $\phi_1=3x^2y+xz^3+f(y,z)$ • $\phi_2=3x^2y-yz+f(x,z)$ **(4M)** $\phi_3=xz^3-yz+f(x,y)$ • $\phi=3x^2y+xz^3-yz+c$ **(2M)**	
5.	**Prove that** $\vec{F}=(y^2+2xz^2)\vec{i}+(2xy-z)\vec{j}+(2zx^2-y+2z)\vec{k}$ **is irrotational and find its scalar potential. (8 M)** BTL5 **Answer : Refer Page No.2.47-Dr.M.CHANDRASEKAR** • $\nabla\times\vec{F}=\begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\ \partial/\partial x&\partial/\partial y&\partial/\partial z\\ (y^2+2xz^2)&(2xy-z)&(2zx^2-y+2z)\end{vmatrix}=0$ **(2 M)** $\phi_1=xy^2+x^2z^2+f(y,z)$ • $\phi_2=xy^2-yz+f(x,z)$ **(4M)** $\phi_3=x^2z^2+xy^2-yz+f(x,y)$ • $\phi=x^2z^2+xy^2-yz+c$ **(2M)**	
6.	**Prove that** $\vec{F}=(y+z)\vec{i}+(z+x)\vec{j}+(x+y)\vec{k}$ **is irrotational and find its scalar potential. (8 M)** BTL5 **Answer : Refer Page No.2.46-Dr.M.CHANDRASEKAR** • $\nabla\times\vec{F}=\begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\ \partial/\partial x&\partial/\partial y&\partial/\partial z\\ (y+z)&(z+x)&(x+y)\end{vmatrix}=0$ **(2 M)** $\phi_1=xy+xz+f(y,z)$ • $\phi_2=xy+yz+f(x,z)$ **(4M)** $\phi_3=xz+yz+f(x,y)$ • $\phi=xz+xy+yz+c$ **(2M)**	

7.	**Evaluate by Green's theorem** $\int_C (xy+x^2)dx+(x^2+y^2)dy$ **where C is the square formed by** $x=-1, x=1, y=-1, y=1$ **(May/June 2016 R-13) (8 M)** BTL1 **Answer : Refer Page No.2.75-Dr.M.CHANDRASEKAR** • $\int_C udx+vdy=\iint_R\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dxdy$ $u=xy+x^2, \text{v}=x^2+y^2 \Rightarrow \frac{\partial u}{\partial y}=x, \frac{\partial v}{\partial x}=2x$ **(4M)** • $\int_C (xy+x^2)dx+(x^2+\text{y}^2)dy=\int_{-1}^{1}\int_{-1}^{1} x\,dx\,dy$ **(2M)** • $\int_C (xy+x^2)dx+(x^2+\text{y}^2)dy=0$ **(2M)**	
8.	**Verify Green's theorem** $\int_C (xy+y^2)dx+(x^2)dy$ **where C is the closed curve of the region bounded by** $y=x$ and $y=x^2$ **(May/June 2013 R-13) (8 M)** BTL3 **Answer : Refer Page No.2.78-Dr.M.CHANDRASEKAR** • $\int_C udx+vdy=\iint_R\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dxdy$ $u=xy+y^2, \text{v}=x^2 \Rightarrow \frac{\partial u}{\partial y}=x+2y, \frac{\partial v}{\partial x}=2x$ **(2M)** • $\iint_R\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dxdy=\int_0^1\int_y^{\sqrt{y}}(x-2y)dx\,dy=\frac{-1}{20}$ **(2M)** • $\int_C (xy+y^2)dx+(x^2)dy=\text{Along OA + Along AO}=\int_0^1(x^4+3x^3)dx+\int_1^0(3x^2)dx$ **(2M)** • $\int_C (xy+y^2)dx+(x^2)dy=\frac{19}{20}-1=\frac{-1}{20}$ **(2M)**	
9.	**Verify Green's theorem** $\int_C (x^2-xy^3)dx+(\text{y}^2-2\,\text{xy})dy$ **where C is the square with vertices (0,0),(2,0),(2,2),(0,2) (May/June 2003)** **(8 M)** BTL3 **Answer : Refer Page No.2.80-Dr.M.CHANDRASEKAR**	

	• $\int_C udx + vdy = \iint_R \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right) dxdy$ $u = x^2 - xy^3, \text{v} = \text{y}^2 - 2\,\text{xy} \Rightarrow \frac{\partial u}{\partial y} = -3xy^2, \frac{\partial v}{\partial x} = -2y$ **(2M)** • $\iint_R \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right) dxdy = \int_0^2 \int_0^2 (3x\,y^2 - 2y) dx\,dy = 8$ **(2M)** • $\int_C (x^2 - xy^3)dx + (\text{y}^2 - 2\,\text{xy})dy = \text{Along OA} + \text{Along AB} + \text{Along BC} + \text{Along CO}$ $= \int_0^2 (x^2)dx + \int_0^2 (\text{y}^2 - 4\,\text{y})dy + \int_2^0 (\text{x}^2 - 8x)dx + \int_2^0 (\text{y}^2)dy$ **(2M)** • $\int_C (x^2 - xy^3)dx + (\text{y}^2 - 2\,\text{xy})dy = \frac{8}{3} - \frac{16}{3} + \frac{40}{3} - \frac{8}{3} = 8$ **(2M)**	
10.	**Evaluate by Green's theorem** $\int_C (y - \sin x)dx + (\cos x)dy$ **where C is the triangle OAB where** $\mathbf{O} = (\mathbf{0}, \mathbf{0}), \text{A} = \left(\frac{\pi}{2}, 0\right), \text{B} = \left(\frac{\pi}{2}, 1\right)$ **(May/June 2015 R-13) (8 M)** BTL3 **Answer : Refer Page No.2.82-Dr.M.CHANDRASEKAR** • $\int_C udx + vdy = \iint_R \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right) dxdy$ $u = y - \sin x, \text{v} = \cos x \Rightarrow \frac{\partial u}{\partial y} = 1, \frac{\partial v}{\partial x} = -\sin x$ **(4M)** • $\int_C (y - \sin x)dx + (\cos x)dy = \int_0^{\frac{\pi}{2}} \int_0^{\frac{2x}{\pi}} (-\sin x - 1)\,dx\,dy$ **(2M)** • $\int_C (y - \sin x)dx + (\cos x)dy = -\left(\frac{\pi^2 + 8}{4\pi}\right)$ **(2M)**	
11.	**Apply Green's theorem to evaluate** $\int_C (3x^2 - 8y^2)dx + (4\,\text{y} - 6\,\text{xy})dy$ **where C is the boundary of the region defined by x=0,y=0 and x+y=1 (NOV/DEC 2014 R-13) (8 M)** BTL3 **Answer : Refer Page No.2.83-Dr.M.CHANDRASEKAR**	

	- $\int_C udx+vdy=\iint_R\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dxdy$ $u=-8y^2+3x^2, \mathrm{v}=4y-6xy \Rightarrow \frac{\partial u}{\partial y}=-16y, \frac{\partial v}{\partial x}=-6y$ **(4M)** - $\int_C (3x^2-8y^2)dx+(4\mathrm{y}-6\,\mathrm{xy})dy=\int_0^1\int_0^{1-y}10y\,dx\,dy$ **(2M)** - $\int_C (3x^2-8y^2)dx+(4\mathrm{y}-6\,\mathrm{xy})dy=\frac{5}{3}$ **(2M)**	
12.	**Verify Gauss Divergence theorem** $\vec{\mathrm{F}}= xy^2\vec{i}+yz^2\vec{j}+zx^2\vec{k}$ over **the region bounded by** $x=0, x=1, y=0, y=2, z=0, z=3$ **(May/June 2012 R-08)** **(16 M)** BTL3 **Answer : Refer Page No.2.96-Dr.M.CHANDRASEKAR** - $\iint_S \vec{F}.\hat{n}\,ds=\iiint_V \nabla.\vec{F}dv$ **(2M)** - $\nabla.\vec{F}=y^2+x^2+z^2$ **(2M)** - $\iiint_V \nabla.\vec{F}dv=\int_0^3\int_0^2\int_0^1(y^2+x^2+z^2)dxdydz=28$ **(4M)** - $\iint_S \vec{F}.\hat{n}\,ds=8+0+18+0+2+0=28$ **(8M)**	
13.	**Verify Gauss Divergence theorem** $\vec{\mathrm{F}}=(x^2-yz)\vec{i}+(y^2-zx)\vec{j}+(z^2-xy)\vec{k}$ over **the rectangular Parallelopiped** $0\le x\le a,\ 0\le y\le b,\ 0\le z\le c$ **(May/June 2009 R-08)** **(16 M)** BTL3 **Answer : Refer Page No.2.99-Dr.M.CHANDRASEKAR** - $\iint_S \vec{F}.\hat{n}\,ds=\iiint_V \nabla.\vec{F}dv$ **(2M)** - $\nabla.\vec{F}=2x+2y+2z$ **(2M)** - $\iiint_V \nabla.\vec{F}dv=2\int_0^c\int_0^b\int_0^a(x+y+z)dxdydz=abc(\mathrm{a}+\mathrm{b}+\mathrm{c})$ **(4M)**	

	$\iint_S \vec{F}.\hat{n}\,ds = \left(a^2bc-\frac{b^2c^2}{4}\right)+\left(\frac{b^2c^2}{4}\right)+\left(b^2ac-\frac{a^2c^2}{4}\right)$ • $+\left(\frac{a^2c^2}{4}\right)+\left(c^2ba-\frac{b^2a^2}{4}\right)+\left(\frac{b^2a^2}{4}\right)$ **(8M)** $\iint_S \vec{F}.\hat{n}\,ds = abc(\mathrm{a+b+c})$	
14.	**Verify Gauss Divergence theorem for** $\vec{\mathrm{F}}= x^3\vec{i}+y^3\vec{j}+z^3\vec{k}$ over **the cube bounded by** $x=0, x=a, y=0, y=a, z=0, z=a$ **(May/June 2014 R-13) (May/June-2018 R-17) (16 M)** BTL3 **Answer : Refer Page No.2.106-Dr.M.CHANDRASEKAR** • $\iint_S \vec{F}.\hat{n}\,ds = \iiint_V \nabla.\vec{F}dv$ **(2M)** • $\nabla.\vec{F} = 3y^2+3x^2+3z^2$ **(2M)** • $\iiint_V \nabla.\vec{F}dv = \int_0^a\int_0^a\int_0^a (3y^2+3x^2+3z^2)dxdydz = 3a^5$ **(4M)** • $\iint_S \vec{F}.\hat{n}\,ds = a^5+0+a^5+0+a^5+0 = 3a^5$ **(8M)**	
15.	**Verify Gauss Divergence theorem for** $\vec{\mathrm{F}}= 4xz\vec{i}-y^2\vec{j}+zy\vec{k}$ over **the region bounded by** $x=0, x=1, y=0, y=1, z=0, z=1$ **(May/June 2012 R-08) (16 M)** BTL3 **Answer : Refer Page No.2.109-Dr.M.CHANDRASEKAR** • $\iint_S \vec{F}.\hat{n}\,ds = \iiint_V \nabla.\vec{F}dv$ **(2M)** • $\nabla.\vec{F} = 4z-y$ **(2M)** • $\iiint_V \nabla.\vec{F}dv = \int_0^1\int_0^1\int_0^1 (4z-y)dxdydz = \frac{3}{2}$ **(4M)** • $\iint_S \vec{F}.\hat{n}\,ds = 2+0-1+0+\frac{1}{2}+0 = \frac{3}{2}$ **(8M)**	
16.	**Verify Gauss Divergence theorem for** $\vec{\mathrm{F}}= y\vec{i}+x\vec{j}+z^2\vec{k}$ over **the cylindrical region bounded by** $x^2+y^2=9, z=0$ and $z=2$ **(Dec/Jan 2015 R-13) (16 M)** BTL3 **Answer : Refer Page No.2.103-Dr.M.CHANDRASEKAR**	

	• $\iint_S \vec{F}.\hat{n}\,ds = \iiint_V \nabla.\vec{F}dv$ **(2M)** • $\nabla.\vec{F} = 2z$ **(2M)** • $\iiint_V \nabla.\vec{F}dv = \int_{-3}^{3}\int_{-\sqrt{9-x^2}}^{\sqrt{9-x^2}}\int_{0}^{2} 2z\ dxdydz = 36\pi$ **(4M)** • $\iint_S \vec{F}.\hat{n}\,ds = 0+36\pi+0=36\pi$ **(8M)**	
17.	**Verify Stokes theorem for** $\vec{F} = (x^2+y^2)\vec{i} - 2xy\vec{j}$ **taken around the rectangle bounded by** $x=\pm a, y=0, y=b$ **(May/June 2004) (16 M)** BTL3 **Answer : Refer Page No.2.122-Dr.M.CHANDRASEKAR** • $\int_C \overrightarrow{F}.\overrightarrow{dr} = \iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds$ **(2M)** • $\nabla\times\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ (x^2+y^2) & -2xy & 0 \end{vmatrix} = -4y\vec{k}$ **(2M)** • $\iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds = \int_0^b\int_{-a}^{a}(-4\,\mathrm{y})dxdy = -4ab^2$ **(4M)** • $\int_C \overrightarrow{F}.\overrightarrow{dr} = AB+BC+CD+DA = \left(\frac{2a^3}{3}\right)-\left(ab^2\right)-\left(2ab^2+\frac{2a^3}{3}\right)-\left(ab^2\right) = -4ab^2$ **(8 M)**	
18.	**Verify Stokes theorem for** $\vec{F} = (x^2-y^2)\vec{i} + 2xy\vec{j}$ **taken around the rectangle bounded by** $x=0, x=a, y=0, y=b$ **(May/June 2004) (16 M)** BTL3 **Answer : Refer Page No.2.124-Dr.M.CHANDRASEKAR** • $\int_C \overrightarrow{F}.\overrightarrow{dr} = \iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds$ **(2M)** • $\nabla\times\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ (x^2-y^2) & 2xy & 0 \end{vmatrix} = 4y\vec{k}$ **(2M)**	

	- $\iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds = \int_0^b\int_0^a (4\,y)dxdy = 2ab^2$ **(4M)** - $\int_C \overrightarrow{F}.\overrightarrow{dr} = OA+AB+BC+CO = \left(\frac{a^3}{3}\right)+\left(ab^2\right)+\left(ab^2-\frac{a^3}{3}\right)+\left(0\right)=2ab^2$ **(8 M)**	
19.	**Verify Stokes theorem for** $\vec{\mathrm{F}}= x^2\vec{i}+xy\vec{j}$ **integrated around the square in z=0 plane whose sides are along the lines** $x=0, x=a, y=0, y=a$ **(May/June 2008) (16 M)** BTL3 **Answer : Refer Page No.2.126-Dr.M.CHANDRASEKAR** - $\int_C \overrightarrow{F}.\overrightarrow{dr} = \iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds$ **(2M)** - $\nabla\times\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ x^2 & xy & 0 \end{vmatrix} = y\vec{k}$ **(2M)** - $\iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds = \int_0^a\int_0^a (\,y)dxdy = \frac{a^3}{2}$ **(4M)** - $\int_C \overrightarrow{F}.\overrightarrow{dr} = OA+AB+BC+CO = \left(\frac{a^3}{3}\right)+\left(\frac{a^3}{2}\right)+\left(-\frac{a^3}{3}\right)=\left(\frac{a^3}{2}\right)$ **(8 M)**	
20.	**Verify Stokes theorem for** $\vec{\mathrm{F}}= (y-z+2)\vec{i}+(yz+4)\vec{j}-xz\vec{k}$ **where S is the open surface of the cube** $x=0, x=2, y=0, y=2, z=0, z=2$ **above the xy-plane (May/June 2005) (May/June-2018 R-17) (16 M)** BTL3 **Answer : Refer Page No.2.132-Dr.M.CHANDRASEKAR** - $\int_C \overrightarrow{F}.\overrightarrow{dr} = \iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds$ **(2M)** - $\nabla\times\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ y-z+2 & yz+4 & -xz \end{vmatrix} = -y\vec{i}+(z-1)\vec{j}-\vec{k}$ **(2M)** - $\iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds = (-4)+(4)+(4)+(-4)+(-4) = -4$ **(4M)** - $\int_C \overrightarrow{F}.\overrightarrow{dr} = OA+AC+CB+BO = \left(4\right)+\left(8\right)+\left(-8\right)+(-8)=\left(-4\right)$ **(8 M)**	

21.

Using Stokes theorem to Evaluate $\int_C \overrightarrow{F}.\overrightarrow{dr}$ where $\vec{\text{F}}= (y^2)\vec{i}+(\text{x}^2)\vec{j}-(x+z)\vec{k}$ and C is the boundary of the triangle with vertices (0,0,0), (1,0,0) and (1,1,0) (8 M) BTL3

Answer : Refer Page No.2.137-Dr.M.CHANDRASEKAR

- $\int_C \overrightarrow{F}.\overrightarrow{dr} = \iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds$ **(2M)**
- $\nabla\times\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial/\partial x & \partial/\partial y & \partial/\partial z \\ y^2 & x^2 & -(x+z) \end{vmatrix} = \vec{j}+2(x-y)\vec{k}$ **(2M)**
- $\iint_S (\nabla\times\overrightarrow{F}).\ \hat{n}\,ds = \int_0^1\int_0^x 2(\text{x}-\text{y})\,dydx = \dfrac{1}{3}$ **(4M)**

UNIT-III ANALYTIC FUNCTIONS

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by $w = z+c, cz, \frac{1}{z}, z^2$ – Bilinear transformation

PART-A

1.

Show that the function $f(z)=\bar{z}$ is no where differentiable. (DEC/JAN-2013) (NOV/DEC-2015) BTL2

Given

$$w = f(z) = \bar{z}$$

$$\therefore u+iv = x-iy \Rightarrow u = x, v = -y$$

$$u_x = 1, v_x = 0$$

$$u_y = 1, v_y = -1$$

$$\therefore u_x \neq v_y$$

So C-R equations are not satisfied for any x and y.

$\therefore f(z)$ is not differentiable anywhere.Hence not analytic anywhere.

2

Test the analyticity of the function $w = \sin z$. BTL4

	Given $w=\sin z$ $u+iy=\sin(x+iy)$ $=\sin x\cos iy+\cos x\sin(iy)$ $=\sin x\cosh y+i\cos x\sinh y$ $\Rightarrow u=\sin x\cosh y\ ; \quad v=\cos x\sinh y$ $\therefore u_x=\cos x\cosh y; \quad v_x=-\sin x\sinh y$ $u_y=\sin x\sinh y\ ; \quad v_y=\cos x\cosh y$ $\therefore u_x=v_y, \quad u_y=-v_x$ So C-R equations are satisfied forall any x and y and $u_x, ,u_y, v_x, v_y$ are continuous $\therefore f(z)$ is analytic everywhere.	
3	**Find the constants a,b,c if** $f(z)=x+ay+i(bx+cy)$ **is analytic. (DEC/JAN-2014)** BTL1 Let $u+iv=f(z)$ Since $f(z)$ is analytic, u and v satisfy the C-R Equations. $u_x=v_y, \quad u_y=-v_x$ $here\, u=x+ay, v=bx+cy$ $u_x=1, \ v_x=b$ $u_y=a, \ v_y=c$ $\therefore u_x=v_y \Rightarrow c=1;$ $u_y=-v_x \Rightarrow a=-b$	
4	**Show that** $u=2x-x^3+3xy^2$ **is harmonic** BTL2 Given $u=2x-x^3+3xy^2$ $u_x=2-3x^2+3y^2; u_y=6xy$ $u_{xx}=-6x; \qquad u_{yy}=6x$ $\therefore u_{xx}+u_{yy}=-6x+6x=0.$ Therefore u is harmonic	
5	**Show that the function** $u=y+e^x\cos y$ **is harmonic.** BTL2 Given	

	$u = y + e^x \cos y$ $u_x = e^x \cos y,\ \ u_y = 1 + e^x(-\sin y)$ $u_{xx} = e^x \cos y,\ u_{yy} = -e^x \cos y$ $u_{xx} + u_{yy} = e^x \cos y - e^x \cos y = 0$ Therefore u is harmonic		
6	**Show that $x^2 + iy^3$ is not analytic anywhere.** Let $u + iv = x^2 + iy^3$ $\therefore u = x^2, \quad v = y^3$ $u_x = 2x,\ v_x = 0$ $u_y = 0\ ,\ \ v_y = 3y^2$ $\therefore u_x \neq v_y,\ \ u_y = -v_x$ $\therefore$ The function is not analytic. But, when $x = 0, y = 0$ the C-R Equations are satisfied.	BTL2	
7	**For the conformal mapping $f(z) = z^2$, find the scale factor at** $z = i$. Given $f(z) = z^2,$ $\therefore\ f'(z) = 2z$ Scale factor at $z = i$ is $\lvert f'(i) \rvert = \lvert 2i \rvert = 2$	BTL1	
8	**Find the image of x** $= 2$ **under the transformation** $w = \frac{1}{z}$. Given $w = \frac{1}{z} \Rightarrow z = \frac{1}{w} = \frac{\overline{w}}{w\overline{w}}$ $\Rightarrow x + iy = \frac{u - iv}{u^2 + v^2}$ $\therefore x = \frac{u}{u^2 + v^2}$ $\therefore$ The image of $x = 2$ *is* $\frac{u}{u^2 + v^2} = 2 \Rightarrow u^2 + v^2 - \frac{u}{2} = 0$ which is a circle in the w – plane.	BTL1	
9	**Find the image of** $x = k$ **under the transformation** $w = \frac{1}{z}$**.**	BTL1	

	Given $w=\frac{1}{z} \Rightarrow z=\frac{1}{w}=\frac{\overline{w}}{w\overline{w}}$ $\Rightarrow \quad x+iy=\frac{u-iv}{u^2+v^2}$ $\therefore x=\frac{u}{u^2+v^2}$ $\therefore$ The image of $x=k$ is $\frac{u}{u^2+v^2}=k \Rightarrow u^2+v^2-\frac{u}{k}=0$ which is a circle in the w − plane	
10	**Find the image of the circle $\lvert z\rvert=2$ under the transformation $w=3z$.(NOV/DEC-2014)** BTL1 Given $w=3z$ $\lvert w\rvert=3\lvert z\rvert$ $=3\times 2$ $=6$ $\therefore$ The image of the circle $\lvert z\rvert=2$ is the circle $\lvert w\rvert=6$ in the w-plane. $\therefore \sqrt{u^2+v^2}=6,$ $\Rightarrow u^2+v^2=36,$ which is a circle	
11	**Find the image of the circle $\lvert z\rvert=2$ under the transformation $w=z+3+2i$.** BTL1 Given $w=z+3+2i$ $u+iv=x+iy+3+2i$ $\therefore \quad u=x+3 \Rightarrow \quad x=u-3$ $v=y+2 \Rightarrow \quad y=v-2$ $\lvert z\rvert=2 \Rightarrow \sqrt{x^2+y^2}=2$ $\Rightarrow \quad x^2+y^2=4$ $\Rightarrow (u-3)^2+(v-2)^2=4$	
12	**Find the image of the line $x-y+1=0$ under the map $w=\frac{1}{z}$.** BTL1 Given $w=\frac{1}{z} \Rightarrow z=\frac{1}{w}=\frac{\overline{w}}{w\overline{w}}$ $\Rightarrow \quad x+iy=\frac{u-iv}{u^2+v^2}$ $\therefore x=\frac{u}{u^2+v^2}\ ,y=\frac{-v}{u^2+v^2}$	

	The image of the line $x-y+1=0$ is $\frac{u}{u^2+v^2}+\frac{v}{u^2+v^2}+1=0$ $\Rightarrow u^2+v^2+u+v=0$ which is a circle in the w$-$plane	
13	**Findthe fixed points of the transformation** $\mathrm{w}=\frac{6z-9}{z}$**.** BTL1 The given transformation $\mathrm{w}=\frac{6z-9}{z}$**.** The fixed points are given points by $\mathrm{w}=z$ $\Rightarrow \quad z=\frac{6z-9}{z}$ $\Rightarrow \quad z^2=6z-9$ $\Rightarrow \quad z^2-6z-9=0$ $\Rightarrow \quad (z-3)^2=0$ $\Rightarrow \quad z=3,3$	
14	**Find the fixed points of the mapping** $\mathrm{w}=\frac{3-z}{1+z}$**.** BTL1 The given maps $\mathrm{w}=\frac{3-z}{1+z}$ The fixed points are given by $\mathrm{w}=z$ $\therefore \quad z=\frac{3-z}{1+z}\Rightarrow z+z^2=3-z$ $\Rightarrow z+z^2-3+z=0$ $\Rightarrow z^2+2z-3=0$ $\Rightarrow (z+3)(\mathrm{z}-1)=0$ $\Rightarrow z=-3,1$	
15	**Find the fixed points of the mapping** $\mathrm{w}=\frac{2z+6}{z+7}$. **(DEC/JAN-2015)** BTL1 The given map is $\mathrm{w}=\frac{2z+6}{z+7}$. The fixed points are given by $\mathrm{w}=z$	

	$\therefore \quad z=\frac{2z+6}{z+7} \Rightarrow 7z+z^2=2z+6$ $\Rightarrow 7z+z^2-2z+6=0$ $\Rightarrow z^2+5z-6=0$ $\Rightarrow (z+6)(\text{z}-1)=0$ $\Rightarrow z=1,-6$	
16	**Find the bilinear map which maps points $\infty, i, 0$ of the z plane onto $0, i, \infty$ of the w-plane.** BTL1 Given $z_1=\infty, z_2=i, z_3=0$ which are mapped onto $w_1=0, w_2=i, w_3=\infty$ Since $z_1=\infty$ & $w_3=\infty$, omitting the factors involving z_1 & w_3 The Bilinear map is, $\frac{w-w_1}{w_2-w_1}=\frac{z_2-z_3}{z-z_3}$ $\frac{w-0}{i-0}=\frac{i-0}{z}$ $\Rightarrow w=-\frac{1}{z}$	
17	**Define the Conformal Mapping**. BTL1 A transformation that preserves angles between every pair of curves through a Point, both in magnitude and sense, is said to be conformal at that point.	
18	**State sufficient condition for analytic function. (DEC/JAN-2016)** BTL1 If the partial derivatives u_x , u_y , v_x , and v_y areall continuous in D and $u_x=v_y,\ u_y=-v_x$ .Then the function *f(z)*is analytic in a domain D.	
19	**Find the constants a, b if $f(z)=x+2ay+i(3x+by)$ is analytic.** BTL1 Given $f(z)=x+2ay+i(3x+by)$ is analytic. $\Rightarrow u_x=v_y,\ u_y=-v_x$ ....(1) Here $u=x+2ay$ and $v=3x+by$ Thus (1) gives $1=b$ and $2a=-3$ $\Rightarrow a=-\frac{3}{2}$ and $b=-1$	
20	**State the Cauchy Riemann equations in polar coordinates satisfied by an analytic Function.** BTL1 Cauchy Riemann equations in polar coordinates are given by $u_r=\frac{1}{r}v_\theta$ and $\text{v}_r=-\frac{1}{r}u_\theta$ where u and v are functions of r and θ.	

21	**Find the critical points of the transformation$\boldsymbol{w = 1 + \frac{2}{z}}$. (NOV/DEC-2016)** BTL1 The critical points of the transformation are obtained by $f\,'(z) = 2z$ $Hence\ -\frac{2}{z^2} = 0$ $\Rightarrow -\frac{2}{0} = z^2$ $\Rightarrow z = \infty$ is the critical point of the given transformation.	
22	**Find the image of the region $\boldsymbol{x} > c$, where $\boldsymbol{c} > 0$ under the transformation $\boldsymbol{w} = \frac{\mathbf{1}}{\boldsymbol{z}}$.**BTL1 $w = \frac{1}{z}. \Rightarrow z = \frac{1}{w}$ Let $z = x + iy$ and$w = u + iv$ $\mathrm{x + iy} = \frac{1}{\mathrm{u+iv}} = \frac{\mathrm{u-iv}}{\mathrm{(u+iv)(u-iv)}} = \frac{\mathrm{u-iv}}{\mathrm{u^2+v^2}}$ $\therefore x = \frac{\mathrm{u}}{\mathrm{u^2+v^2}}\ and\ \ y = \frac{\mathrm{-v}}{\mathrm{u^2+v^2}}$ $\boldsymbol{x} > c \Rightarrow x = \frac{\mathrm{u}}{\mathrm{u^2+v^2}} > c$ $u > c\mathrm{u}^2 + \mathrm{cv}^2$ $\mathrm{u}^2 + \mathrm{v}^2 < \frac{u}{c}$ $\mathrm{u}^2 + \mathrm{v}^2 - \frac{u}{c} < 0.$ This refers to the inside of the circle center $(\frac{1}{2c}, 0)$ and radius $\frac{1}{2c}$.	
23	**Show that an analytic function with constant real part is constant.** BTL2 Let $f(z) = u + iv$ be analytic. $\Rightarrow u_x = v_y\ and\ u_y = -v_x$ Given that $u = constant. = c(say). \Rightarrow u_x = 0\ \ and\ \ v_y = 0 \Rightarrow u_y = 0\ \ and\ \ -v_x = 0$ $\Rightarrow$v is independent of *x* and *y*.$\Rightarrow v$ is constant $\Rightarrow f(z) = u + iv = c + ic$ is a constant.	
24	**Find the critical points of the transformation$\boldsymbol{w^2 = (z-\alpha)(z-\beta)}$.(DEC/JAN-2010) (NOV/DEC-2016)** BTL1 Let $w^2 = (z-\alpha)(z-\beta)$. Then, $2w\frac{dw}{dz} = (z-\alpha).1 + (z-\beta).1$ The Critical points of $w = f(z)$ is given by, $\frac{dw}{dz} = 0 \Rightarrow (z-\alpha).1 + (z-\beta).1 = 0 \qquad \Rightarrow z = \frac{\alpha+\beta}{2}$. Also,$\frac{dz}{dw} = 0 \Rightarrow \frac{2w}{(z-\alpha)+(z-\beta)} = 0. \Rightarrow w = 0, (z-\alpha) + (z-\beta) = 0 \Rightarrow z = \alpha, \beta.$ The critical points are $z = \alpha, \beta, \frac{\alpha+\beta}{2}$.	
25	**Write cross ratio of four points. (NOV/DEC-2018)** BTL1 The cross ratio of four points.$\frac{(w_1-w_2)(w_3-w_4)}{(w_2-w_3)(w_4-w_1)} = \frac{(z_1-z_2)(z_3-z_4)}{(z_2-z_3)(z_4-z_1)}$is invariant under the bilinear transformation	

26	**Verify f(z)= z^3 is analytic or not.** BTL3 Let $f(z)=u+iv=z^3=(x+iy)^3$ $u+iv=(x^3-3xy^2)+i(3x^2y-y^3)$ $u=(x^3-3xy^2)$ and $v=(3x^2y-y^3)$ $u_x=(3x^2-3y^2)\ and\ u_y=-6xy$ $v_x=6xy\ \ and\ \ v_y=(3x^2-3y^2)$ $u_x=v_y$ and $u_y=-v_x$. Hence the C-R Equations are satisfied. Therefore f(z)= z^3 is analytic	
27	**If $f(z)=u+iv$ is an analytic function , prove that u is a harmonic function.** BTL5 $f(z)=u+iv$ be analytic. $\frac{\partial u}{\partial x}=\frac{\partial v}{\partial y}$; $\frac{\partial u}{\partial y}=\frac{-\partial v}{\partial x}$ …………… (1) Now, $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=\frac{\partial}{\partial x}\left(\frac{\partial u}{\partial x}\right)+\frac{\partial}{\partial y}\left(\frac{\partial u}{\partial y}\right)=\frac{\partial}{\partial x}\left(\frac{\partial v}{\partial y}\right)+\frac{\partial}{\partial y}\left(\frac{-\partial v}{\partial x}\right)$ (since by (1)) $=\frac{\partial^2 v}{\partial x\partial y}-\frac{\partial^2 v}{\partial y\partial x}=0$ $\therefore u$ is harmonic	
28	**If $f(z)=r^2(\cos 2\theta+i\sin p\theta)$ is an analytic function ,then find the value of p** **(MAY/JUNE 2018 R-17)** BTL5 C-R Equations are $u_r=\left(\frac{1}{r}\right)v_\theta$, $u_\theta=-rv_r$ $u_r=2r\cos 2\theta, u_\theta=-2r^2\sin 2\theta$ $v_r=2r\sin p\theta, u_\theta=pr^2\cos p\theta$ $\Rightarrow p=2$	
29	**Examine whether the function $u=xy^2$ can be real part of an analytic function** **(MAY/JUNE 2018 R-17)** BTL5 Here $u_{xx}+u_{yy}=0-2x=-2x\neq 0$ It couldn't satisfies harmonic condition. Hence $u=xy^2$ cannot be real part of an analytic function	
	PART-B	
1.	**If $f(z)$ is an analytic function, Prove that** $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\lvert f(z)\rvert^2=4\lvert f'(z)\rvert^2$	

	(NOV/DEC 2014) (8 M) BTL5 **Answer : Refer Page No.3.31-Dr.M.CHANDRASEKAR** • C-R Equations are $u_x = v_y$, $u_y = -v_x$ **(2M)** • $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\|f(z)\|^2 = 2\left[\left(\frac{\partial u}{\partial x}\right)^2+\left(\frac{\partial v}{\partial x}\right)^2+\left(\frac{\partial u}{\partial y}\right)^2+\left(\frac{\partial v}{\partial y}\right)^2\right]$ **(4M)** • $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\|f(z)\|^2 = 4\left[\left(\frac{\partial u}{\partial x}\right)^2+\left(\frac{\partial v}{\partial x}\right)^2\right] = 4\|f\,'(z)\|^2$ **(2M)**	
2.	**If** $f(z)=u+iv$ **is analytic, Prove that** $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\log\|f(z)\| = 0$ **.(MAY/JUNE 2002)** **(8M)** BTL5 **Answer : Refer Page No.3.33-Dr.M.CHANDRASEKAR** • C-R Equations are $u_x = v_y$, $u_y = -v_x$ **(2M)** • $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\log\|f(z)\| = \frac{\begin{array}{c}(u^2+v^2)[u_x^2+v_x^2+u_y^2+v_y^2+u(u_{xx}+u_{yy}) \\ +\mathrm{v}(\mathrm{v}_{xx}+v_{yy})-2[(\mathrm{uu}_x+vv_x)^2+(\mathrm{uu}_y+vv_y)^2]\end{array}}{(u^2+v^2)^2}$ **(4M)** • Since the function f(z) is analytic, it satisfies C-R equations and hence the function is harmonic. **(2 M)** $\therefore\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\log\|f(z)\| = 0$	
3.	**Prove that** $u = x^2 - y^2, v = \frac{-y}{x^2+y^2}$ are harmonic but $u+iv$ **is not regular function.** **(NOV/DEC 2013) (8 M)** BTL5 **Answer : Refer Page No.3.44-Dr.M.CHANDRASEKAR** • For Proving u is harmonic $u_{xx}+u_{yy} = 2-2 = 0$ **(2M)** • For Proving v is harmonic $v_{xx}+v_{yy} = \left(\frac{2y^3-6x^2y}{(x^2+y^2)^3}\right)+\left(-\frac{\left(2y^3-6x^2y\right)}{(x^2+y^2)^3}\right) = 0$ **(2 M)** • But $u_x \ne v_y$, $u_y \ne -v_x \Rightarrow f(z) = u+iv$ is not a regular function. **(2 M)**	

4.	**If** $f(z)=u+iv$ **is analytic, Prove that** $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\lvert u\rvert^p = p(p-1)(u^{p-2})\left\lvert f^{'}(z)\right\rvert^2$ **(MAY/JUNE 2002) (MAY/JUNE 2018 R-17) (8 M)** BTL5 **Answer : Refer Page No.3.36-Dr.M.CHANDRASEKAR** • C-R Equations are $u_x = v_y$, $u_y = -v_x$ **(2M)** • $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\lvert u\rvert^p = pu^{p-1}\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right)+(p-1)pu^{p-2}\left(\left(\frac{\partial u}{\partial x}\right)^2+\left(\frac{\partial u}{\partial y}\right)^2\right)$ **(4M)** • $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\lvert u\rvert^p = p(p-1)(u^{p-2})\left\lvert f^{'}(z)\right\rvert^2$ **(2M)**	
5.	**In a two dimensional flow, the stream function is** $\psi = \tan^{-1}\left(\frac{y}{x}\right)$ **Find the velocityPotential** ϕ **. (NOV/DEC 2016) (8 M)** BTL1 **Answer : Refer Page No.3.50-Dr.M.CHANDRASEKAR** • $\frac{\partial\psi}{\partial x} = \frac{-y}{x^2+y^2}$; $\frac{\partial\psi}{\partial y} = \frac{x}{x^2+y^2}$ **(2M)** • $\phi = \int\left(\frac{\partial\psi}{\partial y}dx - \frac{\partial\psi}{\partial x}dy\right)$ **(2 M)** • $\phi = \log(x^2+y^2)+\mathrm{c}$ **(4M)**	
6.	**Show that the function** $u=\frac{1}{2}\log(x^2+y^2)$ **is harmonic and find its harmonic conjugate (MAY/JUNE 2016) (8 M)** BTL2 **Answer : Refer Page No.3.52-Dr.M.CHANDRASEKAR** • $\frac{\partial u}{\partial x} = \frac{x}{x^2+y^2}$; $\frac{\partial u}{\partial y} = \frac{y}{x^2+y^2}$ **(2M)** • For Proving u is harmonic $u_{xx}+u_{yy} = \left(\frac{y^2-x^2}{(x^2+y^2)^2}\right)+\left(-\frac{y^2-x^2}{(x^2+y^2)^2}\right)=0$ **(2 M)** • $\mathrm{v} = \tan^{-1}\left(\frac{y}{x}\right)+c$ **(4M)**	
7.	**Prove that** $e^x[x\cos y - y\sin y]$ **can be the real part of an analytic function and determineits harmonic conjugate (NOV/DEC 2013) (8 M)** BTL5	

	Answer : Refer Page No.3.55-Dr.M.CHANDRASEKAR • $\frac{\partial u}{\partial x}=e^{x}x\cos y+e^{x}\cos y-e^{x}y\sin y$ $\frac{\partial u}{\partial y}=-e^{x}x\sin y-e^{x}\,\mathrm{y}\cos y-e^{x}\sin y$ **(2M)** • For Proving u is harmonic $u_{xx}+u_{yy}=\left(e^{x}x\cos y+2e^{x}\cos y-e^{x}y\sin y\right)+\left(-e^{x}x\cos y-2e^{x}\cos y+e^{x}y\sin y\right)=0$ **(2 M)** • $\mathrm{v}=e^{x}x\sin y+e^{x}\,\mathrm{y}\cos y+c$ **(4M)**	
8.	**Find an analytic function** $f(z)=u+iv$ **whose real part is** $e^{x}[x\cos y-y\sin y]$ **(8 M)** BTL1 **Answer : Refer Page No.3.64-Dr.M.CHANDRASEKAR** • $\frac{\partial u}{\partial x}=e^{x}x\cos y+e^{x}\cos y-e^{x}y\sin y$ $\frac{\partial u}{\partial y}=-e^{x}x\sin y-e^{x}\,\mathrm{y}\cos y-e^{x}\sin y$ **(2M)** • $\frac{\partial u}{\partial x}(z,0)=e^{z}+ze^{z}$ $\frac{\partial u}{\partial y}(\mathrm{z},0)=0$ **(2 M)** $f(z)=ze^{z}+c$ **(4M)**	
9.	**Find an analytic function** $f(z)=u+iv$ **whose real part is** $e^{2x}[x\cos 2y-y\sin 2y]$ **(8 M)** BTL1 **Answer : Refer Page No.3.66-Dr.M.CHANDRASEKAR** • $\frac{\partial u}{\partial x}=2e^{2x}x\cos 2y+e^{2x}\cos 2y-2e^{2x}y\sin 2y$ $\frac{\partial u}{\partial y}=-2e^{2x}x\sin 2y-2e^{2x}\,\mathrm{y}\cos 2y-e^{2x}\sin 2y$ **(2M)**	

	• $\frac{\partial u}{\partial x}(z,0)=e^{2z}+2ze^{2z}$ $\frac{\partial u}{\partial y}(z,0)=0$ **(2 M)** • $f(z)=ze^{2z}+c$ **(4M)**	
10.	**Find an analytic function** $f(z)=u+iv$ **if** $u-v=e^{x}[\cos y-\sin y]$ **(MAY/JUNE 2018 R-17)(8 M)** BTL1 **Answer : Refer Page No.3.76-Dr.M.CHANDRASEKAR** • $\frac{\partial U}{\partial x}=e^{x}\cos y-e^{x}\sin y$ $\frac{\partial U}{\partial y}=-e^{x}\cos y-e^{x}\sin y$ **(2M)** • $\frac{\partial U}{\partial x}(z,0)=e^{z}$ $\frac{\partial V}{\partial y}(z,0)=-e^{z}$ **(2 M)** • $F(z)=(1+i)f(z)$ $f(z)=e^{z}+c$ **(4M)**	
11.	**Prove that the function** $v=e^{-x}[x\cos y+y\sin y]$ **is harmonic and determine the corresponding analytic function** $f(z)=u+iv$ **(8 M)** BTL5 **Answer : Refer Page No.3.69-Dr.M.CHANDRASEKAR** • $\frac{\partial v}{\partial x}=-e^{-x}x\cos y+e^{-x}\cos y-e^{-x}y\sin y$ $\frac{\partial v}{\partial y}=-e^{-x}x\sin y+e^{-x}\,y\cos y+e^{-x}\sin y$ **(2M)** • For Proving u is harmonic $v_{xx}+v_{yy}=\left(e^{-x}[(x-2)\cos y+y\sin y]\right)+\left(e^{-x}[(2-x)\cos y-y\sin y]\right)=0$ **(2 M)** • $\frac{\partial v}{\partial x}(z,0)=e^{-z}(1-z)$ $\frac{\partial v}{\partial y}(z,0)=0$ **(2 M)**	

	• $f(z)=ize^{-z}+c$ **(2M)**	
12.	**Given that** $u=\dfrac{\sin 2x}{\cosh 2y-\cos 2x}$ **find the analytic function whose real part is u.** **(NOV/DEC 2014)(MAY/JUNE 2006) (8 M)** BTL1 **Answer : Refer Page No.3.71-Dr.M.CHANDRASEKAR** • $\dfrac{\partial u}{\partial x}(z,0)=-\text{cosec}^2 z$ $\dfrac{\partial u}{\partial y}(z,0)=0$ **(4M)** • $f(z)=\cot z+c$ **(4M)**	
13.	**If** $f(z)=u+iv$ **is analytic, find** $f(z)$ **given that** $u+v=\dfrac{\sin 2x}{\cosh 2y-\cos 2x}$ **(NOV/DEC 2015) (8 M)** BTL1 **Answer : Refer Page No.3.74-Dr.M.CHANDRASEKAR** • $\dfrac{\partial V}{\partial x}(z,0)=-\text{cosec}^2 z$ $\dfrac{\partial V}{\partial y}(z,0)=0$ **(4M)** • $f(z)=\left(\dfrac{1+i}{2}\right)\cot z+c$ **(4M)**	
14.	**Find the image of** $\lvert z-3\rvert=3$ **under the mapping** $w=\dfrac{1}{z}$ **(NOV/DEC 2010) (8 M)** BTL1 **Answer : Refer Page No.3.108-Dr.M.CHANDRASEKAR** • $x=\dfrac{u}{u^2+v^2}$ & $y=\dfrac{-v}{u^2+v^2}$ **(4M)** • The image of the circle $\lvert z-3\rvert=3$ is the straight line $u=\dfrac{1}{6}$ **(4M)**	
15.	**Find the image of** $\lvert z+i\rvert=1$ **under the mapping** $w=\dfrac{1}{z}$ **(NOV/DEC 2013) (8 M)** BTL1 **Answer : Refer Page No.3.109-Dr.M.CHANDRASEKAR**	

	• $x=\frac{u}{u^2+v^2}$ & $y=\frac{-v}{u^2+v^2}$ **(4M)** • The image of the circle $\lvert z+i\rvert=1$ is the straight line $v=\frac{1}{2}$ **(4M)**	
16.	**Find the image of** $1<y<2$ **under the mapping** $w=\frac{1}{z}$ **(MAY/JUNE 2014) (8 M)** BTL1 **Answer : Refer Page No.3.110-Dr.M.CHANDRASEKAR** • $x=\frac{u}{u^2+v^2}$ & $y=\frac{-v}{u^2+v^2}$ **(4M)** • $1<y<2$ is mapped onto the region between the circles $u^2+v^2+v=0$ and $2(u^2+v^2)+v=0$ **(4M)**	
17.	**Find the image of** $\lvert z-2i\rvert=2$ **under the mapping** $w=\frac{1}{z}$ **(NOV/DEC 2007) (MAY/JUNE 2018 R-17) (8 M)** BTL1 **Answer : Refer Page No.3.112-Dr.M.CHANDRASEKAR** • $x=\frac{u}{u^2+v^2}$ & $y=\frac{-v}{u^2+v^2}$ **(4M)** • The image of the circle $\lvert z-2i\rvert=2$ is the straight line $v=-\frac{1}{4}$ **(4M)**	
18.	**Find the bilinear transformation which maps** $-1,-i,1$ **in the z-plane** $\infty,i,0$ **in the w-planerespectively. (8 M)** BTL1 **Answer : Refer Page No.3.132-Dr.M.CHANDRASEKAR** • $\frac{(w-w_1)(w_2-w_3)}{(w-w_3)(w_2-w_1)}=\frac{(z-z_1)(z_2-z_3)}{(z-z_3)(z_2-z_1)}$ **(2M)** • $w=\frac{(1-z)}{(1+z)}$ **(6M)**	
19.	**Find the bilinear transformation which maps** $\infty,i,0$ **onto** $0,i,\infty$ **respectively. (8 M)** BTL1 **Answer : Refer Page No.3.133-Dr.M.CHANDRASEKAR** • $\frac{(w-w_1)(w_2-w_3)}{(w-w_3)(w_2-w_1)}=\frac{(z-z_1)(z_2-z_3)}{(z-z_3)(z_2-z_1)}$ **(2M)**	

	• $w=\frac{-1}{z}$ **(6M)**	
20.	**Find the bilinear transformation which maps $z=1,0,-1$ onto $w=\infty,-1,0$ respectively.** **(8 M)** BTL1 **Answer : Refer Page No.3.133-Dr.M.CHANDRASEKAR** • $\frac{(w-w_1)(w_2-w_3)}{(w-w_3)(w_2-w_1)}=\frac{(z-z_1)(z_2-z_3)}{(z-z_3)(z_2-z_1)}$ **(2M)** • $w=\frac{z+1}{z-1}$ **(6M)**	
21.	**Find the bilinear transformation which maps $-1,0,1$ onto $-1,-i,1$ respectively. Show that under this transformation the upper half of the z-plane maps onto the interior of the unit circle $\|w\|=1$ (MAY/JUNE 2018 R-17) (8 M)** BTL1 **Answer : Refer Page No.3.134-Dr.M.CHANDRASEKAR** • $\frac{(w-w_1)(w_2-w_3)}{(w-w_3)(w_2-w_1)}=\frac{(z-z_1)(z_2-z_3)}{(z-z_3)(z_2-z_1)}$ **(2M)** • $w=\frac{1-iz}{z-i}$ **(2M)** • $x=\frac{2u}{u^2+(v-1)^2}$ & $y=\frac{-(u^2+v^2-1)}{u^2+(v-1)^2}$ **(2M)** • For proving the upper half of the z-plane maps onto the interior of the unit circle $\|w\|\le 1$ **(2M)**	
	UNIT IV- COMPLEX INTEGRATION	
	Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.	
Q.No.	**PART-A**	
1	**State Cauchy integral theorem. (NOV/DEC 2014)(MAY/JUNE 2016)** BTL1 If a function $f(z)$ is analytic and its derivative $f'(z)$ is continuous at all points inside and on a simple closed curve C, then $\int_C f(z)dz=0$.	
2	**State Cauchy integral formula.** BTL1	

	If $f(z)$ is analytic inside and on a simple closed curve C in the region R and if 'a' is any point in R then $\int_C \frac{f(z)}{z-a}dz = 2\pi i f(a)$ where the integration around C taken in the positive direction.	
3	**State Cauchy integral formula for derivatives. (NOV/DEC 2010)** BTL1 If a function f(z) is analytic within and on a simple closed curve c and 'a' is any point lying in it, then $\int_C \frac{f(z)}{(z-a)^{n+1}}dz = \begin{cases} \frac{2\pi i}{n!} f^n(a) \text{ ; a lies inside c} \\ 0 \quad \text{;a lies outside c} \end{cases}$	
4	**State Cauchy Residue Theorem (NOV/DEC 2012)** BTL1 If f (z) is analytic at all points inside and on a simple closed curve C except at a Finite number of points $z_1, z_2, z_3, ..., z_n$ inside C then $\int_C f(z)dz = 2\pi i\left[\text{sum of residues of } f(z)\right]$	
5	**Evaluate $\int_C \frac{dz}{z-2}$ where C is the square with vertices (0,0), (1,0), (1,1), (0,1).** BTL5 Given C is the square with vertices (0,0), (1,0), (1,1), (0,1). ie) x=1,y=1. Since $\int_C \frac{dz}{z-2}$. Equating the denominator to zero. $z-2=0, \Rightarrow z=2$. Which lies outside C.	
6	**Evaluate $\int_C \frac{3z^2+7z+1}{z-3}dz$ where C is $\|z\|=2$.** BTL5 Given $\|z\|=2$ that is, $x^2+y^2=2^2$ with center (0,0) and radius 2. Given $\int_C \frac{3z^2+7z+1}{z-3}dz$. Equating the denominator to zero. $(z-3)^2=0 \Rightarrow z=3$ which lies outside C. $\therefore$ By Cauchy's integral formula $\int_C \frac{3z^2+7z+1}{z-3}dz = 0$.	
7	**Evaluate $\int_C \frac{\cos \pi z}{z-1}dz$ where C is $\|z\|=2$.** BTL5 Given $\|z\|=2$ that is, $x^2+y^2=2^2$ with center (0,0) and radius 2. Given $\int_C \frac{\cos \pi z}{z-1}dz$. Equating the denominator to zero. $z-1=0, \Rightarrow z=1$. Which lies inside C. $\therefore$ By Cauchy's integral formula $\int_C \frac{dz}{z-a} = 2\pi i\, f(a)$.	

	$Here\ \ a = 1, f(z) = \cos \pi z \Rightarrow f(a) = f(1) = \cos \pi = -1$. $\therefore \int_C \frac{\cos \pi z}{z-1}\, dz = 2\pi i(-1) = -2\pi i$.	
8	**Evaluate $\int_C \tan z\, dz$ where C is $\lvert z\rvert = 2$ (NOV/DEC 2015)** BTL5 Given $\lvert z\rvert = 2$ that is, $x^2 + y^2 = 2^2$ with center (0,0) and radius 2. Given $\int_C \tan z\, dz = \int_C \frac{\sin z}{\cos z}\, dz$. Equating the denominator to zero. Cos z = 0 = $\cos\frac{\pi}{2} \Rightarrow z = \frac{\pi}{2}$ =1.732 . Which lies inside C. $\therefore$ By Cauchy's integral formula $\int_C \frac{dz}{z-a} = 2\pi i\, f(a)$. $Here\ \ a = \frac{\pi}{2}, f(z) = \sin z \Rightarrow f(a) = f(\frac{\pi}{2}) = \sin\frac{\pi}{2} = 1$. $\therefore \int_C \tan z\, dz = 2\pi i(1) = 2\pi i$	
9	**Evaluate the integral $\int_C \left(z^2 + 2z\right) dz$ where C is $\lvert z\rvert = 1$.** BTL5 Given $\lvert z\rvert = 1$. that is, $x^2 + y^2 = 1$ with centre (0,0)and radius 1. $f(z) = z^2 + 2z$ is a function which is analytic in the region bounded by C Hence by Cauchy's theorem $\int_C \left(z^2 + 2z\right) dz = 0$.	
10	**Find the contour C: $\lvert z\rvert < 1$ for which $\int_C \frac{e^z}{(z+1)^2 (z+1)} dz$ =0.** BTL1 $\int_C \frac{e^z}{(z+1)^2 (z+1)} dz$ **=0** when $\lvert z\rvert < 1$. [since the points lies outside the contour, then the integral value is 0.]	
11	**Evaluate $\int_C \frac{dz}{(z-3)^2}$ where C is $\lvert z\rvert = 1$** BTL5 Given $\lvert z\rvert = 1$. that is,) $x^2 + y^2 = 1$ with center (0,0) and radius 1. $\int_C \frac{dz}{(z-3)^2}$. Equating the denominator to zero. $(z-3)^2 = 0 \Rightarrow z = 3$ which lies outside C. $\therefore$ By Cauchy's integral formula for derivatives $\int_C \frac{dz}{(z-3)^2} = 0$.	

12	**Evaluate** $\int_c \frac{e^z dz}{z-2}$ **, where C is the unit circle with centre as origin.** BTL5 **(MAY/JUNE 2009)** $f\left(z\right)=\frac{e^z}{z-2}$ z=2 lies outside C. $f\left(z\right)$ is analytic inside and on C. $f'\left(z\right)$ is continuous in C, By Cauchy's integral theorem $\int_c f(z)dz=0$	
13	**Define Taylor's series.** BTL1 If $f(z)$ is analytic inside a circle C with its centre at z = a then, For all z inside c, $f(z)=f(a)+\frac{f'(a)}{1!}\left(z-a\right)+\frac{f''(a)}{2!}\left(z-a\right)^2+............+\frac{f^n(a)}{n!}\left(z-a\right)^n+.......+\infty$.	
14	**Define Laurent's series.** BTL1 If C_1 and C_2 are two concentric circles with centre "a" and radii r_1 and r_2 ($r_1<r_2$) and if $f(z)$ is analyticon C_1 and C_2 and in the annulus region between them, then at any point z in R $f(z)=\sum_{n=0}^{\infty}a_n(z-a)^n+\sum_{n=1}^{\infty}\frac{b_n}{(z-a)^n}$, where $a_n=\frac{1}{2\pi i}\int_{C_1}\frac{f(z)}{\left(z-a\right)^{n+1}}dz \quad and \; b_n=\frac{1}{2\pi i}\int_{C_2}\frac{f(z)}{\left(z-a\right)^{1-n}}dz$ The integrals being taken in the anticlockwise direction.	
15	**Define Essential singularity.** BTL1 A singular point z =a is called an essential singular point of $f(z)$ if the Laurent's series of $f(z)$ containing negative powers of z.	
16	**Discuss the nature of singularities** $f(z)=e^{\frac{1}{z}}$ **.(NOV/DEC 2015)(MAY/JUNE 2012)** BTL6 $f(z)=e^{\frac{1}{z}}=1+\frac{\left(\frac{1}{z}\right)}{1!}+\frac{\left(\frac{1}{z}\right)^2}{2!}+\frac{\left(\frac{1}{z}\right)^3}{3!}+....$ $=1+z^{-1}+\frac{z^{-2}}{2!}+\frac{z^{-3}}{3!}+...$ Therefore z =0 is an essential singularity, since the principal part contains negative powers of z.	
17	**Define removable singularity.** BTL1 A singular point z=a is called a removable singular point of $f(z)$, if the Laurent's series of $f(z)$ containing positive powers of z.	

18	**Find the nature of the singularity** $f(z)=\dfrac{\sin z}{z}$. BTL1 $f(z)=\dfrac{\sin z}{z}=\dfrac{1}{z}\left(z-\dfrac{z^3}{3!}+\dfrac{z^5}{5!}+......\right)=1-\dfrac{z^2}{3!}+\dfrac{z^4}{5!}$ **-....** There is no negative power of z. Therefore $z=0$ is a removable singularity.	
19	**Define isolated singularity with an example.** BTL1 A point $z=z_0$ is said to be isolated singularity of $f(z)$ i) If $f(z)$ is not analytic at $z=z_0$, ii)There exist neighborhoods of $z=z_0$ containing no other singularity Example: $f(z)=\dfrac{1}{(z-1)(z-2)}$ has two isolated singularity namely z =1 and z =2.	
20	**Find the singularities of** $f(z)=\dfrac{z^2+4}{z^2+2z+2}$**.** BTL1 Given $f(z)=\dfrac{z^2+4}{z^2+2z+2}$**.** [The singularities are poles] The poles of $f(z)$ are given by equating the denominator to zero. $z^2+2z+2=0,\quad z=\dfrac{-2\pm\sqrt{4-8}}{2}=-1\pm i$. Which is a pole of order 1.	
21	**Find the singularities of the function** $f(z)=\dfrac{\cot\pi z}{(z-a)^3}$**.** BTL1 Given $f(z)=\dfrac{\cot\pi z}{(z-a)^3}=\dfrac{\cos\pi z}{\sin\pi z(z-a)^3}$ $i.e. \sin\pi z(z-a)^3=0 \quad\Rightarrow\quad \sin\pi z=0 \quad (or)(z-a)^3=0$ Now $(z-a)^3=0$ $z=a$ is a pole of order 3 and then $\sin\pi z=0$ $\pi z=n\pi\Rightarrow \quad z=\pm n, \quad n=0,1,2,3.......$ $z=\pm n$ are simple poles.	
22	**State nature of the singularities of** $f(z)=\sin\left(\dfrac{1}{z+1}\right)$**.** BTL1 Given $f(z)=\sin\left(\dfrac{1}{z+1}\right)$ $\sin\left(\dfrac{1}{z+1}\right)=\left(\dfrac{1}{z+1}\right)-\dfrac{\left(\dfrac{1}{z+1}\right)^3}{3!}+\dfrac{\left(\dfrac{1}{z+1}\right)^5}{5!}+.......=\left(\dfrac{1}{z+1}\right)-\dfrac{1}{3!}\left(\dfrac{1}{z+1}\right)^3+\dfrac{1}{5!}\left(\dfrac{1}{z+1}\right)^5-........$ Z=-1 is an essential singularity.	
23	**Find the zeros of the function** $f(z)=\tan z$ **and its pole. (NOV/DEC 2016)** BTL1	

	Given $f(z)=\tan z=\frac{\sin z}{\cos z}=\frac{P(z)}{Q(z)}$ The poles are given by $\cos z=0$ $z=(2n+1)\frac{\pi}{2}\quad where\quad n=0,\pm1,\pm 2\ ,\pm3,....$ $\operatorname{Re}s\left[f(z),a\right]=\frac{P(a)}{Q'(a)}$ Now $\frac{P(z)}{Q'(z)}=\frac{\sin z}{-\sin z}=-1$ $\operatorname{Re}s\left[f\left(z\right),\left(2n+1\right)\frac{\pi}{2}\right]=-1\quad where\quad n=0,\pm1,\pm 2\ ,\pm3,....$ Hence the residue of each pole is -1	
24	**Find the zeros of the function $f(z)=\cot z$ and it's pole .** BTL1 Given $f(z)=\cot \mathrm{z}=\frac{\cos z}{\sin z}=\frac{P(z)}{Q(z)}$ The poles are given by $\sin z=0$ $z=n\pi\quad where\quad n=0,\pm1,\pm 2\ ,\pm3,....$ Residue of f(z) at $z=n\pi$ is $\frac{P\left[n\pi\right]}{Q'\left[n\pi\right]}$ $\frac{P(z)}{Q'(z)}=\frac{\cos z}{\cos z}$ $\frac{P(z)}{Q'(z)}=\frac{\cos\left(2n+1\right)\frac{\pi}{2}}{\cos\left(2n+1\right)\frac{\pi}{2}}=1\qquad where\quad n=0,\pm1,\pm 2\ ,\pm3,....$	
25	**Find residue of $f(z)=\frac{z^2}{\left(z-1\right)^2\left(z+2\right)}$ and at its simple pole.** BTL1 Given $f(z)=\frac{z^2}{\left(z-1\right)^2\left(z+2\right)}$ The poles of f(z) are given by $\left(z-1\right)^2\left(z+2\right)=0$ $z=1$ is a pole of order 2 and $z=-2$ is a pole order 1[Simple pole] Residue of f(z) at z=-2: [simple Pole] $\operatorname{Res}\left[f\left(z\right)\right]_{z=a}=\lim_{z\to a}(z-a)f(z)$ $\operatorname{Re}s\left[f(z)\right]_{z=-2}=\lim_{z\to -2}(z+2)\frac{z^2}{(z-1)^2(z+2)}=\lim_{z\to -2}\frac{z^2}{(z-1)^2}=\frac{4}{9}$	

26	**Evaluate** $\int_C \frac{3z^2+7z+1}{(z+1)}dz$ **where C is the circle** $\lvert z\rvert=\frac{1}{2}$ **(MAY/JUNE 2018 R-17)** BTL3 Here z=-1 lies outside C. Therefore $\begin{cases} f(z) \text{ is analytic inside and on C.} \\ \text{And } f^{'}(z) \text{ is Continuous inside C} \end{cases}$ $\therefore \int_C f(z)dz = 0$	
27	**If C is the circle** $\lvert z\rvert=3$ and if $g(z_0)=\int_C \frac{2z^2-z-2}{(z-z_0)}dz$ then find g(2) **(MAY/JUNE 2018 R-17)** BTL3 $\int_C f(z)dz = 2\pi\text{i [sum of the residues]}$ Here $z=2$ is a pole order 1[Simple pole] $\left\{\text{Res } f(z)_{at\,z=2}\right\} = \lim_{z\to 2} (z-2)\left[\frac{2z^2-z-2}{(z-2)}\right]=4$ $\int_C \frac{2z^2-z-2}{(z-2)}dz = 8\pi\text{i}$	
	PART-B	
1.	**Use Cauchy's integral formula to evaluate** $\int_C \frac{\sin\pi z^2+\cos\pi z^2}{(z-1)(z-2)}dz$ **where C is the circle** $\lvert z\rvert=3$ **(MAY/JUNE 2016) (8 M)** BTL3 **Answer : Refer Page No.4.10-Dr.M.CHANDRASEKAR** - $\frac{\sin\pi z^2+\cos\pi z^2}{(z-1)(z-2)} = \frac{1}{(z-2)} - \frac{1}{(z-1)}$ **(2M)** - $\int_C \frac{f(z)}{(z-a)}dz = 2\pi i\, f(a)$ **(2M)** - $\int_C \frac{\sin\pi z^2+\cos\pi z^2}{(z-1)(z-2)}dz = 4\pi i$ **(4M)**	

2.	**Use Cauchy's integral formula to evaluate** $\int_C \frac{z+4}{(z^2+2z+5)}dz$ **where C is the circle** $\lvert z+1-i\rvert=3$ **(NOV/DEC 2006) (NOV/DEC 2014) (8 M)** BTL3 **Answer : Refer Page No.4.16-Dr.M.CHANDRASEKAR** • $\frac{z+4}{(z^2+2z+5)}=\frac{\left(\frac{3+2i}{4i}\right)}{z-(-1+2\mathrm{i})}+\frac{\left(\frac{3-2i}{-4i}\right)}{z-(-1-2\mathrm{i})}$ **(2M)** • $\int_C \frac{f(z)}{(z-a)}dz=2\pi i\, f(a)$ **(2M)** • $\int_C \frac{z+4}{(z^2+2z+5)}dz=\frac{\pi(3+2i)}{2}$ **(4M)**
3.	**Use Cauchy's integral formula to evaluate** $\int_C \frac{z}{(z-1)(z-2)}dz$ **where C is the circle** $\lvert z-2\rvert=\frac{1}{2}$ **(MAY/JUNE 2015) (8 M)** BTL3 **Answer : Refer Page No.4.24-Dr.M.CHANDRASEKAR** • $\int_C \frac{f(z)}{(z-a)}dz=2\pi i\, f(a)$ **(2M)** • $\int_C \frac{z}{(z-1)(z-2)}dz=4\pi i$ **(6M)**
4.	**Use Cauchy's integral formula to evaluate** $\int_C \frac{z+1}{(z-3)(z-1)}dz$ **where C is the circle** $\lvert z\rvert=2$ **(MAY/JUNE 2016) (8 M)** BTL3 **Answer : Refer Page No.4.29-Dr.M.CHANDRASEKAR** • $\int_C \frac{f(z)}{(z-a)}dz=2\pi i\, f(a)$ **(2M)** • $\int_C \frac{z+1}{(z-3)(z-1)}dz=-2\pi i$ **(6M)**
5.	**Use Cauchy's integral formula to evaluate** $\int_C \frac{z-1}{(z-2)(z+1)^2}dz$ **where C is the circle** $\lvert z-i\rvert=2$ **(8 M)** BTL3

	Answer : Refer Page No.4.31-Dr.M.CHANDRASEKAR • $\int_C \frac{f(z)}{(z-a)^{n+1}}dz = \begin{cases} \frac{2\pi i}{n!} f^n(a) \text{ ; a lies inside c} \\ 0 \text{ ; a lies outside c} \end{cases}$ **(2M)** • $\int_C \frac{z-1}{(z-2)(z+1)^2}dz = -\frac{2\pi i}{9}$ **(6M)**	
6.	**Use Cauchy's integral formula to evaluate** $\int_C \frac{z^2}{(z^2+1)^2}dz$ **where C is the circle** $\lvert z-i \rvert = 1$ **(MAY/JUNE 2018 R-17)(8 M)** BTL3 **Answer : Refer Page No.4.30-Dr.M.CHANDRASEKAR** • $\int_C \frac{f(z)}{(z-a)^{n+1}}dz = \begin{cases} \frac{2\pi i}{n!} f^n(a) \text{ ; a lies inside c} \\ 0 \text{ ; a lies outside c} \end{cases}$ **(2M)** • $\int_C \frac{z^2}{(z^2+1)^2}dz = \frac{\pi}{2}$ **(6M)**	
7.	**Use Cauchy's integral formula to evaluate** $\int_C \frac{z+1}{(z^2+2z+4)}dz$ **where C is the circle** $\lvert z+1+i \rvert = 2$. **(8 M)** BTL3 **Answer : Refer Page No.4.39-Dr.M.CHANDRASEKAR** • $\int_C \frac{f(z)}{(z-a)}dz = 2\pi i\, f(a)$. **(2M)** • $\int_C \frac{z+1}{(z^2+2z+4)}dz = \pi i$ **(6M)**	
8.	**Expand** $\frac{z^2-1}{(z+2)(z+3)}$ **in the appropriate series in the regions** $(i)\, 2 < \lvert z \rvert < 3 \quad (ii)\, \lvert z \rvert > 3$ **using Laurent's series. (8 M)** BTL2 **Answer : Refer Page No.4.51-Dr.M.CHANDRASEKAR** • $f(z) = 1 + \frac{3}{z+2} - \frac{8}{z+3}$ **(2M)**	

	(i) In $2<\lvert z\rvert<3,$ • $f(z)=1+\frac{3}{z}\sum_{n=0}^{\infty}(-1)^n\left(\frac{2}{z}\right)^n-\frac{8}{3}\sum_{n=0}^{\infty}(-1)^n\left(\frac{z}{3}\right)^n$ **(3M)** (ii) In $\lvert z\rvert>3,$ • $f(z)=1+\frac{3}{z}\sum_{n=0}^{\infty}(-1)^n\left(\frac{2}{z}\right)^n-\frac{8}{z}\sum_{n=0}^{\infty}(-1)^n\left(\frac{3}{z}\right)^n$ **(3M)**	
9.	**Expand** $f(z)=\frac{7z-2}{z(z-2)(z+1)}$ **in Laurent's series in the regions** $(i)\,2<\lvert z\rvert<3 \quad (ii)\ \lvert z\rvert>3$ **(8 M)** BTL2 **Answer : Refer Page No.4.52-Dr.M.CHANDRASEKAR** • $f(z)=\frac{1}{z}+\frac{2}{z-2}-\frac{3}{z+1}$ **(2M)** (i) In $2<\lvert z\rvert<3,$ • $f(z)=\frac{1}{z}+\sum_{n=0}^{\infty}\left(\frac{2}{z}\right)^{n+1}+3\sum_{n=0}^{\infty}(-1)^{n+1}\left(\frac{1}{z}\right)^{n+1}$ **(3M)** (ii) In $\lvert z\rvert>3,$ • $f(z)=\frac{1}{z}+\sum_{n=0}^{\infty}\left(\frac{2}{z}\right)^{n+1}+3\sum_{n=0}^{\infty}(-1)^{n+1}\left(\frac{1}{z}\right)^{n+1}$ **(3M)**	
10.	**Expand** $f(z)=\frac{7z-2}{z(z-2)(z+1)}$ **in Laurent's series in the region** $(i)\lvert z\rvert<2 \quad (ii)\ 1<\lvert z+1\rvert<3$ **(MAY/JUNE 2014) (8 M)** BTL2 **Answer : Refer Page No.4.52-Dr.M.CHANDRASEKAR** • $f(z)=\frac{1}{z}+\frac{2}{z-2}-\frac{3}{z+1}$ **(2M)** (i) In $\lvert z\rvert<2,$ • $f(z)=\frac{1}{z}-\sum_{n=0}^{\infty}\left(\frac{z}{2}\right)^n-3\sum_{n=0}^{\infty}(z)^n$ **(3M)** (ii) In$1<\lvert z+1\rvert<3,$ • $f(z)=\frac{-3}{z+1}+\sum_{n=1}^{\infty}\left(\frac{1}{z+1}\right)^n-\frac{2}{3}\sum_{n=0}^{\infty}\left(\frac{z+1}{3}\right)^n$ **(3M)**	

11.	**Expand** $f(z)=\frac{6z+5}{z(z-2)(z+1)}$ **in Laurent's series in the region** $1<\lvert z+1\rvert<3$ **(MAY/JUNE 2018 R-17) (8 M)** BTL2 **Answer : Refer Page No.4.56-Dr.M.CHANDRASEKAR** • $f(z)=\frac{-5}{2z}+\frac{17}{6(z-2)}-\frac{1}{3(z+1)}$ **(2M)** $\text{In } 1<\lvert z+1\rvert<3,$ • $f(z)=\frac{-1}{3(z+1)}-\frac{5}{2(z+1)}\sum_{n=0}^{\infty}\left(\frac{1}{z+1}\right)^n-\frac{17}{8}\sum_{n=0}^{\infty}\left(\frac{z+1}{3}\right)^n$ **(6M)**	
12.	**Expand** $f(z)=\frac{1}{(z-1)(z-2)}$ **in Laurent's series in the region** $(i)\lvert z\rvert>2 \quad (ii)\ 0<\lvert z-1\rvert<1$ **(NOV/DEC 2014) (8 M)** BTL2 **Answer : Refer Page No.4.57-Dr.M.CHANDRASEKAR** • $f(z)=\frac{-1}{z-1}+\frac{1}{z-2}$ **(2M)** $(i)\text{ In } \lvert z\rvert>2,$ • $f(z)=-\sum_{n=0}^{\infty}\left(\frac{1}{z}\right)^n+\frac{1}{z}\sum_{n=0}^{\infty}\left(\frac{2}{z}\right)^n$ **(3M)** $(ii)\text{ In } 0<\lvert z-1\rvert<1,$ • $f(z)=\frac{-1}{z-1}+\sum_{n=0}^{\infty}(z-1)^n$ **(3M)**	
13.	**Use Cauchy's Residue theorem to evaluate** $\int_C \frac{\sin\pi z^2+\cos\pi z^2}{(z-1)^2(z-2)}dz$ **where C is the circle** $\lvert z\rvert=3$ **(NOV/DEC 2015) (8 M)** BTL3 **Answer : Refer Page No.4.96-Dr.M.CHANDRASEKAR** • $\int_C f(z)dz=2\pi i\ [\text{sum of the residues}]$ **(2M)** • $\left\{\text{Res } f(z)_{at\,z=2}\right\}=1$ $\left\{\text{Res } f(z)_{at\,z=1}\right\}=-2\pi+1$ **(4M)**	

	• $\int_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)^2(z-2)} dz = 4\pi i(1-\pi)$ **(2M)**	
14.	**Use Cauchy's Residue theorem to evaluate** $\int_C \frac{12z-7}{(z-1)^2(2z+3)} dz$ **where C is the circle** $\lvert z \rvert = 2$ **(8 M)** BTL3 **Answer : Refer Page No.4.92-Dr.M.CHANDRASEKAR** • $\int_C f(z)dz = 2\pi \mathrm{i}$ [sum of the residues] **(2M)** • $\left\{\text{Res } f(z)_{at\, z=-3/2}\right\} = -4$ $\left\{\text{Res } f(z)_{at\, z=1}\right\} = 4$ **(4M)** • $\int_C \frac{12z-7}{(z-1)^2(2z+3)} dz = 0$ **(2M)**	
15.	**Use Cauchy's Residue theorem to evaluate** $\int_C \frac{z^2}{(z+1)^2(z^2+4)} dz$ **where C is the circle** $\lvert z \rvert = 3$ **(8 M)** BTL3 **Answer : Refer Page No.4.99-Dr.M.CHANDRASEKAR** • $\int_C f(z)dz = 2\pi \mathrm{i}$ [sum of the residues] **(2M)** $\left\{\text{Res } f(z)_{at\, z=-1}\right\} = -\frac{8}{25}$ • $\left\{\text{Res } f(z)_{at\, z=2i}\right\} = \frac{-4}{(1+2i)^2(4i)}$ **(4M)** $\left\{\text{Res } f(z)_{at\, z=-2i}\right\} = \frac{-4}{(1-2i)^2(-4i)}$ • $\int_C \frac{z^2}{(z+1)^2(z^2+4)} dz = 0$ **(2M)**	
16.	**Use Cauchy's Residue theorem to evaluate** $\int_C \frac{dz}{(z^2+4)^2}$ **where C is the circle** $\lvert z-i \rvert = 2$ **(8 M)** BTL3 **Answer : Refer Page No.4.100-Dr.M.CHANDRASEKAR**	

	• $\int_C f(z)dz = 2\pi i$ [sum of the residues] **(2M)** • $\left\{\text{Res } f(z)_{at\, z=2i}\right\} = \frac{1}{32i}$ $\left\{\text{Res } f(z)_{at\, z=-2i}\right\} = 0$ **(4M)** • $\int_C \frac{dz}{(z^2+4)^2} = \frac{\pi}{16}$ **(2M)**	
17.	**Evaluate $\int_0^{2\pi} \frac{\cos 2\theta}{5+4\cos\theta} d\theta$ by using Contour integration (MAY/JUNE 2018 R-17) (16M)** BTL5 **Answer : Refer Page No.4.105-Dr.M.CHANDRASEKAR** • $\int_0^{2\pi} \frac{\cos 2\theta}{5+4\cos\theta} d\theta = \frac{1}{4i} \int_C \frac{(z^2+1)dz}{z^2(z+1/2)(z+2)}$ **(4M)** • $\int_C f(z)dz = 2\pi i$ [sum of the residues] **(2M)** $\left\{\text{Res } f(z)_{at\, z=0}\right\} = \frac{-5}{2}$ • $\left\{\text{Res } f(z)_{at\, z=-1/2}\right\} = \frac{17}{6}$ **(8M)** $\left\{\text{Res } f(z)_{at\, z=-2}\right\} = 0$ • $\int_0^{2\pi} \frac{\cos 2\theta}{5+4\cos\theta} d\theta = \frac{\pi}{6}$ **(2M)**	
18.	**Prove that $\int_0^{2\pi} \frac{d\theta}{5+4\sin\theta} = \frac{2\pi}{3}$ by using Contour integration. (NOV/DEC 2006) (8 M)** BTL5 **Answer : Refer Page No.4.120-Dr.M.CHANDRASEKAR** • $\int_0^{2\pi} \frac{d\theta}{5+4\sin\theta} = \int_C \frac{dz}{(z+2i)(2z+i)}$ **(3M)** • $\int_C f(z)dz = 2\pi i$ [sum of the residues] **(1M)**	

	• $\left\{\text{Res } f(z)_{at\, z=-i/2}\right\}=\frac{1}{3i}$ $\left\{\text{Res } f(z)_{at\, z=-2i}\right\}=0$ **(3M)** • $\int_0^{2\pi}\frac{d\theta}{5+4\sin\theta}=\frac{2\pi}{3}$ **(1M)**	
19.	**Evaluate** $\int_0^{2\pi}\frac{d\theta}{13+5\sin\theta}$ **by using Contour integration. (NOV/DEC 2014) (8 M)** BTL5 **Answer : Refer Page No.4.123-Dr.M.CHANDRASEKAR** • $\int_0^{2\pi}\frac{d\theta}{13+5\sin\theta}=\int_C\frac{2dz}{(5\text{z}+i)(2+5i)}$ **(3M)** • $\int_C f(z)dz=2\pi\text{i [sum of the residues]}$ **(1M)** • $\left\{\text{Res } f(z)_{at\, z=5i}\right\}=0$ $\left\{\text{Res } f(z)_{at\, z=-\frac{i}{5}}\right\}=\frac{1}{12i}$ **(3M)** • $\int_0^{2\pi}\frac{d\theta}{13+5\sin\theta}=\frac{\pi}{6}$ **(1M)**	
20.	**Evaluate** $\int_{-\infty}^{\infty}\frac{x^2dx}{(x^2+1)(x^2+4)}$ **by using Contour integration. (NOV/DEC 2008) (8 M)** BTL5 **Answer : Refer Page No.4.92-Dr.G.BALAJI** • $\int_{-\infty}^{\infty}\frac{x^2dx}{(x^2+1)(x^2+4)}=\int_C\frac{z^2}{(z^2+1)(z^2+4)}dz$ **(1M)** • $\int_C f(z)dz=2\pi\text{i [sum of the residues]}$ **(1M)** • $\left\{\text{Res } f(z)_{at\, z=i}\right\}=\frac{i}{6}$ $\left\{\text{Res } f(z)_{at\, z=2i}\right\}=-\frac{i}{3}$ **(3M)** • $\int_{-\infty}^{\infty}\frac{x^2dx}{(x^2+1)(x^2+4)}=\frac{\pi}{3}$ **(3M)**	

21.	**Evaluate $\int_0^\infty \frac{\cos mx}{(x^2+a^2)}dx$ by using Contour integration. (NOV/DEC 2016) (8 M)** BTL5 **Answer : Refer Page No.4.101-Dr.G.BALAJI** • $\int_0^\infty \frac{\cos mx\,dx}{(x^2+a^2)} = R.P\ of\ \int_C \frac{e^{mz}}{(z^2+a^2)}dz$ **(1M)** • $\int_C f(z)dz = 2\pi i\ [\text{sum of the residues}]$ **(1M)** • $\left\{\text{Res } f(z)_{at\,z=ai}\right\} = \frac{e^{-ma}}{2ai}$ **(3M)** • $\int_0^\infty \frac{\cos mx}{(x^2+a^2)}dx = \frac{\pi e^{-ma}}{2a}$ **(3M)**

	UNIT V LAPLACETRANSFORMS
	Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constantcoefficients.
	PART * A
Q.No.	**Questions**
1.	**State the sufficient condition for the existence of Laplace transforms.** **(OR) State the conditions under which the Laplace Transform of $f(t)$ exisits.** **(APR/MAY 2015, 2017 R-13)** BTL1 The Laplace transform of $f(t)$ exists if a) $f(t)$ is piecewise continuous in $[a, b]$ where $a > 0$. b) $f(t)$is of exponential order.
2.	**Is the linearity property applicable to $L\left[\frac{1-cost}{t}\right]$?Reason out?** BTL5 Given, $L\left[\frac{1-cost}{t}\right] = L\left[\frac{1}{t}\right] - L\left[\frac{cos\,t}{t}\right]$by linearity property, provided the result exists. $L\left[\frac{1}{t}\right]$does not exist. Since $\lim_{t\to 0}\frac{1}{t} = \frac{1}{0} = \infty$. $L\left[\frac{cos\,t}{t}\right]$does not exist. Since, $\lim_{t\to 0}\frac{\cos t}{t} = \frac{1}{0} = \infty$.

	$\therefore$ Linearity property is not applicable to $\boldsymbol{L}\left[\frac{\boldsymbol{1-cost}}{\boldsymbol{t}}\right]$.
3.	**If $\boldsymbol{L}$[F(t)]=$\boldsymbol{F(s)}$, Prove that $\boldsymbol{L}\left[\boldsymbol{f}\left(\frac{\boldsymbol{t}}{\boldsymbol{5}}\right)\right]=\boldsymbol{5F(5s)}$.** BTL5 $L[f(t)]=\int_0^\infty e^{-st}f(t)dt$ $put \quad \frac{t}{5}=u\Rightarrow 5du=dt$ $L\left[f\left(\frac{t}{5}\right)\right]=\int_0^\infty e^{-(5s)u}f(u)5du$ $=5\int_0^\infty e^{-(5s)u}f(u)du=5F(5s)$
4	**Find the Laplace transform of unit step function.** BTL1 The unit step function is $u_a(t)=\{\begin{matrix}0 & t<a\\ 1 & t>a,\end{matrix} \qquad a\geq 0$ The Laplace transform $L[f(t)]=\int_0^\infty e^{-st}f(t)dt=\int_a^\infty e^{-st}(1)dt=\left[\frac{e^{-st}}{-s}\right]_a^\infty=-\frac{1}{s}\left[e^{-\infty}-e^{-as}\right]=\frac{e^{-as}}{s}.$
5	**Prove that $L\left(\int_0^t f(t)dt\right)=\frac{F(s)}{s}$ where $\boldsymbol{L[f(t)]=F(s)}$. [DEC 2016 R-13]** BTL5 Let $F(t)=\int_0^t f(t)dt$ $F'(t)=f(t)$ $L[F'(t)]=sL[F(t)]-F(0)=sL[F(t)]-0$ $L[f(t)]=sL[F(t)]=sL[\int_0^t f(t)dt]$ $\therefore L\left(\int_0^t f(t)dt\right)=\frac{F(s)}{s}$
6	**Does $L\left[\frac{\cos at}{t}\right]$ exist?** BTL4 $\underset{t\to 0}{Lt}\frac{f(t)}{t}=\underset{t\to 0}{Lt}\frac{\cos at}{t}=\frac{1}{0}=\infty$ $\therefore L\left[\frac{\cos at}{t}\right] does \quad not \quad exist.$
7	**Obtain the Laplace transform of $\boldsymbol{sin2t-2tcos2t}$.** BTL3

	$L[\sin 2t-2t\cos 2t]=L[\sin 2t]-2L[t\cos 2t]=L[\sin 2t]-2\left(-\frac{d}{ds}L[\cos 2t]\right)$ $=\frac{2}{s^2+4}+2\frac{d}{ds}\left(\frac{s}{s^2+4}\right)=\frac{2}{s^2+4}+2\left(\frac{(s^2+4)(1)-s(2s)}{(s^2+4)^2}\right)$ $=\frac{2(s^2+4)+2(4-s^2)}{(s^2+4)^2}=\frac{16}{(s^2+4)^2}.$
8	**Find $L^{-1}\left[\frac{s+2}{s^2+2s+2}\right]$.** BTL4 $L^{-1}\left[\frac{s+2}{s^2+2s+2}\right]=L^{-1}\left[\frac{(s+1)+1}{(s+1)^2+1}\right]\{\because L^{-1}[F(s+a)]=e^{-at}L^{-1}[F(s)]\}$ $=L^{-1}\left[\frac{(s+1)}{(s+1)^2+1}\right]+L^{-1}\left[\frac{1}{(s+1)^2+1}\right]$ $=e^{-t}\left(L^{-1}\left[\frac{s}{s^2+1}\right]+L^{-1}\left[\frac{1}{s^2+1}\right]\right)$ $=e^{-t}(\cos t+\sin t).$
9	**What is the Laplace transform of $f(t), 0<t<10$ with $f(t)=f(t+10)$?** BTL3 Given $f(t)$ is a periodic function with period p. $L[f(t)]=\frac{1}{1-e^{-ps}}\int_0^p e^{-st}f(t)dt$ *put* $p=10,\quad L[f(t)]=\frac{1}{1-e^{-10s}}\int_0^{10} e^{-st}f(t)dt$
10	**State and Prove Linearity property. [MAY/JUNE 2016]** BTL1 *Statement*: $L[af(t)\pm bg(t)]=aL[f(t)]\pm bL[g(t)]$ *proof* : $L[f(t)]=\int_0^\infty e^{-st}f(t)dt$ $L[af(t)\pm bg(t)]=\int_0^\infty e^{-st}L[af(t)\pm bg(t)]dt$ $=\int_0^\infty e^{-st}af(t)dt\pm\int_0^\infty e^{-st}bg(t)dt$ $=a\int_0^\infty e^{-st}f(t)dt\pm b\int_0^\infty e^{-st}g(t)dt$ $=aL[f(t)]\pm bL[g(t)].$
11	**Find $L^{-1}\left(\frac{S}{S^2+4S+5}\right)$. [MAY/JUNE 2016]** BTL3

	$L^{-1}\left(\frac{S}{S^2+4S+5}\right)=L^{-1}\left(\frac{(S+2)-2}{(S+2)^2+1}\right)=e^{-2t}L^{-1}\left(\frac{S-2}{S^2+1}\right)$ $=e^{-2t}\left[L^{-1}\left(\frac{S-2}{S^2+1}\right)-2L^{-1}\left(\frac{1}{S^2+1}\right)\right]=e^{-2t}[\cos t-2\sin t].$
12	**Find** $L[te^{-3t}\cos 2t]$**.** BTL3 We know that $L[t\cos at]=\frac{s^2-a^2}{(s^2+a^2)^2}$, $L[te^{-3t}\cos 2t]=\left[\frac{s^2-2^2}{(s^2+2^2)^2}\right]_{s\to s+3}=\frac{(s+3)^2-2^2}{((s+3)^2+2^2)^2}$
13	**Find**$\boldsymbol{L^{-1}}\left[\tan^{-1}\left(\frac{1}{s}\right)\right]$**.** BTL3 $Let \quad F(s)=\tan^{-1}\left(\frac{1}{s}\right)$ $F^{'}(s)=\frac{1}{1+\left(1/s\right)^2}\left(\frac{-1}{s^2}\right)=\frac{-1}{s^2+1}$ $By \quad property \quad L^{-1}\left[F^{'}(s)\right]=-L^{-1}\left[\frac{1}{s^2+1}\right]=-\sin t$ $\therefore L^{-1}\left[F^{'}(s)\right]=-\sin t;$ $L^{-1}\left[F(s)\right]=\frac{-1}{t}L^{-1}\left[F^{'}(s)\right]$ $\mathrm{L}^{-1}\left[\tan^{-1}\left(\frac{1}{s}\right)\right]=\frac{\sin t}{t}.$
14	**Solve using Laplace transform** $\frac{dy}{dt}+y=e^{-t}$ **given that** $\boldsymbol{y(0)=0}$. BTL3 Taking Laplace transform on both sides, we get $L[y'(t)]+L[y(t)]=L[e^{-t}]$ $sL[y(t)]-y(0)+L[y(t)]=L[e^{-t}]$ $sL[y(t)]-0+L[y(t)]=\frac{1}{s+1}$

	$(s+1)L[y(t)]=\frac{1}{s+1}$ $L[y(t)]=\left(\frac{1}{(s+1)^2}\right)$ $\therefore y(t)=L^{-1}\left(\frac{1}{(s+1)^2}\right)=e^{-t}L\left(\frac{1}{s^{2]gh}[\;]}\right)=e^{-t}t.$ $\{\because L[e^{-at}f(t)]=F(s+a)\}$
15	**Given an example for a function that do not have Laplace transform.** BTL5 Consider $f(t)=e^{t^2}$, since $\underset{t\to\infty}{Lt}\, e^{-st}e^{t^2}=\infty$, hence e^{t^2} is not exponential order. Hence $f(t)=e^{t^2}$ does not have Laplace transform.
16	**Can $F(s)=\frac{s^3}{(s+1)^2}$ be the Laplace transform of some $f(t)$?** BTL5 $\underset{s\to\infty}{Lt}F(s)=\underset{s\to\infty}{Lt}\frac{s^3}{(s+1)^2}\neq 0$ Hence $F(s)$ cannot be Laplace transform of $f(t)$.
17	**Evaluate $\int_0^t \sin u\cos(t-u)du$ using Laplace Transform.** BTL3 $Let\quad L\left[\int_0^t \sin u\cos(t-u)du\right]=L[\sin t*\cos t]$ $=L[\sin t]L[\cos t]\qquad (by\quad convolution\quad theorem)$ $=\frac{1}{(s^2+1)}\frac{s}{(s^2+1)}=\frac{s}{(s^2+1)^2}.$ $\int_0^t \sin u\cos(t-u)du=L^{-1}\left[\frac{s}{(s^2+1)^2}\right]=\frac{1}{2}L^{-1}\left[\frac{2s}{(s^2+1)^2}\right]=\frac{t}{2}\sin t.$ $\left[\because L^{-1}\left(\frac{2s}{(s^2+1)^2}\right)=t\sin at\right].$
18	**Given an example for a function having Laplace transform but not satisfying the continuity condition.** BTL1 $f(t)=t^{\frac{-1}{2}}$ has Laplace transform even though it does not satisfy the continuity condition. (i.e.) It is not piecewise continuous in $(0,\infty)$ $\quad as\ \underset{t\to 0}{Lt}\ f(t)=\infty.$
19	**Define a Periodic function with example.** BTL1 $f(t)$ for all t. The least value of $p>0$ is called the period of $f(t)$. For example, $\sin t$ and $\cos t$ are periodic functions with period 2π.
20	**If $L[f(t)]=F(s)$, find $L[f(at)]$. [APR/MAY 2018 R-17]** BTL5

	$L[f(at)] = \int_0^\infty e^{-st} f(at)dt$ $put \qquad u = at$ $L[f(at)] = \int_0^\infty e^{-\left(\frac{s}{a}\right)u} f(u)\frac{du}{a} = \frac{1}{a}\int_0^\infty e^{-\left(\frac{s}{a}\right)u} f(u)du = \frac{1}{a}F\left(\frac{s}{a}\right).$
21	**Find the Laplace transform of $\frac{t}{e^t}$. [APR/MAY 2018 R-17]** BTL3 $L\left[\frac{t}{e^t}\right] = L[e^{-t}t] = \left[\frac{1}{s^2}\right]_{s\to s+1} = \frac{1}{(s+1)^2}$.
22	**State Convolution theorem on Laplace Transform. [MAY/JUNE 2017 R-13]** BTL1 The Laplace transform of convolution of two functions is equal to the product of their Laplace transform. (i.e) $L[f(t)*g(t)] = L[f(t)]L[g(t)]$.
23	**Find $L\left[\frac{1}{\sqrt{t}}\right]$. [APR/MAY 2017 R-13]** BTL3 We know that, $L[t^n] = \frac{\Gamma(n+1)}{s^{n+1}}$ $L\left[\frac{1}{\sqrt{t}}\right] = L[t^{-1/2}]$ $= \frac{\Gamma(-1/2+1)}{s^{-1/2+1}}$ $= \frac{\Gamma(1/2)}{s^{1/2}} = \sqrt{\frac{\pi}{s}}.$
24	**Find the Laplace transform $sin^3(2t)$.** BTL3 $L[\sin^3(2t)] = \frac{1}{4}L[3\sin 2t - \sin 6t]$ $= \frac{3}{4}L[\sin 2t] - \frac{1}{4}L[\sin 6t]$ $\{\because \sin^3 t = \frac{1}{4}[3\sin t - \sin 3t]\}$ $= \frac{3}{4}\left(\frac{2}{s^2+4}\right) - \frac{1}{4}\left(\frac{6}{s^2+36}\right)$ $= \frac{6}{4}\left\{\left(\frac{1}{s^2+4}\right) - \left(\frac{1}{s^2+36}\right)\right\}$
25	**Find the Laplace transform of $e^{-2t}t^{1/2}$.** BTL3

	$L(e^{-2t}t^{1/2}) = L[t^{1/2}]_{s \to s+2}$ $\because if \quad L[f(t)] = F(s), \quad then \quad l[e^{-at}f(t)] = F(s)/_{s \to s+2}$ $\left[\frac{\Gamma\left(\frac{1}{2}+1\right)}{s^{\frac{3}{2}}}\right]_{s \to s+2} = \left[\frac{\frac{1}{2}\Gamma\left(\frac{1}{2}\right)}{s^{\frac{3}{2}}}\right]_{s \to s+2}$ $= \frac{\frac{1}{2}\sqrt{\pi}}{(s+2)^{\frac{3}{2}}} \qquad \left(\because \Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}, \quad \Gamma n+1 = n\Gamma n\right).$
26	**Does** $L\left[\frac{\cos at}{t}\right]$ **exist?** BTL5 $\underset{t\to 0}{Lt}\frac{f(t)}{t} = \underset{t\to 0}{Lt}\frac{\cos at}{t} = \frac{1}{0} = \infty$ $\therefore L\left[\frac{\cos at}{t}\right] does \quad not \quad exist.$
27	**Using Laplace transform, Evaluate** $\int_0^\infty te^{-2t}\sin t\,dt$**. [APR/MAY 2015 R-13]** BTL3 $\int_0^\infty e^{-2t} f(t)dt = \left[\int_0^\infty e^{-st} f(t)dt\right]_{s=2} = [L[t\sin t]]_{s=2} = \left[-\frac{d}{ds}L[\sin t]\right]_{s=2} = -\frac{d}{ds}\left(\frac{1}{s^2+1}\right) = \frac{4}{25}$
	Part*B
1	**Find** 1) $L[\frac{sinh2t}{t}]$. 2) $L[\frac{e^{-t}sint}{t}]$ 3) $L[\frac{cosat-\cos bt}{t}]$. **[APR/MAY 2011,2015, NOV/DEC 2012,2016 R-13]** **(12M)** BTL3 **Answer: Refer Page No:5.35-Dr. G. Balaji.** 1) $L\left[\frac{\sinh\ 2t}{t}\right] = \int_s^\infty L[\sinh\ 2t]ds = \int_s^\infty \frac{2}{s^2-4}ds = 2\left[\frac{1}{2(2)}\log\left(\frac{s-2}{s+2}\right)\right]_s^\infty$ $= \frac{1}{2}\left[\log\frac{s+2}{s-2}\right] = \log\sqrt{s+2/s-2} \qquad (4M)$ 2)

	$L\left[\frac{e^{-t}\sin t}{t}\right]=\left[L\left[\sin t\big/ t\right]\right]_{s\to s+1}$ $=\left[\cot^{-1}s\right]_{s\to(s+1)}=\cot^{-1}(s+1).\qquad(3M)$ 3) $L\left[\frac{\cos at-\cos bt}{t}\right]=\int_s^\infty L[\cos at-\cos bt]ds$ $=\int_s^\infty\left[\frac{s}{s^2+a^2}-\frac{s}{s^2+b^2}\right]ds=\frac{1}{2}\left[\log(s^2+a^2)-\log(s^2+b^2)\right]_s^\infty=\frac{1}{2}\log\frac{s^2+b^2}{s^2+a^2}.\qquad(5M)$
2	**1) State and prove Initial Value and Final value theorem. [APR/MAY 2017 R-13]** **2) Verify the initial and Final value theorem for $f(t)=1+e^t(\sin t+\cos t)$. [NOV/DEC 2009, MAY/JUNE 2012R-13]** **3) Using the initial value theorem, find $\underset{s\to\infty}{Lt}\, sL[f(t)]$ for the function $f(t)=e^{-t}\cos t$. [NOV/DEC 2016 R-13] (16M)** BTL3 **Answer: Refer Page No:5.40-Dr. G. Balaji.** 1) Initial Value theorem Statement: $L[f(t)]=F(s),\quad then\quad \underset{t\to0}{Lt}\, f(t)=\underset{s\to\infty}{Lt}\, sF(s).$ $\Pr oof: We\quad know\quad that\quad L[f^{'}(t)]=sL[f(t)]-f(0)=sF(s)-f(0)$ $=\int_0^\infty e^{-st}f^{'}(t)dt$ $\underset{s\to\infty}{Lt}\left[sF(s)-f(0)\right]=\underset{s\to\infty}{Lt}\int_0^\infty e^{-st}f^{'}(t)dt=\underset{s\to\infty}{Lt}\, sF(s)-f(0)=0$ $hence\quad \underset{t\to0}{Lt}\, f(t)=\underset{s\to\infty}{Lt}\, sF(s).\qquad(2M)$ Final Value theorem Statement: $L[f(t)]=F(s),\quad then\quad \underset{t\to\infty}{Lt}\, f(t)=\underset{s\to0}{Lt}\, sF(s).$ $\Pr oof: We\quad know\quad that\quad l[f^{'}(t)]=sL[f(t)]-f(0)=sF(s)-f(0)$ $=\int_0^\infty e^{-st}f^{'}(t)dt$ $\underset{s\to0}{Lt}\left[sF(s)-f(0)\right]=\underset{s\to0}{Lt}\int_0^\infty e^{-st}f^{'}(t)dt=\underset{s\to0}{Lt}\, sF(s)-f(0)=f(\infty)-f(0)$ $hence\quad \underset{t\to\infty}{Lt}\, f(t)=\underset{s\to0}{Lt}\, sF(s).\qquad(2M)$ 2) $f(t)=1+e^t(\sin t+\cos t)$ Initial Value theorem state that $L[f(t)]=F(s),\quad then\quad \underset{t\to0}{Lt}\, f(t)=\underset{s\to\infty}{Lt}\, sF(s).$

	$L[f(t)] = L[1+e^{t}(\sin t+\cos t)]$ $= \frac{1}{s}+\frac{1}{(s+1)^2+1}+\frac{s+1}{(s+1)^2+1}$ $LHS \quad = \lim_{t\to 0} f(t) = 2.$ $RHS = \underset{s\to\infty}{Lim}\left[1+\frac{s(s+2)}{(s+1)^2+1}\right] = 2 \qquad (4M)$ $LHS \quad = \quad RHS$ Hence, Initial Value theorem verified. Final Value theorem state that $L[f(t)] = F(s), \quad then \quad \underset{t\to\infty}{Lt} f(t) = \underset{s\to 0}{Lt}\, sF(s).$ $LHS \quad = \lim_{t\to\infty} f(t) = 1.$ $RHS = \underset{s\to 0}{Lim}\left[1+\frac{s(s+2)}{(s+1)^2+1}\right] = 1 \qquad (4M)$ $LHS \quad = \quad RHS$ 3) <u>Initial Value theorem Statement:</u> $L[f(t)] = F(s), \quad then \quad \underset{t\to 0}{Lt} f(t) = \underset{s\to\infty}{Lt}\, sF(s).$ $f(t) = e^{-t}\cos t$ $\lim_{t\to 0} f(t) = 1$ $\lim_{s\to\infty} sF(s) = 1 \qquad (4M)$ Hence proved.
3	**Using convolution theorem find** $L^{-1}\left[\frac{1}{(s+a)(s+b)}\right]$**. [APR/MAY 2011 R-13] (8M)**BTL3 **Answer: Refer Page No:5.77-Dr. G. Balaji.** $L^{-1}\left[\frac{1}{(s+a)(s+b)}\right] = L^{-1}\left[\left(\frac{1}{(s+a)}\right)\left(\frac{1}{(s+b)}\right)\right]$ $= L^{-1}\left(\frac{1}{(s+a)}\right) * L^{-1}\left(\frac{1}{(s+b)}\right)$ $= e^{-at} * e^{-bt} \qquad (3M)$ $= \int_0^t e^{-at}e^{-b(t-u)}du$

$$= e^{-bt}\left[\frac{e^{-(a-b)u}}{-(a-b)}\right]_{u=0}^{u=t} \qquad (3M)$$

$$= \frac{e^{-bt}-e^{-at}}{a-b}. \qquad (2M)$$

Note:

Using convolution theorem find $L^{-1}\left[\frac{1}{(s+1)(s+2)}\right]$. [NOV/DEC 2007,2012 R-13] (8M)

Hint:

In the above problem put $a = 2, b = 1$.

4

Find the Laplace inverse of $\left[\frac{s^2}{(s^2+a^2)^2}\right]$ using convolution theorem. [NOV/DEC 2011R-13] (8M)BTL3

Answer: Refer Page No:5.84-Dr. G. Balaji.

$$L^{-1}\left[\frac{s^2}{(s^2+a^2)^2}\right] = L^{-1}\left[\left(\frac{s}{(s^2+a^2)}\right)\left(\frac{s}{(s^2+a^2)}\right)\right]$$

$$= L^{-1}\left(\frac{s}{(s^2+a^2)}\right) * L^{-1}\left(\frac{s}{(s^2+a^2)}\right)$$

$$= \cos at * \cos at \qquad (3M)$$

$$= \int_0^t \cos au \cos a(t-u)du$$

$$= \frac{1}{2}\int_0^t [\cos(au+at-au)+\cos(au-at+au)]du \qquad (2M)$$

$$= \frac{1}{2}\left[[(\cos at)u] + \left[\frac{\sin[2au-at]}{2a}\right]\right]_{u=0}^{u=t}$$

$$= \frac{1}{2}\left[t\cos at + \frac{\sin at}{a}\right]$$

$$L^{-1}\left[\frac{s^2}{(s^2+a^2)^2}\right] = \frac{1}{2a}[\sin at + at\cos at]. \qquad (3M)$$

Note:

Using Convolution theorem, find $L^{-1}\left[\frac{s^2}{(s^2+4)^2}\right]$. [NOV/DEC 2012 R-13] (8M)

	Hint: In the problem put $a = 2$.
5	**Using convolution theorem find** $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$**. [NOV/DEC 2013, APR/MAY 2017 R-13] (8M)**BTL3 **Answer: Refer Page No:5.83-Dr. G. Balaji.** $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]=L^{-1}\left[\left(\frac{s}{(s^2+a^2)}\right)\left(\frac{1}{(s^2+a^2)}\right)\right]$ $=L^{-1}\left(\frac{s}{(s^2+a^2)}\right)*\frac{1}{a}L^{-1}\left(\frac{a}{(s^2+a^2)}\right)$ $=\cos at*\frac{1}{a}\sin at \qquad (3M)$ $=\frac{1}{a}\int_0^t \cos au \sin a(t-u)du$ $=\frac{1}{2a}\int_0^t [\sin(at-au+au)+\sin(at-au-au)]du \qquad (2M)$ $=\frac{1}{2a}\left[[(\sin at)u]+\left[\frac{-\cos[a(t-2u)]}{-2a}\right]\right]_0^t$ $=\frac{1}{2a}\left[t\sin at+\frac{\cos at}{2a}-\frac{\cos at}{2a}\right]$ $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]=\frac{1}{2a}t\sin at. \qquad (3M)$
6	**Using convolution theorem find** $L^{-1}\left[\frac{s}{(s^2+a^2)(s^2+b^2)}\right]$**. [MAY/JUNE 2016 R-13] (8M)**BTL3 **Answer: Refer Page No:5.81-Dr. G. Balaji.**

	$L^{-1}\left[\frac{s}{(s^2+a^2)(s^2+b^2)}\right]=L^{-1}\left[\left(\frac{s}{(s^2+a^2)}\right)\left(\frac{1}{(s^2+b^2)}\right)\right]$ $=L^{-1}\left(\frac{s}{(s^2+a^2)}\right)*L^{-1}\left(\frac{1}{(s^2+b^2)}\right)$ $=\cos at*\frac{1}{b}\sin bt \qquad (3M)$ $=\frac{1}{b}\int_0^t \cos au\sin b(t-u)du$ $=\frac{1}{2b}\int_0^t[\sin(au+bt-bu)+\sin(bt-bu-au)]du \qquad (2M)$ $=\frac{1}{2b}\left[\left[\frac{-\cos[(a-b)u+bt}{a-b}\right]+\left[\frac{-\cos[bt-(a+b)u]}{-(a+b)}\right]\right]_0^t$ $=\frac{1}{2b}\left[\cos at\left(\frac{1}{a+b}-\frac{1}{a-b}\right)-\cos bt\left(\frac{1}{a+b}-\frac{1}{a-b}\right)\right]$ $L^{-1}\left[\frac{s}{(s^2+a^2)(s^2+b^2)}\right]=\frac{\cos at-\cos bt}{b^2-a^2}. \qquad (3M)$ Note: **Using convolution theorem find** $L^{-1}\left[\frac{s}{(s^2+1)(s^2+4)}\right]$**.** [**MAY/JUNE 2015,2016 R-13] (8M)** **Hint:** In the above problem put $a=1, b=2$, **Using convolution theorem find** $L^{-1}\left[\frac{s}{(s^2+4)(s^2+9)}\right]$**.** [**MAY/JUNE 2015,2016 R-13] (8M)** **Hint:** In the above problem put $=2, b=3$.
7	**Find** $L^{-1}\left[\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right]$ **using convolution theorem. [APR/MAY 2014, 2015,2016, NOV/DEC 2014, 2016 R-13] (8M)**BTL3

Answer: Refer Page No:5.86-Dr. G. Balaji.

$$L^{-1}\left[\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right]=L^{-1}\left[\left(\frac{s}{(s^2+a^2)}\right)\left(\frac{s}{(s^2+b^2)}\right)\right]$$

$$=L^{-1}\left(\frac{s}{(s^2+a^2)}\right)*L^{-1}\left(\frac{s}{(s^2+b^2)}\right)$$

$$=\cos at*\cos bt \qquad (3M)$$

$$=\int_0^t \cos au\cos b(t-u)du$$

$$=\frac{1}{2}\int_0^t [\cos(au+bt-bu)+\cos(au-bt+bu)]du \qquad (2M)$$

$$=\frac{1}{2}\left[\left[\frac{\sin[(a-b)u+bt}{a-b}\right]+\left[\frac{\sin[(a+b)u-bt}{a+b}\right]\right]_0^t$$

$$=\frac{1}{2}\left[\sin at\left(\frac{1}{a-b}+\frac{1}{a+b}\right)+\sin bt\left(\frac{1}{a+b}-\frac{1}{a-b}\right)\right]$$

$$L^{-1}\left[\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right]=\frac{a\sin at-b\sin bt}{a^2-b^2}. \qquad (3M)$$

<u>Note:</u>

Find $L^{-1}\left[\frac{s^2}{(s^2+1)(s^2+4)}\right]$ **using convolution theorem. [APR/MAY 2017 R-13] (8M)**

Hint: In the above problem put $a=1$ & $b=2$.

8 **Find the Laplace transform of the rectangular wave given by** $f(t)=\begin{cases} k & ,0<t<b \\ -k & ,b<t<2b \end{cases}$.

[APR/MAY 2008, 2015 R-13] (8M)BTL5

Answer: Refer Page No:5.92-Dr. G. Balaji.

Given, $f(t)=\begin{cases} k & ,0<t<b \\ -k & ,b<t<2b \end{cases}$.

This function is periodic in the interval $(0,2b)$ with period $2b$.

	$L[f(t)] = \frac{1}{1-e^{-ps}}\int_0^p e^{-st} f(t)dt$ $L[f(t)] = \frac{1}{1-e^{-2bs}}\int_0^{2b} e^{-st} f(t)dt$ $= \frac{1}{1-e^{-2bs}}\left[\int_0^b e^{-st}(k)dt + \int_b^{2b} e^{-st}(-k)dt\right] \qquad (2M)$ $= \frac{k}{1-e^{-2bs}}\left[\left[\frac{e^{-st}}{-s}\right]_0^b - \left[\frac{e^{-st}}{-s}\right]_b^{2b}\right] \qquad (2M)$ $= \frac{k}{s}\frac{1}{1-e^{-2bs}}\left[1-2e^{-bs}+e^{-2bs}\right]$ $= \frac{k}{s}\frac{\left[1-e^{-bs}\right]^2}{\left(1-e^{-bs}\right)\left(1+e^{-bs}\right)} \qquad (2M)$ $= \frac{k}{s}\tanh\left[\frac{bs}{2}\right] \qquad (2M)$ Note: **Find the Laplace transform of the rectangular wave given by** $f(t) = \begin{cases} 1 & ,0<t<b \\ -1 & ,b<t<2b \end{cases}$**.** **[APR/MAY 2013, 2014 R-13] (8M)** **Hint:** In the above problem put $k = 1$. **Find the Laplace transform of the rectangular wave given by** $f(t) = \begin{cases} E & ,0<t<a \\ -E & ,a<t<2a \end{cases}$ **for all** $\boldsymbol{f(t+2a) = f(t)}$ **[NOV/DEC 2010 R-13] (8M)** **Hint:** In that above solved problem put $k = E$and $b = a$.
9	**Find the Laplace transform of a square wave function given by** $f(t) = \begin{cases} E & for \quad 0 \le t \le a/2 \\ -E & for \quad a/2 \le t \le a \end{cases}$ **and** $\boldsymbol{f(t+a) = f(t)}$**. [NOV/DEC 2011, 2016, MAY/JUNE 2016 R-13] (8M)**BTL5 **Answer: Refer Page No:5.95-Dr. G. Balaji.**

	$L[f(t)]=\frac{1}{1-e^{-ps}}\int_0^p e^{-st}f(t)dt$ $L[f(t)]=\frac{1}{1-e^{-as}}\int_0^a e^{-st}f(t)dt$ $=\frac{1}{1-e^{-as}}\left[\int_0^{a/2} e^{-st}(E)dt+\int_{a/2}^{a} e^{-st}(-E)dt\right] \qquad (2M)$ $=\frac{E}{1-e^{-as}}\left[\left[\frac{e^{-st}}{-s}\right]_0^{a/2}-\left[\frac{e^{-st}}{-s}\right]_{a/2}^{a}\right] \qquad (2M)$ $=\frac{E}{s}\frac{1}{1-e^{-as}}\left[1-2e^{-as/2}+e^{-sa}\right]$ $=\frac{E}{s}\frac{\left[1-e^{-as/2}\right]^2}{\left(1-e^{-as/2}\right)\left(1+e^{-as/2}\right)} \qquad (2M)$ $=\frac{E}{s}\tanh\left[\frac{as}{4}\right] \qquad (2M)$
10	**Find the Laplace Transform of triangular wave function** $\begin{cases} t & , \quad 0<t<a \\ 2a-t & , \quad a<t<2a \end{cases}$ **with** $f(t+2a)=f(t)$**. [APR/MAY 2000, 2008, 2015, 2016, MAY/JUNE 2006, 2009, 2012, NOV/DEC 2005, 2009, 2014 R-13] (8M)**BTL5 **Answer: Refer Page No:5.94-Dr. G. Balaji.** $L[f(t)]=\frac{1}{1-e^{-2as}}\int_0^{2a} e^{-st}f(t)dt$ $=\frac{1}{1-e^{-2as}}\left[\int_0^{a} e^{-st}tdt+\int_{a}^{2a} e^{-st}(2a-t)dt\right] \qquad (2M)$ $L[f(t)]=\frac{1}{1-e^{-2as}}\left[\frac{-ae^{-as}}{s}-\frac{e^{-as}}{s^2}+\frac{1}{s^2}+\frac{ae^{-as}}{s}+\frac{e^{-2as}}{s^2}-\frac{e^{-as}}{s^2}\right] \qquad (3M)$

	$L[f(t)] = \frac{1}{1-e^{-2as}}\left[\frac{1-2e^{-as}+e^{-2as}}{s^2}\right]$ $= \frac{1}{s^2}\frac{(1-e^{-as})^2}{(1-e^{-as})(1+e^{-as})}$ $= \frac{1}{s^2}\frac{(1-e^{-as})}{(1+e^{-as})}.$ $= \frac{1}{s^2}\tanh\left[\frac{as}{2}\right].$ $(3M)$
11	**Using Laplace transform technique, solve $y'' + y' = t^2 + 2t$, given $y = 4, y' = -2$ when $t = 0$. [NOV/DEC 2013, MAY/JUNE 2016 R-13] (8M)**BTL 3 **Answer: Refer Page No:5.109-Dr. G. Balaji.** Given: $y'' + y' = t^2 + 2t,\ y = 4, y' = -2$ when $t = 0$, $L[y''(t)] + L[y'(t)] = L[t^2] + 2L[t]$ $s^2L[y(t)] - sy(0) - y'(0) + sL[y(t)] - y(0) = \frac{2}{s^3} + 2\frac{1}{s^2}$ $(2M)$ $(s^2+s)L[y(t)] = 4s + 2 + \frac{2+2s}{s^3} = \frac{4s^4+2s^3+2+2s}{s^3}$ $L[y(t)] = \frac{4s^4+2s^3+2+2s}{s^3(s^2+s)}$ $L[y(t)] = \frac{4}{s+1} + \frac{2}{s(s+1)} + \frac{2}{s^4}$ $(3M)$ $L[y(t)] = \frac{2}{s} + \frac{2}{s+1} + \frac{2}{s^4}$ $y(t) = 2L^{-1}\left[\frac{1}{s}\right] + 2L^{-1}\left[\frac{1}{s+1}\right] + 2L^{-1}\left[\frac{1}{s^4}\right]$ $y(t) = 2 + 2e^{-t} + \frac{1}{3}t^3.$ $(3M)$
12	**Solve** $\frac{d^2y}{dt^2} + 4y = \sin 2t,$ **given $y(0) = 3$, and $y'(0) = 4$. [MAY/JUNE 2014 R-13] (8M)**BTL 3 **Answer: Refer Page No:5.106-Dr. G. Balaji.** Given: $\frac{d^2y}{dt^2} + 4y = \sin 2t,\ y(0) = 3$, and $y'(0) = 4$.

	$L[y''(t)]+4L[y(t)]=L[\sin 2t]$ $[s^2L[y(t)]-sy(0)-y'(0)]+4L[y(t)]=\frac{2}{s^2+4}$ $[s^2+4]L[y(t)]=\frac{2}{s^2+4}+3s+4 \qquad (3M)$ $L[y(t)]=\frac{2}{(s^2+4)^2}+\frac{3s}{s^2+4}+\frac{4}{s^2+4}$ $y(t)=\frac{2}{8}L^{-1}\left[\frac{(s^2+2^2)-(s^2-2^2)}{(s^2+2^2)^2}\right]+3\cos 2t+\frac{4}{2}\sin 2t. \qquad (3M)$ $y(t)=\frac{1}{8}\sin 2t-\frac{1}{4}t\cos 2t+3\cos 2t+2\sin 2t. \qquad (2M)$
13	**Solve** $\frac{d^2x}{dt^2}-3\frac{dx}{dt}+2x=2$ **given** $x=0$ **and** $\frac{dx}{dt}=5$ **for** $t=0$ **using Laplace transform method.** **[APR/MAY 2011, NOV/ DEC 2012 R-13] (8M)**BTL 3 **Answer: Refer Page No:5.100-Dr. G. Balaji.** Given: $\frac{d^2x}{dt^2}-3\frac{dx}{dt}+2x=2$ given $x=0$ and $\frac{dx}{dt}=5$ for $t=0$. $L[x''(t)]-3L[x'(t)]+2L[x(t)]=L[2]$ $[s^2L[x(t)]-sx(0)-x'(0)]-3[sL[x(t)]-x(0)]+2L[x(t)]=2L[1]$ $[s^2-3s+2]L[x(t)]=\frac{2}{s}+5$ $L[x(t)]=\frac{2+5s}{s(s^2-3s+2)} \qquad (2M)$ $L[x(t)]=\frac{1}{s}+\frac{(-7)}{s-1}+\frac{6}{(s-2)}$ $x(t)=L^{-1}\left[\frac{1}{s}\right]-7L^{-1}\left[\frac{1}{s-1}\right]+6L^{-1}\left[\frac{1}{(s-2)}\right] \qquad (3M)$ $x(t)=1-7e^{t}+6e^{2t} \qquad (3M)$
14	**Solve using Laplace transform,** $x''-2x'+x=e^t$ **when** $x(0)=2, x'(0)=-1$. **[NOV/DEC 2015, APRIL 2017 R-13] (8M).**BTL 3 **Answer: Refer Page No:5.103-Dr. G. Balaji.** Given:

	$x''(t)-2x'(t)+x(t)=e^t$ $x(0)=2;x'(0)=-1$ $[s^2L[x(t)]-sx(0)-x'(0)]-2[sL[x(t)]-x(0)]+L[x(t)]=L(e^t)$ $L[x(t)](s-1)^2 = \frac{1}{s-1}+2s-2-3. \qquad (3M)$ $L[x(t)]=\frac{1}{(s-1)^3}+\frac{2(s-1)}{(s-1)^2}-\frac{3}{(s-1)^2}$ $x(t)=L^{-1}\left[\frac{1}{(s-1)^3}\right]+2L^{-1}\left[\frac{1}{(s-1)}\right]-3L^{-1}\left[\frac{1}{(s-1)^2}\right]$ $=e^t\frac{t^2}{2}+2e^t-3e^tt \qquad (5M)$
15	**Solve by using L.T$(D^2+9)y=cos\ 2t$, given that if $y(0)=1, y\left(\frac{\pi}{2}\right)=-1$. [NOV/DEC 2004, MAY/JUNE 2009, APR/MAY 2015, DEC/JAN 2016 R-13] (8M)**BTL 3 **Answer: Refer Page No: 5.99-Dr. G. Balaji.** Given: $(D^2+9)y=\cos 2t.$ $y''(t)+9y(t)=\cos 2t.$ $L(y''(t))+9L(y(t))=L(\cos 2t).$ $[s^2L[y(t)]-sy(0)-y'(0)]+9L[y(t)]=\frac{s}{s^2+4}. \qquad (2M)$ $(s^2+9)L[y(t)]=\frac{s}{s^2+4}+s+k.$ $L[y(t)]=\frac{s}{(s^2+4)((s^2+9)}+\frac{s+k}{(s^2+9)}.$ $L[y(t)]=\frac{1}{5}\frac{s}{s^2+4}+\frac{4}{5}\frac{s}{s^2+9}+\frac{k}{s^2+9} \qquad (2M)$ $y(t)=\frac{1}{5}\cos 2t+\frac{4}{5}\cos 3t+\frac{k}{3}\sin 3t. \qquad (2M)$ $\because y\left(\frac{\pi}{2}\right)=-1$ $\therefore y\left(\frac{\pi}{2}\right)=\frac{1}{5}\cos 2\left(\frac{\pi}{2}\right)+\frac{4}{5}\cos 3\left(\frac{\pi}{2}\right)+\frac{k}{3}\sin 3\left(\frac{\pi}{2}\right)=-1$ $k=\frac{12}{5}.$ $y(t)=\frac{1}{5}\cos 2t+\frac{4}{5}\cos 3t+\frac{4}{5}\sin 3t. \qquad (2M)$

16

Find the Laplace transform of theHalf-sine wave rectifier function given by

$$f(t)=\begin{cases} \sin \omega t & for \quad 0\le t\le \pi/\omega \\ 0 & for \quad \pi/\omega \le t \le 2\pi/\omega \end{cases}$$

. [NOV/DEC 2012, 2016,2019 MAY/JUNE 2017, 2019 R-13] (8M)BTL5

Answer: Refer Page No:5.95-Dr. G. Balaji.

$$L[f(t)]=\frac{1}{1-e^{-ps}}\int_0^p e^{-st} f(t)dt$$

$$L[f(t)]=\frac{1}{1-e^{-as}}\int_0^{2\pi/\omega} e^{-st} f(t)dt$$

$$=\frac{1}{1-e^{-2\pi/\omega s}}\left[\int_0^{\pi/\omega} e^{-st}(\sin \omega t)dt+\int_{\pi/\omega}^{2\pi/\omega} e^{-st}(0)dt\right] \qquad (2M)$$

$$=\frac{1}{1-e^{-2\pi/\omega s}}\left[\frac{e^{-st}}{s^2+\omega^2}[-s\sin \omega t-\omega\cos\omega t\right]_0^{\pi/\omega} \qquad (2M)$$

$$=\frac{1}{1-e^{-2\pi/\omega s}}\left[\frac{e^{-st}\omega+\omega}{s^2+\omega^2}\right]$$

$$=\frac{\omega}{[1-e^{-\pi/\omega s}][[s^2+\omega^2]]} \qquad (2M)$$

PH 8252 **L T P C 3 0 0 3**

PHYSICS FOR INFORMATION SCIENCE (Common to CSE & IT)

OBJECTIVES: To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic and optical properties of materials and Nano-electronic devices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole.

UNIT II SEMICONDUCTOR PHYSICS

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor: random motion, drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT III MAGNETIC PROPERTIES OF MATERIALS

Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility - Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-– Magnetic principle in computer data storage – Magnetic hard disc (GMR sensor).

UNIT IV OPTICAL PROPERTIES OF MATERIALS

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode – solar cell - LED – Organic LED – Laser diodes – Optical data storage techniques.

UNIT V NANO DEVICES

Electron density in bulk material – Size dependence of Fermi energy – Quantum confinement – Quantum structures – Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials – Tunneling: single electron phenomena and single electron transistor – Quantum dot laser. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance – Carbon nanotubes: Properties and applications. TOTAL : 45 PERIODS OUTCOMES: At the end of the course, the students will able to Gain knowledge on classical and quantum electron theories, and energy band structuues, Acquire knowledge on basics of semiconductor physics and its applications in various devices, Get knowledge on magnetic properties of materials and their applications in data storage, Have the necessary understanding on the functioning of optical materials for optoelectronics, Understand the basics of quantum structures and their applications in carbon electronics..

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the students will able to Gain knowledge on classical and quantum electron theories, and energy band structuues, Acquire knowledge on basics of semiconductor physics and its applications in various devices, Get knowledge on magnetic properties of materials and their applications in data storage, Have the necessary understanding on the functioning of optical materials for optoelectronics, Understand the basics of quantum structures and their applications in carbon electronics..

TEXT BOOKS:

1. Jasprit Singh, —Semiconductor Devices: Basic Principles‖, Wiley 2012. 2. Kasap, S.O. —Principles of Electronic Materials and Devices‖, McGraw-Hill Education, 2007. 3. Kittel, C. —Introduction to Solid State Physics‖. Wiley, 2005.

REFERENCES:

1. Garcia, N. & Damask, A. —Physics for Computer Science Students‖. Springer-Verlag, 2012.

2. Hanson, G.W. —Fundamentals of Nanoelectronics‖. Pearson Education, 2009.

3. Rogers, B., Adams, J. & Pennathur, S. —Nanotechnology: Understanding Small Systems‖. CRC Press, 2014.

Subject Code: PH8253 **Year/Semester: I /02**
Subject Name: PHYSICS FOR ELECTRONICS ENGINEERING
Subject Handler: Mrs.A.JAYANTHI

UNIT I ELECTRICAL PROPERTIES OF MATERIALS

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential: Bloch theorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

Q. No. **PART – A**

1. **List out the properties of metallic conductors.** BTL1(May 2011, Dec 2012)
   - Metallic conductors have high electric and thermal conductivities.
   - Metallic conductor obey Ohm's law,
   - They have low electrical resistivity.
   - Resistivity (ρ) α Temperature (T)
   - Near absolute zero, ρ tends to zero.
   - Resistivity is inversely proportional to Pressure (i.e.) ρ α 1/p

   Examples : all metals

2 **Define mean free path.** BTL1(June 2009, June 2012)

The average distance traveled by a free electron between two successive collisions in the presence of an applied field. $\boldsymbol{\lambda = V_d X \tau_C}$

3 **Define relaxation time and collision time.** BTL1(June 2012)

Relaxation time (τ) : The average time taken by a free electron to reach its equilibrium position from its disturbed position due to the application of an external electric field.

Collision time (τ_c) : The average time taken by a free electron between two successive collisions. $\tau_C = \lambda / V_d$

4 **Define drift velocity of electrons and give its formula.** BTL1(June 2010, June 2011)

The average velocity acquired by free electrons when they are drifted towards the positive terminal of the xternal electric field. Its unit is m/S.

$$\boldsymbol{V_d = (Ee\tau / m)}$$

5 **What are the differences between Drift velocity and thermal velocity of an electron?** BTL1(June 2010)

S. No.	Drift velocity	Thermal velocity
1.	Drift velocity is the average velocity acquired by the free electron. In the presence of electric field.	Thermal velocity is the velocity of an electron without any external field.
2.	The electrons moving with drift velocity moves in the direction opposite to that of the field direction	The direction of the electrons moving with thermal velocity is random
3.	The velocity is very less (0.5 m/s)	The velocity is very high (10^6 m/s)

6 **Distinguish electrical (drift) conductivity and thermal conductivity of an electron.**BTL4 (April 2002)

S. No	Electrical (Drift) conductivity	Thermal conductivity

1.	Electrical conductivity is based on the no of free electrons	Thermal conductivity is based on both free electrons and phonons
2.	It is the quantity of electric charge flowing per unit time across unit area in for unit applied electric field.	It is the amount of heat flowing per unit time through the material having unit area of cross-section maintaining unit temperature gradient.
3.	Electrical conductivity takes place from higher potential side to lower potential side	Thermal conductivity takes place from hot end to cold end
4.	Its unit is $\Omega^{-1}m^{-1}$	Its unit is $Wm^{-1}\ k^{-1}$

7 **Define mobility of electrons.** BTL1(June 2011)

The drift velocity (V_d) acquired by the free electron per unit electric field (E) applied on it. ItsUnit is $m^2\ V^{-1}\ s^{-1}$.

8 **Define current density.** BTL1

The amount of current flowing per unit area of cross section normal to the direction of flow. Its unit is Am^{-2}. (J=I/A)

9 **Define electrical conductivity (σ).** BTL1(April 2002)

The amount of charge conducted per unit time, per unit area per unit electric field strength. It has the unit $\Omega^{-1}m^{-1}$.

$$\sigma = \frac{q}{AEt}$$

10 **Define thermal conductivity (K). Give its unit.** BTL1(April 2002)

Thermal conductivity of a material is defined as the amount of heat flowing per unit time through the material having unit area of cross-section maintaining unit temperature gradient. Its unit is $Wm^{-1}K^{-1}$

$$K = \frac{Q}{A\frac{dT}{dx}t}$$

11 **Define thermal conductivity (K). Give its unit.** BTL1

The amount of heat flowing per unit time through the material having unit area of cross-section maintaining unit temperature gradient. Its unit is $Wm^{-1}K^{-1}$

$$K = \frac{Q}{A\frac{dT}{dx}t}$$

12 **State Wiedemann – Franz Law.** BTL1(June 2007,2009, Dec 2009, May 2011)

The ratio of thermal conductivity (K) to electrical conductivity (σ) of a metal is directly proportional to the absolute temperature (T) of the metal.

(i.e) $\frac{K}{\sigma} \propto T \qquad ie \ \ \frac{K}{\sigma} = LT$

L = Lorentz number = $1.12\ X10^{-8}\ W\Omega K^{-2}$ at 293K.

13 **What is Lorentz number? Give the value of Lorenz number and state whether it holds good for all metals and at all temperatures?** BTL4

The ratio between thermal conductivity (K) to the product of electrical conductivity (σ) and absolute temperature (T) of the metal. It is a constant.

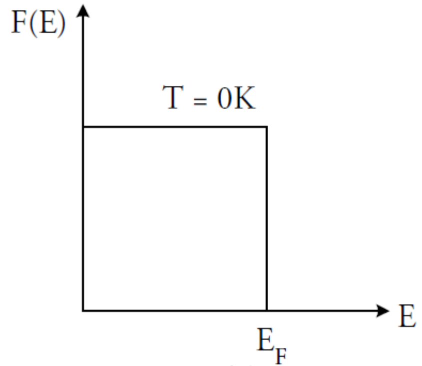
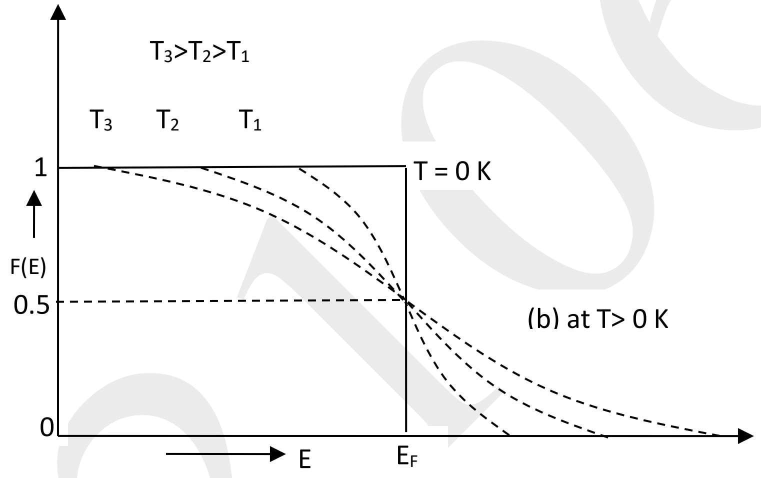
(i.e) $L = \frac{K}{\sigma T}$**;** Where, $L = \frac{3}{2}\left(\frac{K_B}{e}\right)^e = 1.12\ \ x\ 10^{-8}\ W\Omega K^{-2}\ at\ 293\ K,$

$where\ K_B\ is\ Boltzman\ constant, e - Charge\ of\ electron$

14 **State the postulates of classical free electron theory or what are the special features of classical free electron theory of metals?** BTL1(June 2009, May 2011)

- A metal is composed of atoms in which electrons revolve around the nucleus at its centre.
- The free electrons (electron gas) of atoms are free to move about the whole volume of the metal like the molecule of a perfect gas in a container.

	• In the absence of an electric field, the free electrons move in random directions, making collision with each other or with positive ion core. All the collisions are elastic collisions. • When an external electric filed is applied, the electrons are accelerated towards positive potential with a constant velocity known as drift velocity (V_d). • Free electrons obey Maxwell distribution and kinetic theory of gases
15	**What are the merits of classical free electron theory?** BTL1(June 2005, June 2007, May 2011) • Explains the electrical and thermal conductivities of metals. • Used to derive Wiedemann - Franz law. • Explains the optical properties of metals. • Used to verify ohm's law.
16	**Mention the drawbacks of classical free electron theory.** BTL2(May 2011) • The electrical conductivity of semiconductors and insulators cannot be explained by this theory. • Classical theory states that all free electrons absorb the supplied energy, but quantum theory states that only a few electrons absorb the supplied energy. • By Classical theory Lorentz Number ($L = K / \sigma T$) is a constant at all temperatures but by quantum theory it is not constant at low temperatures. • The value of specific heat of a metal is 4.5R but experimental value is only 3R, where R is a universal gas constant. • The susceptibility of a paramagnetic material is inversely proportional to temperature. But experimental results show that it is independent to temperature. This theory cannot be used to explain the Ferro-magnetism. • Photo-electric effect, Compton Effect and black body radiation cannot be explained by this theory.
17	**Mention the important features of quantum free electron theory of metals.** BTL2 • Explains the electrical & thermal conductivity and specific heat capacity of metals. • Can be used to explain photoelectric effect, Compton Effect, Black body radiation
18	**Write Fermi-Dirac distribution function and give its importance.** BTL1(April 2003, Nov.2003, May 2011) Represents the probability of an electron occupying a given energy level at absolute temperature. It is also called as Fermi factor or Fermi distribution (FD) function. It is given by $F(E) = \frac{1}{1+e^{(E-E_F)/KT}}$ Where, E is energy of the level whose occupancy is being considered. E_F is Fermi energy or Fermi level of the system and k is Boltzmann's Constant & T is absolute temperature. The probability value F (E) lies between 0 and 1. • Used to analyse the occupancy of electron in a given energy leave To find Fermi energy levelu
19	**Define Fermi energy level and Fermi energy with their importance.** BTL1(June 2012, June 2010) **Fermi level** The highest energy level of the filled state at 0 K. **Fermi energy** The maximum energy of filled states at 0K. **Importance of Fermi energy** • Gives the information about the filled electrons state and empty states. • At 0 K, below EF electrons filled and above EF it will be empty. • It acts as a reference level which separates the vacant and filled states at 0 K.

	When the temperature is increased, few electrons gain the thermal energy and they go to higher energy levels.
20	**What is the effect of temperature on Fermi function? (or) How Fermi energy varies with respect to temperature?** BTL1(June 2010, May 2011) $$F(E)=\frac{1}{1+e^{(E-E_F)/KT}}$$ Where, E_F is called Fermi energy. Case 1: In metals at 0K if $E < E_F$, F (E) = 1, (i.e) 100% chance for occupation of electron in E. Case 2: If $E>E_F$, F (E) = 0, (i.e) 0% chance for occupation of electron in E. Case 3: IF T > OK, at E_F, F (E) = ½, (i.e) 50% chance for occupation of electron in E.  (a) at T= 0K 
21	**Define density of states with example.** BTL1(Dec 2003) The number of available electron states per unit volume in an energy interval E and E + dE. It is denoted by Z (E). It is given by $$Z(E)\,dE=\frac{\text{Number of energy states available between E and E+dE in a metal piece }(N(E)dE)}{\text{Volume of that metal piece }\quad(V)}$$
22	**Define carrier concentration in metals.** BTL1 The number of free electrons per unit volume. It can be obtained by multiplying density of states and probability of electrons occupancy in the energy band. $$n_c=\int_{Energy\ band} Z(E)dE\,F(E)$$
23	**A uniform silver wire has a resistivity of 1.54 x 10^{-8} Ω m at room temperature, for an electric field along the wire of 1 V cm^{-1}. Compute the average drift velocity of electron assuming that there is 5.8 x 10^{28} conduction electron m^{-3}. Also calculate the mobility. (April 2003)** BTL4 **Given data** Conduction electron concentration n = 5.8 X 10^{28} m^{-3} Resistivity ρ = 1.54 x 10^{-8} Ω m

Electric field E = 1 V / cm = $\frac{1}{10^{-2}}$ V / m = 100 V / m

Formula

Mobility $\mu = \frac{\sigma}{ne} = \frac{1}{\rho\, n\, e}$

Drift velocity $V_d = \mu E$

$$\mu = \frac{1}{1.54\times10^{-8}\times5.8\times10^{28}\times1.6\times10^{-19}} = \mu = 6.9973\times10^{-3}$$

$V_d = 6.9973\times10^{-3}\times100$; $V_d = 0.69973$ m/s

24 **The Fermi temperature of a metal is 24,600 K. Calculate the Fermi velocity. (Apr.2003)** BTL4

Given data

Fermi temperature T_F = 24,600 K

We know, Mass of electron m = 9.1 X 10^{-31} Kg

Formula

$$E_F = kT_F = \frac{1}{2} m \mathrm{V}_\mathrm{F}^2$$

$$\mathrm{V}_\mathrm{F}^2 = \frac{2kT_F}{m}; \quad V_F = \sqrt{\frac{2kT_F}{m}}$$

$$V_F = \sqrt{\frac{2\times1.38\times10^{-23}\times24600}{9.11\times10^{-31}}} = 0.8633\times10^{6}$$

Answer ; Fermi velocity $V_F = 0.8633\times10^{6}$ m / S

25 **Use Fermi function to obtain the value of F(E) for E – E_F = 0.01 eV at 200 K.** BTL4

Given data

E – E_F = 0.01 eV and Temperature T = 200 K

We know that eV = 1.6 X 10^{-19} J

E – E_F = 0.01 X 1.6 X 10^{-19} J = 1.6 X 10^{-21} J

Formula

$$F(E) = \frac{1}{1+e^{(E-E_F)/\ KT}}$$

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<tr><td></td><td>

$$F(E)=\frac{1}{1+\exp\left[(1.6\times10^{-21})/(1.38\times10^{-23}\times200)\right]}$$

$$F(E)=\frac{1}{1+\exp[0.5797]}=\frac{1}{1.7855}=0.3589$$

F (E) = 0.3589; ***Answer***Fermi Function F (E) = 0.3589 No unit

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<tr><td>26.</td><td>

Comment on effective mass of electron. BTL1
The mass acquired by a free electron when it accelerated in a periodic potential. It is also called as negative mass behaviour of electron.

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<tr><td>27.</td><td>

Define energy band. BTL1
A set of closed spaced energy levels.

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<tr><td>28.</td><td>

Appraise the concept of hole. BTL1
The electron with the negative effective mass is considered as a new entity having the same positive mass of that of an electron but with positive charge, this new entity is named as hole.

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PART – B

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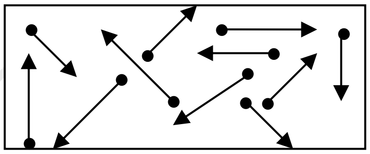
<tr><td>1.</td><td>

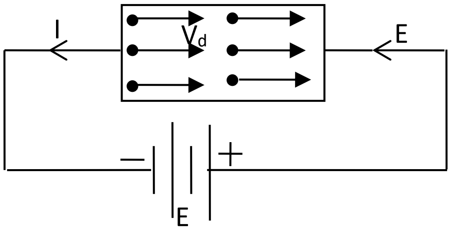
(i) Give the postulates of free electron theory. Derive an expression for electrical conductivity of a metal by using classical free electron theory. (3M+7M) BTL1
(ii) Compute the electrical conductivity, resistivity and thermal conductivity for a metal with relaxation time 10 $^{-14}$ S at 300 K. Also calculate the Lorentz number using the above result (Density of electrons is 6 X 10^{23} m^{-3}). (6 M) BTL4(Dec 2001, June 2011)

Answer: Page: 1.10 P.MANI
Postulates of CFE

- *A solid metal is composed of atoms and atoms have nucleus around which there are revolving electron.*
- *The valence electrons of an atom are free to move about the whole volume of the metal like the molecule of a perfect gas in a container.*
- *In the absence of an electric field, the free electrons move in random directions making collision with each other or with positive ion core.*



- *When an external electric filed is applied, they begin to move towards the positive potential with a constant velocity known as drift velocity (V_d).*



- *The movement of free electrons obeys the classical kinetic theory of gases and the electron velocities in the metal obey Maxwell – Boltzmann statistics.* (3M)

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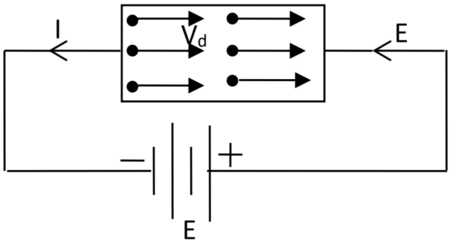
Expression for electrical conductivity (7M)

Answer page:

Electrical Conductivity: The amount charge conducted per unit time through unit cross-sectional area in unit electric field. (1 M)



(1M)

$$J = neV_d$$

$$F = eE \qquad \text{(1M)}$$

By Newton's second law,

$$F = ma \qquad a = \frac{eE}{m} \qquad \text{(1M)}$$

i.e., $a = \frac{V_d}{\tau}$; or $V_d = \tau$ a ; $V_d = \tau\left(\frac{eE}{m}\right)$; $\frac{J}{E} = \frac{ne^2\tau}{m}$ (1M)

From Ohm's law, Current density $J = \sigma E$ or $\sigma = \frac{J}{E}$ (1M)

Electrical conductivity $\sigma = \frac{ne^2\tau}{m}$ (1M)

Thus the electrical conductivity of a metal depends on 'n' and 'τ'.

(ii) Given data

Temperature T = 300 K

Electron concentration n = 6 X 10^{23} m^{-3}

Relaxation time τ = 10^{-14} S

We know, Mass of electron m = 9.1 X 10^{-31} Kg

Charge of electron e = 1.6 X 10^{-19} coulomb

Formula

i) Electrical conductivity $\sigma = \frac{ne^2\tau}{m}$ (1 M)

$$\sigma = \frac{6\times10^{28}\times(1.6\times10^{-19})^2\times10^{-14}}{9.1\times10^{-31}}$$

$$= \frac{6\times10^{28}\times2.56\times10^{-38}\times10^{-14}}{9.1\times10^{-31}} = \frac{15.36\times10^{28}\times10^{-52}}{9.1\times10^{-31}}$$

$$=1.688\times10^{28}\times10^{-52}\times10^{+31} = 1.688\times10^{7}$$

$$\sigma = 1.688\times10^{7}\ \Omega^{-1}\ \text{m}^{-1}$$ (1 M)

ii) Electrical conductivity $\rho = \frac{1}{\sigma}$

$$\rho = \frac{1}{1.688\times10^{7}} = 0.5924\times10^{-7} = 5.924\times10^{-8}$$

$$\rho = 5.924\times10^{-8}\ \Omega\ \text{m}$$ (1 M)

iii) Thermal Conductivity $K = \frac{1}{2}nv^{2}k\tau$

(Multiplying and dividing by m)

$$K\times\frac{m}{m} = \frac{1}{2}\frac{mv^{2}nk\tau}{m}$$

$$K = \frac{3}{2}\frac{kTnk\tau}{m} \qquad \frac{1}{2}mv^{2} = \frac{3}{2}kT$$

$$K = \frac{3}{2}\frac{k^{2}Tn\tau}{m}$$ (1 M)

$$K = \frac{3\times6\times10^{28}\times(1.38\times10^{-23})^{2}\times300\times10^{-14}}{2\times9.1\times10^{-31}}$$

$$= \frac{10283.76\times10^{28}\times10^{-46}\times10^{-14}}{18.2\times10^{-31}}$$

$$= 565.0418\times10 = 56.5042$$

$$\text{K} = 56.5042\ \text{W m}^{-1}\ \text{K}^{-1}$$ (1 M)

iv) Lorentz number $L = \frac{K}{\sigma T}$

$$L = \frac{56.504}{1.688\times10^{7}\times300} = 0.1116\times10^{-7} = 1.116\times10^{-8}$$

$$L = 1.116\times10^{-8}\ \text{W}\,\Omega\,\text{K}^{-2}$$ (1 M)

Answers

$$\sigma = 1.688\times10^{7}\ \Omega^{-1}\ \text{m}^{-1}\ ;\quad \rho = 5.924\times10^{-8}\ \Omega\ \text{m}$$

$$\text{K} = 56.5042\ \text{W m}^{-1}\ \text{K}^{-1}\ ;\quad L = 1.116\times10^{-8}\ \text{W}\,\Omega\,\text{K}^{-2}$$

2.

State and prove Wiedemann-Franz law. Why does the Lorentz number determined experimentally does not agree with the value calculated from the classical theory?(14M+2M) BTL2(May 2011)

Answer: Page: 1.10 P.MANI

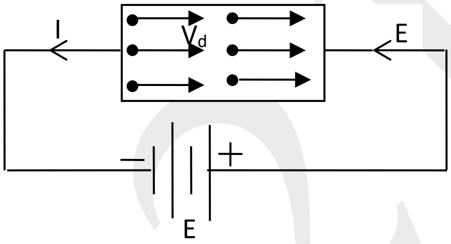
Statement of Wiedemann-Franz law

The ratio of thermal conductivity to electrical conductivity of a metal is directly proportional to the absolute temperature of the metal. This ratio is constant for all metals at a given temperature.

$$\text{i.e.,}\quad \frac{K}{\sigma}\ \alpha\ T\ \text{ or }\ \frac{K}{\sigma} = LT\ \text{(1M)}$$

Derivation of electrical conductivity

Electrical Conductivity: The amount charge conducted per unit time through unit cross-sectional area in unit electric field.



(1M)

$$J = neV_d$$

$$F = eE \qquad \text{(1M)}$$

By Newton's second law,

$$F = ma \qquad a = \frac{eE}{m} \qquad \text{(1M)}$$

$$\text{i.e., } a = \frac{V_d}{\tau} \qquad \text{or } V_d = \tau\,\text{a} \qquad V_d = \tau\left(\frac{eE}{m}\right)$$

$$\frac{J}{E} = \frac{ne^2\tau}{m} \qquad \text{(1M)}$$

From Ohm's law, Current density $J = \sigma E$ or $\sigma = \dfrac{J}{E}$

Electrical conductivity $\sigma = \dfrac{ne^2\tau}{m}$ (1M)

Derivation of thermal conductivity

Thermal conductivity: The amount of heat flowing per unit time through the material having unit area of cross-section per unit temperature gradient.

$$\text{i.e., } Q = K\frac{dT}{dx} \quad \text{or} \quad K = \frac{Q}{\frac{dT}{dx}} \qquad \text{(1M)}$$

In a uniform metallic rod AB, let us consider two cross-sections A at high temperature T and B at low temperature (T – dT) separated by a distance of mean free path **λ.**

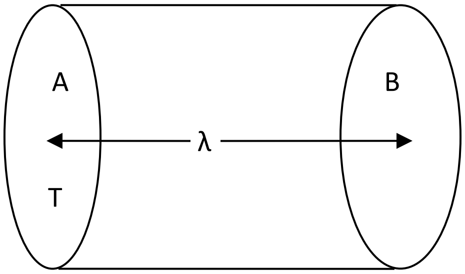


Fig. Conduction of heat in a metallic rod (1M)

Let n be the free electron density and v be the velocity of free electron.

Average kinetic energy of the electron At A = $\frac{3}{2}kT$

Average kinetic energy of an electron At B = $\frac{3}{2}k(T-dT)$

Excess kinetic energy carried by the electron from A to B = $K.E._{\text{Excess}} = \frac{3}{2}kdT$ (1M)

Number of electrons crossing unit area per unit time from A to B $= \frac{1}{6}nv$ (1M)

Excess energy carried from A to B for unit area in unit time = $= \frac{1}{6}nv \times \frac{3}{2}kdT = \frac{1}{4}nvkdT$(1M)

Similarly, Deficient energy carried from B to A for unit area in unit time $= -\frac{1}{4}nvkdT$

The net amount energy transferred from A to B for unit area in unit time $Q = \frac{1}{2}nvkdT$(1M)

Thermal conductivity is the amount of heat conducted per unit area per unit time = $Q = K\frac{dT}{\lambda}$

$$\frac{1}{2}nvkdT = K\frac{dT}{\lambda} \qquad \text{OR } K = \frac{1}{2}nvk\lambda$$

We know for metals $\tau \ v = \lambda$, Therefore $K = \frac{1}{2} n v^2 k \tau$ (1M) Thus the classical expression for thermal conductivity depends on ' **v** ', '**n**' and 'τ'

Proof of Wiedemann-Franz law

From Classical theory, $\sigma = \frac{ne^2\tau}{m}$ and $K = \frac{1}{2} n v^2 k \tau$ (1M)

By dividing $\frac{K}{\sigma} = \frac{1}{2} \frac{nv^2 k}{e^2}$ or $\frac{K}{\sigma} = \frac{3}{2} \left(\frac{k}{e}\right)^2 T$

or $\frac{K}{\sigma} = LT$ or $\frac{K}{\sigma} \ \alpha \ T$ (1M)

According to Quantum Physics, the expressions for electrical and thermal conductivity are different when compared to CFE. Therefore Lorentz number are not agree with one another. (2M)

3.

(i) Obtain Eigen values and Eigen functions of an electron enclosed in a 3-D potential box.(10M) BTL3

(ii) Calculate the number of states lying in an energy interval of 0.01 eV above the Fermi level for a crystal of unit volume with Fermi energy E_F = 3.0 eV.

(i)Answer: Page: 1.23 P.MANI

Energy of the particle (Eigen values) in 3D (5M)

Wave function of the particle (Eigen values) in 3D (5M)

(ii) Solution

Given data

Fermi energy E_F = 3.0 eV ; Energy interval $\Delta E = E - E_F$ = 0.01 eV

We know, Mass of electron m = 9.1×10^{-31} Kg ; Planck's constant h = 6.62×10^{-34} J S

We know that eV = 1.6×10^{-19} J; Fermi energy in Joule $E_F = 3.0 \times 1.6 \times 10^{-19}$ J

$E_F = 4.8 \times 10^{-19}$ J

Energy interval $\Delta E = E - E_F$ = 0.01 eV

$E = \Delta E + E_F$ = (0.01 + 3.0) eV = $3.01 \times 1.6 \times 10^{-19}$ J = 4.816×10^{-19} J

Formula

Number of states per unit volume lying between E_F and E is given by

$$n = \int_{E_F}^{E} \frac{4\pi}{h^3} (2m)^{3/2} E^{1/2} dE \qquad (2\text{ M})$$

$$= \frac{4\pi}{h^3} (2m)^{3/2} \int_{E_F}^{E} E^{1/2} dE = \frac{4\pi}{h^3} (2m)^{3/2} \left[\frac{E^{3/2}}{3/2} \right]_{E_F}^{E}$$

$$= \frac{4\pi}{h^3}(2m)^{3/2} \times \frac{2}{3}\left[E^{3/2} - E_F{}^{3/2} \right]$$

$$n = \frac{4\times 3.14\times\left(2\times 9.1\times 10^{-31}\right)^{3/2}}{\left(6.625\times 10^{-34}\right)^{3}}\times\frac{2}{3}\left[\left(4.816\times 10^{-19}\right)^{3/2}-\left(4.8\times 10^{-19}\right)^{3/2}\right] \quad (2M)$$

= 3.74 X 10^{55} X (1.108 X 10^{-30}) ; n = 4.14 X 10^{25} m^{-3} (2M)

4.

Develop an expression for the density of states and based on that calculate the carrier concentration in metals. (10M+6M) BTL1(Dec 2005, June 2009, June 2010)

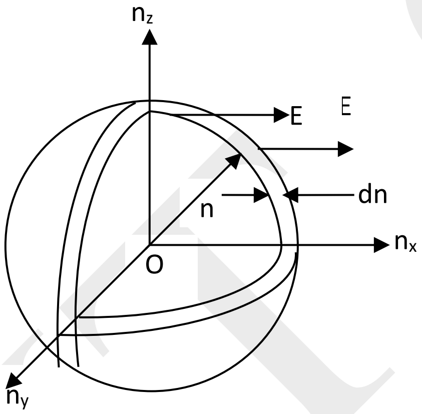
Answer: Page: 1.31 P.MANI
Density of statesderivation

Definition: Density of states is defined as the number of available electron states per unit volume in an energy interval E and E + dE.

$$Z(E)dE = \frac{\text{Number of energy states in energy interval E and } E + dE \text{ in a metal piece N(E) dE}}{\text{Volume of the metal piece}} \quad (2M)$$

Calculation of density of states in three dimensions (derivation)

Let us consider a cubical sample with side 'a' length and volume V. A sphere is constructed with radius 'n' in the space.



(1M)

In this space, unit volume represents one energy state.

$$\text{Number of energy states within a sphere of radius n} = \frac{4}{3}\pi n^3 \quad (1M)$$

Number of available energy states within one octant of the sphere of radius n corresponding to energy E, $= \frac{1}{8}\left[\frac{4}{3}\pi\, n^3\right]$ (1M)

Similarly, the number of available energy states within one octant of the sphere of radius n+dn corresponding to energy E+dE $= \frac{1}{8}\left[\frac{4}{3}\pi\,(n + dn)^3\right]$ (1M)

As a result, the number of available energy states between the shell of radius n and n+dn or between the energy levels E and E+dE,

$$\mathrm{N(E)\ dE} = \frac{1}{8}\left[\frac{4}{3}\pi\,(\mathrm{n}+\mathrm{dn})^{3}\right] - \frac{1}{8}\left[\frac{4}{3}\pi\,\mathrm{n}^{3}\right]$$

(1M)

$$N(E)dE = \frac{1}{8}\left(\frac{4}{3}\pi\right)\left[dn^{3}+3n^{2}dn+3ndn^{2}\right]$$

Higher powers of dn is very small, Hence dn^2 and dn^3 can be neglected

i.e., Number of available energy states between the energy interval E and dE

$$N(E)dE = \frac{\pi}{2}\mathrm{n}^{2}dn \quad \text{or} \quad N(E)\,dE = \frac{\pi}{2}n\,(ndn) \qquad \text{(1M)}$$

According to Particle in a box problem, the energy of an electron in a cubical metal piece of sides a is given by

$$E = \frac{n^{2}h^{2}}{8ma^{2}}$$

$$\text{Or} \quad n^{2} = \frac{8ma^{2}E}{h^{2}} \quad \text{and} \quad n = \left[\frac{8ma^{2}E}{h^{2}}\right]^{1/2} \qquad \text{(1M)}$$

Differentiating we get , $2ndn = \frac{8ma^{2}dE}{h^{2}}$ Or $ndn = \frac{8ma^{2}dE}{2h^{2}}$

Substituting $N(E)dE = \frac{\pi}{4}\left[\frac{8ma^{2}}{h^{2}}\right]^{3/2}E^{1/2}dE$ (2M)

Pauli's exclusion principle states that two electrons of opposite spins can occupy each state.

$N(E)dE = \frac{4\pi}{h^{3}}(2m)^{3/2}a^{3}E^{1/2}dE$; The number of energy per unit volume $Z(E)dE = \frac{4\pi}{h^{3}}(2m)^{3/2}E^{1/2}dE$ (1M)

Carrier concentration in metal

Carrier concentration is the number of electrons per unit volume in a given energy interval.

i.e., $n_c = \int_{energyband} Z(E)F(E)dE$ (2M)

Substituting the expressions for Z (E) and F (E)

$$n_c = \int_{energyband}\frac{4\pi}{h^{3}}(2m)^{3/2}E^{1/2}dE \times \frac{1}{1+e^{(E-E_F)/KT}}dE \qquad \text{(2 M)}$$

5. **Starting with the density of energy states obtain the expression for the Fermi energy of an electron at 0 K and hence obtain the expression for the average energy of an electron.(12 M+4M)** BTL3

Answer: Page: 1.37 P.MANI

Density of energy states

The number of energy per unit volume $Z(E)dE = \frac{4\pi}{h^3}(2m)^{3/2}E^{1/2}dE$ (2M)

Expression for Fermi energy of electron

Carrier concentration is the number of electrons per unit volume in a given energy interval.

i.e., $n_c = \int\limits_{energyband} Z(E)F(E)dE$ (2M)

Substituting the expressions for Z (E) and F (E)

$$n_c = \int\limits_{energyband} \frac{4\pi}{h^3}(2m)^{3/2}E^{1/2}dE \times \frac{1}{1+e^{(E-E_F)/KT}}dE \quad \text{(2 M)}$$

For a metal at 0 K, the upper occupied level is E_F and F (E) for all the levels below E_E is 1.i.e., F (E) =1

$$n_c = \int_0^{E_F} \frac{4\pi}{h^3}(2m)^{3/2}a^3E^{1/2}dE \quad \text{(2M)}$$

i.e., $n_c = \frac{8\pi}{3h^3}(2mE_F)^{3/2}$ (2 M)

Fermi energy E_F at 0 K is given by, $E_{F_0} = \left(\frac{h^2}{2m}\right)\left(\frac{3n_c}{8\pi}\right)^{2/3}$ (2M)

Expression for average energy of an electron

Average energy of an electron at 0K

Eave = Total energy of the electrons at 0K ET / Number of energy states at 0K (N) $E_{ave} = 3/5\ E_{F0}$ (4M)

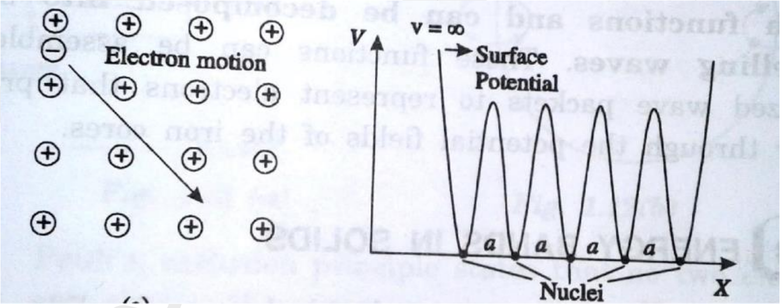
6. **Explain the energy band theory of solids with necessary theory. (or) Describe the behaviour of electron in a periodic potential. (8 M)** BTL2

Answer: Page: 1.40 P.MANI

Energy band theory postulates

P.E. of electron within the crystal is periodic due to periodicity of the crystal

P.E. of the solid varies periodically with the periodicity of space lattice "a" (2M)

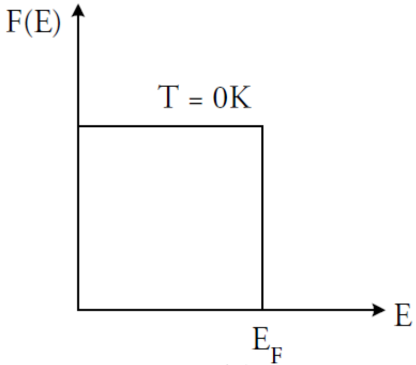
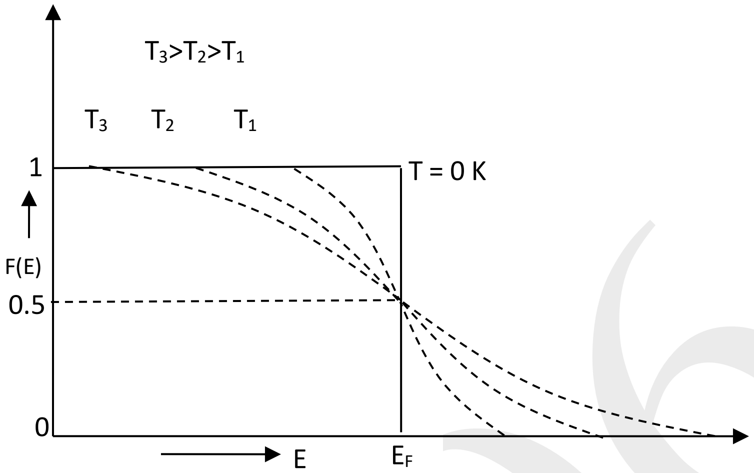


(2 M)

Bloch Theory Postulates

The solutions of Schrodinger equations are plane waves modulated by the function $u_k(x)$ which has the same periodicity as the lattice.

	$\frac{\partial^2\psi}{\partial x^2}+\left(\frac{2m}{\hbar^2}\right)[E-V(x)]\psi=0$ $\Psi(x) = e^{\pm ikx} u_k(x)$ Where, $u_k(x) = u_k(x+a)$ (2M) These wave functions are called Bloch function, $\psi(x+a) = e^{\pm ikx} u_k(x+a) = e^{\pm ikx} \psi(x)$ Thus Bloch functions have the property that, $\psi(x+a) = \lambda\psi(x)$ where the constant λ is $\lambda = e^{\pm ika}$ (2M)
8.	**Write an expression for the Fermi energy distribution function F (E) and illustrate its behaviour with change in temperature. Plot F (E) versus E for T= 0 K, and T > 0 K. (2M+8M)(or) What is Fermi function? Describe the variation of Fermi function with respect to temperature**.**(8M)**BTL2 **Answer: Page: 1.26 P.MANI** Fermi function *Represents the probability of an electron occupying a given energy level at absolute temperature. It is also called as Fermi factor or Fermi distribution (FD) function.* It is given by $F(E)=\frac{1}{1+e^{(E-E_F)/KT}}$ (2M) Variation of Fermi energy with respect to Temperature Case (i) When $E<E_F$, at T = 0K, F(E) = 1 (2M) Case (ii) When $E>E_F$, at T = 0K, F(E) = 0 (2M) Case (iii) When $E=E_F$, at T > 0K, F(E) = 0.5 (2M)

	 (a) at T= 0K  (2M)
9.	**Explain free electron approximation and tight binding approximation with suitable diagrams.** (**8 M**) BTL2 **Answer Page:1.48 P. MANI** Free electron approximation (4M) Tight binding approximation (4M)
10.	(i) **Discuss the concept of holes formation.(7M**) BTL1 (ii) **Write a short note on effective mass of an electron. (or) What is effective mass? Obtain an expression for effective mass of an electron. (8 M**) BTL3 **(i) Answer: Page: 1.55 P.MANI** Definition of Hole (2M) Concept of hole formation (5M) **(ii) Answer Page: 1.51 P. MANI** Definition (2 M) Derivation (6M)

UNIT-II

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport - Einstein‘s relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions - Ohmic contacts – tunnel diode - Schottky diode – MOS capacitor - power transistor.

Q. No.	PART * A
1.	**What are semiconductors? Give example.** BTL1 A solid material which conducts electricity partially. Act as insulator at 0 K and conductors at high temperature Atoms are bonded with covalent band Eg: Si, Ge,
2.	**State the properties of semiconductor.** BTL2(May 2003, June 2009, May 2011) • They are crystalline in nature. • They have E_g≈1eV • They possess negative temperature coefficient of resistance. • They have four valence electrons. • At 0 K, semiconducting materials possess filled valence band and empty conduction band. • Conductivity increases with increase in temperature and impurity.
3.	**What are the types of semiconductor?** BTL1 Semiconductor is generally classified on the basics of purity 1) Intrinsic semiconductor and 2) Extrinsic semiconductor Semiconductor may also classified on the basics of recombination process 1) Elemental / Indirect band gap semiconductors Compound / Direct band gap semiconductors
4.	**What are the types of semiconductor based on impurity?** BTL2 • N-type semiconductors • P-type semiconductors
5.	**Distinguish intrinsic and extrinsic semiconductor.**BTL4(Nov 2003, Dec2003, May 2011)

S. No	Intrinsic semiconductor	Extrinsic semiconductor
1.	Semiconductor in pure form is called as intrinsic semiconductor	Semiconductor doped with impurity is called as extrinsic semiconductor
2.	Here charge carriers are produced only due to thermal agitation	Here charge carriers are produced due to impurities and may also due to thermal agitation
3.	At 0 K, Fermi level exactly lies between conduction band and valance band	At 0K, Fermi level exactly lies closer to conduction band in n- type semiconductor and lies near valance band in the case of p- type semiconductor
4.	They have low electrical conductivity and operating temperature.	They have high electrical conductivity and operating temperature.
5.	Eg . Pure silicon and Germanium	Eg . Si and Ge doped with Al, In, P, As etc.

Q. No.	PART * A
6.	**Distinguish between direct/compound and indirect band gap/elemental semiconductors.** BTL4(April 2002, June 2009, May 2011)

S. No.	**Direct band gap / Compound semiconductors**	**Indirect band gap/ Elemental semiconductors**
1.	Here electron-hole recombines directly by emitting a photon.	Here electron-hole recombines directly by emitting a phonon (Heat).
2.	Recombination time of the charge carriers are very less	Recombination time of the charge carriers are more
3.	These are mostly compound semiconductors.	These are mostly elemental semiconductors.
4.	Life time of charge carriers is less	Life time of charge carriers is large
5.	They are used in LED and laser diode fabrication.	They are used in amplification of signals as in the case of diodes and transistors
6.	Example. InP, GaAs, MgO, ZnO	Example . Ge, Si

7. **Distinguish between n – type and p – type extrinsic semiconductors.** BTL4(Nov 2003, Dec 2003, May 2011)

	n – type extrinsic semiconductors	**p – type extrinsic semiconductors**
1.	When pentavalent impurities added to the intrinsic semiconductors, n- type semiconductors are formed	When trivalent impurities added to the intrinsic semiconductors, p- type semiconductors are formed
2.	Majority charge carriers are electrons	Majority charge carriers are holes
3.	Minority charge carriers are holes	Minority charge carriers are electrons
4.	The impurity is called donor impurity	The impurity is called acceptor impurity
5.	Fermi energy decrease with increase of temperature	Fermi energy increases with increase of temperature
6.	The donor energy level is very close to the bottom of the conduction band	The acceptor energy level is very close to the top of the valance band.

8. **Define mobility and electrical conductivity of intrinsic semiconductors?** BTL1

Mobility:

The velocity of a charge carrier produced due to unit field strength $\mu = v_d / E$

Electrical conductivity:

The total electrical conductivity σ_i of the intrinsic semiconductor is the sum of electrical conductivities due to the electrons and holes. $\sigma_i = en_i(\mu_e + \mu_e)$

9. **Define the term carrier concentration in intrinsic semiconductors.** BTL1

The number of electrons in the conduction band per unit volume (n) or the number of holes in the valence band per unit volume (p) of the semiconducting material. It is also known as density of charge carriers.

10. **Define Hall Effect, Hall field, Hall voltage and Hall angle.** BTL1(Nov 2003, May 2005, June 2010)

When a conductor or semiconductor carrying a current (I) is placed in a perpendicular magnetic field (B), a potential difference is produced inside the conductor in a direction normal both the current and the magnetic field. This phenomenon is called Hall Effect and the voltage thus developed is known as Hall voltage. The field induced is known as Hall filed. The angle between applied field and Hall field is known as Hall Angle.

11.	**Define hall coefficient.** BTL1 The ratio of the induced electric field to the product of the current density and the applied magnetic field. $R_H = \frac{E_H}{J_x B_z}$; $R_H = \frac{bV_H}{I_x B_z}$; $R_H = -\frac{1}{ne}(N - Type)$; $R_H = +\frac{1}{pe}(P - Type)$
12.	**Mention four applications of Hall Effect?** BTL4(Nov 2003, May 2005, June 2010) • To identify the nature of semiconductors. • Carrier concentration, Mobility of charge carriers can be measured directly. • Electrical conductivity can be determined. • It can be used to determine whether the solid is metal, insulator or semiconductor • Magnetic field can be measured.
13.	**How can you distinguish p – type and n- type semiconductors using Hall Effect?** BTL4(June 2010, June 2012) The n- type and p-type semiconductors can be distinguished by determining the hall coefficient using Hall Effect. $R_H = -\frac{1}{ne}(N - type)$: $R_H = +\frac{1}{pe}(P - type)$
14.	**What is hall device? List its types.** BTL4 The device which uses hall effect for its applications. • Gauss meter • Electronic meter • Electronic wattmeter
15.	Find the conductivity of intrinsic germanium at 300 K. (Given: $n_i = 2.5 \times 10^{19}\ m^{-3}$) **Solution:** **Given data:** $\mu_e = 0.38\ m^2V^{-1}s^{-1}$ $\mu_e = 0.18\ m^2V^{-1}s^{-1}$ $\sigma_i = en_i(\mu_e + \mu_h)$ $= 2.5 \times 10^{19} \times 1.6 \times 10^{-19}(0.38+0.18)$ $= 2.24\ ohm^{-1}m^{-1}$ Answer: $\sigma_i = 2.24\ ohm^{-1}m^{-1}$
16.	Calculate the intrinsic concentration of charge carriers of germanium at 300 K. The effective masses of electrons and holes are $m_e^* = 0.12m_0$ and $m_h^* = 0.28m_0$ respectively. $E_g = 0.67$ for germanium. **Solution:** **Given data:** T = 300 K ; $m_0 = 9.11\times10^{-31}$; $m_e^* = 0.12m_0 = 1.0932\times10^{-31}$ $m_h^* = 0.28m_0 =$ 2.5508×10^{-31} ; $E_g = 0.67$ eV $n_i = 2\left(\frac{2\pi kT}{h^2}\right)^{3/2}\left(m_e^* m_h^*\right)^{3/4} e^{-E_g/2kT}$

$$n_i = 2\left(\frac{2\times3.14\times1.38\times10^{-23}\times300}{(6.626\times10^{-34})^2}\right)^{3/2}\times\left(1.0932\times10^{-31}\times2.5508\times10^{-31}\right)^{3/4}.$$

$$e^{\left(\frac{-0.67\times1.6\times10^{-19}}{2\times1.38\times10^{-23}\times300}\right)}$$

$$n_i = 4.69\times10^{18}/m^3$$

Answer: $n_i = 4.69\times10^{18}/m^3$

17.

The donor density of a n-type silicon sample is $10^{21}/m^3$. The sample is arranged in a Hall experiment having magnetic field of 0.5 tesla and the current density 300 Ampere/m^2. Find the Hall voltage if the sample is 2 mm wide.

Given data: $n_e = 10^{21}/m^3$; B = 0.5 tesla ; $J_x = 300A/m^2$; t =0.3 mm

$$R_H = \frac{-1}{n_e e}$$

$$R_H = \frac{-1}{10^{21}\times1.6\times10^{-19}} = -6.25\times10^{-3}\ m^3C^{-1}$$

Hall Voltage $V_H = R_H J_x Bt$; $V_H = 6.25\times10^{-3}\times300\times0.5\times2\times10^{-3}$

$V_H = 1.875\times10^{-3}$ Volts; $V_H = 1.875$ mV

Answer: $V_H = 1.875$ mV

18.

A n-type semiconductor has Hall coefficient $4\times10^{-4}\,m^3C^{-1}$. The conductivity is $200\Omega^{-1}m^{-1}$. Calculate its charge carrier density and electron mobility at room temperature.

Given data: $R_H = 4\times10^{-4}m^3C^{-1}$; $\sigma = 200\Omega^{-1}m^{-1}$

Charge density $n_e = \dfrac{-1}{R_H e}$

$$n_e = \frac{3\pi}{8}\frac{1}{R_H e} \quad \text{(Considering the periodic potential in crystals)}$$

$$n_e = \frac{3\times3.14}{8}\times\frac{1}{1.6\times10^{-19}\times4\times10^{-4}}$$

$$n_e = 1.8398\times10^{22}/m^3$$

Electron mobility $\mu_e = \dfrac{\sigma_e}{n_e e}$; $\mu_e = \dfrac{200}{1.8398\times10^{22}\times1.6\times10^{-19}}$

$\mu_e = 0.0679m^{2^{-1}}Vs^{-1}$; Answer: $n_e = 1.8398\times10^{22}/m^3$ and $\mu_e = 0.0679m^{2^{-1}}Vs^{-1}$

PART * B

1

Derive an expression for density of electrons in the conduction band and density of holes in the valence band of an intrinsic semiconductor, hence deduce the expression for intrinsic carrier concentration. (16 M) BTL2(Dec 2001)

<u>Electron concentration (n):</u> The number of electrons in the conduction band per unit volume

Hole concentration (p): The number of holes in the valence band per unit volume

Carrier concentration (or) Density of electron: The number of charge carries per unit volume of the material. (1M)

Calculation of Density of Holes in the Valence Band of Intrinsic Semiconductors

Let d_p be the number of holes per unit volume in the valence band between the energy E and E + d E

$$dp = Z(E)(1-F(E))dE \qquad \text{(1M)}$$

The probability of an unoccupied electron state, i.e., presence of a hole.

$$1-F(E) = 1-\left[\frac{1}{1+e^{(E-E_F)/kT}}\right]$$

Since E is very small when compared to E_F in the valence band, $\left(E-E_F\right)$ is a negative quantity and hence $e^{(E-E_F)/\kappa}$ is very small.

i.e., $\therefore 1-F(E) = e^{(E-E_F)/kT}$ (1M)

E_v, the top level in the valence band is the potential energy of a hole at rest. Hence, $\left(E_V - E\right)$ is the kinetic energy of the hole at level below E_V.

Density of states in the valence band, $Z(E)dE = \frac{4\pi}{h^3}(2m_h^*)^{3/2}(E_v - E)^{1/2}dE$ (1M)

$$dp = \frac{4\pi}{h^3}(2m_h^*)^{3/2}(E_v - E)e^{(E-E_F)/kT}dE$$

The number of holes in the valence band for the entire range is obtained

$$p = \int dp = \int_{-\infty}^{E_v} \frac{4\pi}{h^3}(2m_h^*)^{3/2}(E_v - E)^{1/2}e^{(E-E_F)/kT}dE \qquad \text{(1M)}$$

To solve the integral in eqn (7), let us assume,

	when	when
$E_v - E = x$	$E = -\infty$	$E = E_v$
$E = -x + E_v$	$E_v + \infty = x$	$x = E_v - E_v$
$\therefore dE = -dx$	$\therefore x = \infty$	$\therefore x = 0$

Substituting these values in equation,

$$p = \frac{4\pi}{h^3}(2m_h^*)^{3/2}e^{(E_V-E_F)/kT}\int_0^{\infty} x^{1/2}e^{(-x/kT)}dx \qquad \text{(1M)}$$

Using the gamma function,

$$\int_0^{\infty} x^{1/2}e^{(-x/kT)}dx = \frac{(kT)^{3/2}\pi^{1/2}}{2}$$

	$p = 2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2} e^{(E_V - E_F)/kT}$ (1M) Similarly $n_i = 2\left(\frac{2\pi_e^* kT}{h^2}\right)^{3/2} e^{(E_F - E_C)/kT}$ (6M) **INTRINSIC CARRIER CONCENTRATION** In an intrinsic semiconductor, since the concentration of electrons in the conduction band is equal to the concentration of the holes in the valence band. i.e. $n = p = n_i$, $np = n_i \times n_i = n_i^2$ Substituting the corresponding expressions for n and p, $n_i^2 = 2\left(\frac{2\pi_e^* kT}{h^2}\right)^{3/2} e^{(E_F - E_C)/kT} \times 2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2} e^{(E_V - E_F)/kT}$ (1M) where $E_C - E_v = E_g$ is the forbidden energy gap. $\therefore n_i = 2\left(\frac{2\pi kT}{h^2}\right)^{3/2} (m_e^* m_h^*)^{3/4} e^{-E_g/2kT}$ (2M)
2	**Obtain an expression for the carrier concentration of holes in the valance band of intrinsic semiconductor. (10 M)** BTL2(Dec 2001) **Hole concentration (or) Density of Holes (p)**: The number of holes in the valence band per unit volume. (1M) **Calculation of Density of Holes in the Valence Band of Intrinsic Semiconductors** Let d_p be the number of holes per unit volume in the valence band between the energy E and E + d E $dp = Z(E)(1 - F(E))dE$ (1M) The probability of an unoccupied electron state, i.e., presence of a hole. $1 - F(E) = 1 - \left[\frac{1}{1 + e^{(E - E_F)/kT}}\right]$ Since E is very small when compared to E_F in the valence band, $(E - E_F)$ is a negative quantity and hence $e^{(E - E_F)/\kappa}$ is very small. i.e., $\therefore 1 - F(E) = e^{(E - E_F)/kT}$ (1M) E_v, the top level in the valence band is the potential energy of a hole at rest. Hence, $(E_V - E)$ is the kinetic energy of the hole at level below E_V. Density of states in the valence band, $Z(E)dE = \frac{4\pi}{h^3}(2m_h^*)^{3/2}(E_v - E)^{1/2} dE$ (1M)

$$dp = \frac{4\pi}{h^3}(2m_h^*)^{3/2}(E_v - E)e^{(E-E_F)/kT}dE \qquad \text{(1M)}$$

The number of holes in the valence band for the entire range is obtained

$$p = \int dp = \int_{-\infty}^{E_v} \frac{4\pi}{h^3}(2m_h^*)^{3/2}(E_v - E)^{1/2}e^{(E-E_F)/kT}dE \qquad \text{(1M)}$$

To solve the integral in eqn (7), let us assume,

	when	when
$E_v - E = x$	$E = -\infty$	$E = E_v$
$E = -x + E_v$	$E_v + \infty = x$	$x = E_v - E_v$
$\therefore dE = -dx$	$\therefore x = \infty$	$\therefore x = 0$ (1M)

Substituting these values in equation,

$$p = \frac{4\pi}{h^3}(2m_h^*)^{3/2}e^{(E_V-E_F)/kT}\int_0^{\infty} x^{1/2}e^{(-x/kT)}dx \qquad \text{(1M)}$$

Using the gamma function,

$$\int_0^{\infty} x^{1/2}e^{(-x/kT)}dx = \frac{(kT)^{3/2}\pi^{1/2}}{2} \qquad \text{(1M)}$$

$$p = 2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2} e^{(E_V-E_F)/kT} \qquad \text{(2M)}$$

3

Explain extrinsic semiconductors and derive the expression for carrier concentration for n-type and p-type semiconductor. (2 M + 7M+7M) BTL2(May 2003, Dec 2009, May 2011)

Answer Page: Dr. P. Mani

Extrinsic semiconductor: doped semiconductors are extrinsic semiconductors. Pentavalent doped semiconductors are n-type and trivalent doped semiconductors are p-type semiconductors. (2M)

Carrier concentration in n-type semiconductor (derivation):

Density of electrons per unit volume= $n = 2\left(\frac{2\pi m_e^* kT}{h^2}\right)^{3/2} e^{(E_F-E_C)/kT}$ (1 M)

Equating $2\left(\frac{2\pi m_e^* kT}{h^2}\right)^{3/2} e^{(E_F-E_C)/kT} = N_d e^{(E_d-E_F)/kT}$ (2 M)

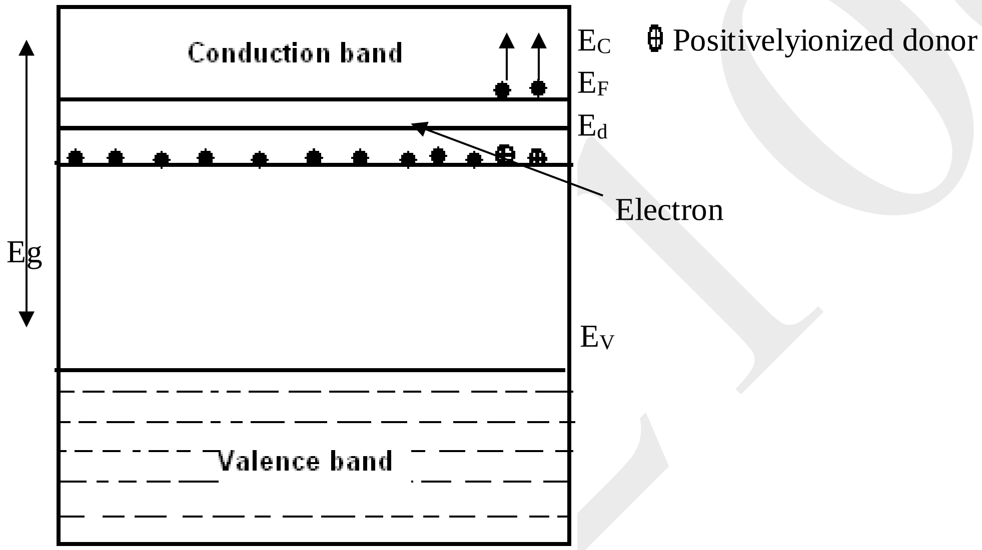
Taking log on both sides, we get

$$\log_e\left[2\left(\frac{2\pi m_e^* kT}{h^2}\right)^{3/2}\right] + \frac{E_F - E_C}{kT} = \log_e N_d + \frac{E_d - E_F}{kT}$$

$$E_F = \frac{E_d + E_C}{2} + \frac{kT}{2} \log_e \left[\frac{N_d}{2\left(\frac{2\pi m_e^* kT}{h^2}\right)^{3/2}} \right]$$ (2M)

Substituting the expression of E$_F$ $\boxed{n = (2N_d)^{1/2} \left(\frac{2\pi m_e^* kT}{h^2}\right)^{3/4} e^{-\Delta E/2kT}}$ (1M)

Where $\Delta E = E_C - E_d$ is the ionization energy of the donor



(1M)

Concentration of holes in the valence band of p-type semiconductor (derivation):

Let E$_\alpha$ represent the energy of the acceptor level and N$_\alpha$denote the number of acceptor atoms per unit volume, Density of holes $p = 2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2} e^{(E_V - E_F)/kT}$ (1M)

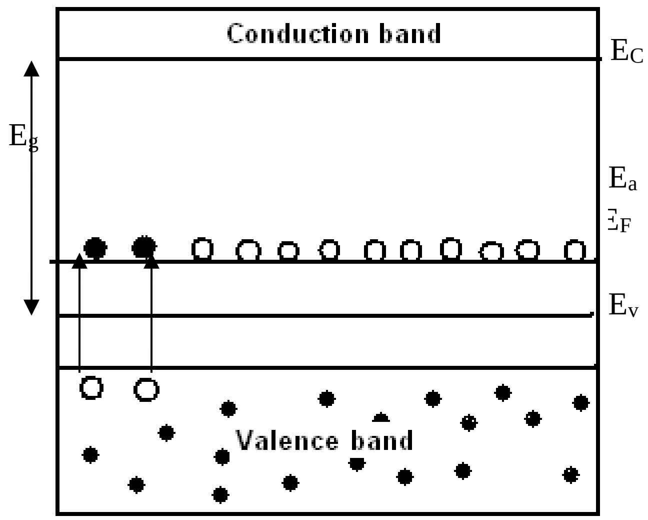
Where E$_F$ is Fermi energy level; E$_V$ is the energy corresponding to the top level of valence band.

Density of ionized Acceptors $N_a F(E_a) = \frac{N_a}{1 + e^{(E_d - E_F)/kT}}$

Density of ionized Acceptors $= N_a e^{(E_d - E_F)/kT}$ (1M)

At equilibrium,= Density of holes in the valence band= Density of ionized acceptors

$$2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2} e^{(E_V - E_F)/kT} = N_a e^{(E_d - E_F)/kT}$$ (1 M)



(1M)

Taking log on both sides, we have

$$\log_e 2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2} + \frac{E_V - E_F}{kT} = \log_e N_a + \frac{E_F - E_a}{kT}$$

Rearranging the expressions, we have

$$E_F = \frac{E_a + E_V}{2} - \frac{kT}{2}\log_e\left[\frac{N_a}{2\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/2}}\right]$$ (2M)

Substituting the expression of E_F , If $E_a - E_v = \Delta E$,

$$\boxed{p = (2N_a)^{1/2}\left(\frac{2\pi m_h^* kT}{h^2}\right)^{3/4} e^{-\Delta E/2kT}}$$ (1M)

4

What is carrier transport? Explain drift transportation in detail. (2M+8M) BTL1

Answer Page: 2.35 Dr. P. MANI

Carrier transport:

- Any motion of free carriers in a semiconductor leads to a current.
- This motion can be caused by an electric field due to an externally applied voltage, since the carriers are charged particles.
- This transport mechanism is *carrier drift.*
- Carriers also move from high density regions to low density region.
- This carrier transport mechanism is due to the thermal energy and the associated random motion of the carries.
- This transport mechanism *is carrier diffusion*.
- The total current equals the sum of the drift and the diffusion current. (2M)

Drift transportation

For electron	For Holes
$V = -\frac{eE}{m_n}.t$	$V = \frac{eE}{m_n}.t$
Average net velocity of electron	Average net velocity of holes
$V_{d_n} = -\frac{eE}{m_n}.\tau_c$	$V_{d_p} = \frac{eE}{m_p}.\tau_c$
We know that,	We know that,
Mobility $\mu_n = \frac{V_{d_n}}{E}$	Mobility $\mu_p = \frac{V_{d_p}}{E}$
$\therefore V_{d_n} = -\mu_n.E$	$\therefore V_{d_p} = \mu_p.E$

(3 M)

$J_{nd} = -enV_{dn}$ $\qquad$ $J_{pd} = epV_{dp}$

$J_{nd} = +en\mu_n E$ $\qquad$ $J_{pd} = ep\,\mu_p E$

(2M)

$$J_{drift} = e(\mu_n n + \mu_p p)E$$

We know that, $\quad J_{drift} = \sigma E$

Comparing the above two equation, we get

Conductivity, $\quad \sigma = e(\mu_n n + \mu_p p)$

Resistivity $\quad P = \frac{1}{e(\mu_n n + \mu_p p)}$

Resistivity is commonly used to specify doping level.

In n-type semiconductor	In p-type semiconductor
$P_n = \frac{1}{eN_d\mu_n}$	$P_p = \frac{1}{eN_a\mu_p}$

(3M)

5 **Write a short notes on (i) Diffusion transport (8 M) (ii) Einstein Relation (6M)** BTL2

(i) Answer Page: 2.39 Dr. P. MANI

In semiconductors, the "flow of carriers" from one region to higher concentration to lower concentration results in a "diffusion current" or carrier diffusion.

Ficks law describes diffusion as the flux 'F' is proportional to the gradient in concentration.

i.e. Diffusion flux $\propto$ - concentration gradient

(2M)

For electron, For holes,

$$F_n = -D_n \frac{dn}{dx} \qquad F_p = -D_p \frac{dp}{dx}$$

$$J_{n', \, dif} = e \, Dn \frac{dn}{dx} \qquad J_{p, \, dif} = -e \, Dp \frac{dp}{dx}$$

(2M)

$$J_n = en\mu_n E_x + eD_n \frac{dn}{dx} \qquad J_p = ep\mu_p E_x - eD_p \frac{dp}{dx}$$

$$J = J_n + J_p \qquad = en\mu_n E_x + ep\mu_p E_x + eD_n \frac{dn}{dx} - eD_p \frac{dp}{dx}$$

(2 M)

(ii) Answer Page: 2.41 Dr. P. MANI

Einstein derived the relationship between the mobility (μ) and diffusion coefficient (D) using non-uniformly doped semiconductor model

$$\boxed{\frac{D}{\mu} = \frac{K_B T}{e}}$$

(3M)

In semiconductor,

$$\boxed{\frac{D_n}{\mu_n} = \frac{D_p}{\mu_p} = \frac{K_B T}{e}}$$

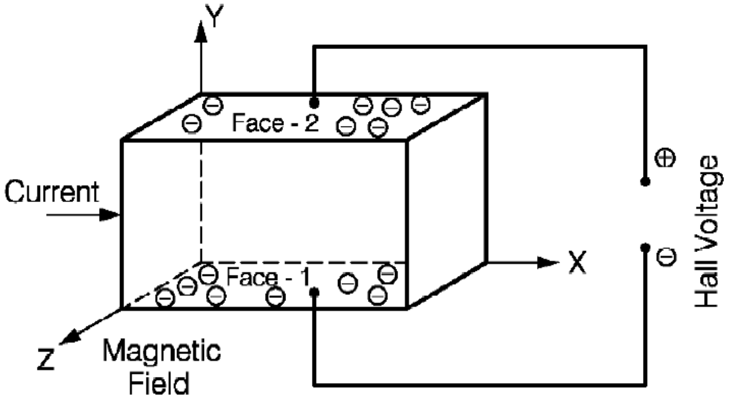
(3 M)

6 **State and explain Hall effect. With necessary theory and diagram, derive the Hall coefficient. (3 M+ 13M)** BTL2(May 2007, Dec 2009)

Hall Effect: When a conductor (metal or semiconductor) carrying a current (I) is placed in a magnetic field (B) perpendicular to this current, a potential difference (electric field) is developed inside the conductor in a direction normal to the directions of both the current and the magnetic field. This phenomenon is known as Hall effect and the voltage thus generated is called Hall voltage. (3 M)

Hall effect in n-type semiconductor

Let us consider a n-type semiconducting material in the form of rectangular slab,



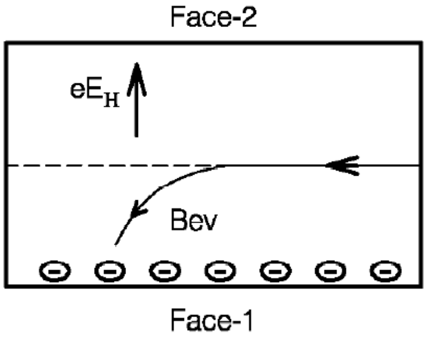
(1M)

Fig. Hall effect

When a magnetic field (B) is applied in Z-direction, the electrons moving with velocity v will experience a downward force.

Downward force experienced by the electrons = Bev (1 M)

This downward force deflects the electrons in downward direction and therefore, there is an accumulation of negatively charged electrons on the bottom face of the slab as shown in fig.



Hall effect in n-type semiconductor (1 M)

This electric field develops a force which is acting in the upward direction on each electron,

Upward force acting on each electron = eE_H (1 M)

At equilibrium, **the downward force Bev will balance the upward force eE_H**

$$\therefore Bev = eE_H \quad \text{or} \quad E_H = Bv \qquad \text{(1 M)}$$

The current density (J_x) acting along the X-direction is related to the velocity v as

$J_x = -nev$, Where n is the concentration of current carriers (electrons).

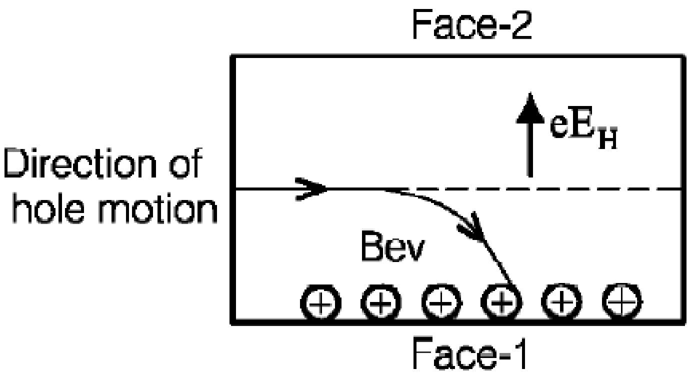
$$v = \frac{-J_x}{ne} \text{ ; Substituting v, } E_H = \frac{-BJ_x}{ne} \quad \text{OR} \quad E_H = R_H J_x B \quad \text{OR} \qquad \text{(1 M)}$$

$$\text{or} \quad R_H = \frac{E_H}{J_x B}, \quad \text{where} \quad R_H = -\frac{1}{ne} \qquad \text{(1 M)}$$

R_H is a constant and it is known as Hall coefficient.

Hall effect in p-type semiconductor

Consider a rectangular slab of p-type semiconducting material and the current flow in this case is entirely due to the flow of positive holes from left to right as shown in fig.



(1 M)

Hall effect in p-type semiconductor

Due to applied magnetic field, the holes are accumulated in the bottom of the slab and thus produce a potential difference.Similar to n-type semiconductor, we can write $E_H = R_H J_x B$ (4 M)

Where Hall coefficient (R_H) , $R_H = +\frac{1}{pe}$; Where p is the concentration of current carriers (holes). (1 M)

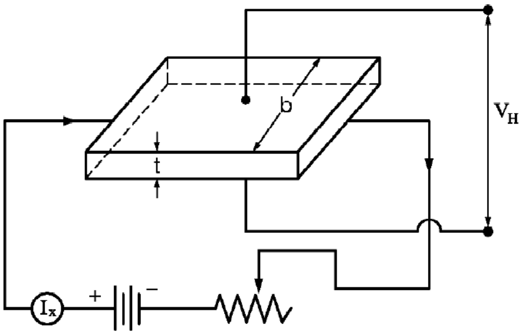
7

(i) Describe the experiment to determine the Hall Coefficients. List the various Hall devices and explain them. (10 M) BTL2

(ii) Find the Hall coefficient and electron mobility of germanium for a given sample of length 1 cm , breadth 5 mm and thickness 1 mm. A current of 5 mA flows from a 1.3 volt supply and develops a Hall voltage of 20 millivolt across the specimen in a magnetic field of 0.45 wb/m^2. (4 M) BTL4

(i) Answer Page : 2.48 Dr. P. MANI

Experimental set up



(2 M)

Explanation

$$V_H = \frac{R_H I_x B t}{bt}$$

$$V_H = \frac{R_H I_x B}{b}$$

$$\boxed{R_H = \frac{V_H b}{I_x B}}$$

(2 M)

Hall Devices

Gauss Meter (2 M)
Electronic Multiplier (2 M)
Electronic Wattmeter (2 M)

(ii) Answer

Given data: $I = 5\times10^{-3}\,A$; $V = 1.35$ V ; $l = 1\times10^{-2}$ m ; $b = 5\times10^{-3}$ m; $t = 1\times10^{-3}$ m ; $V_y = 20\times10^{-3}$ V ; H = 0.45 wb/m^2

Resistance $R = \frac{V}{I} = \frac{1.35}{5\times10^{-3}}$ = 270 ohm

Resistivity $\rho = \frac{Ra}{l}$

Area $a = b\times t = 5\times10^{-3}\times1\times10^{-3} = 5\times10^{-6}$ m^2

$$\therefore \rho = \frac{270\times5\times10^{-6}}{1\times10^{-2}} = 0.135 \text{ ohm m}$$

Hall field $E_y = \frac{V_y}{thickness} = \frac{20\times10^{-3}}{1\times10^{-3}}$ = 20 V/m (2 M)

Current density $J_x = \frac{Current}{Area} = \frac{5\times10^{-3}}{5\times10^{-6}}$ = 1000 A/ m^2

$$\frac{1}{ne} = \frac{E_y}{HJ_x} = \frac{20}{0.45\times1000} = 0.044 \text{ m}^3\text{/C}$$

Hall coefficient $R_H = \frac{3\pi}{8}\times\frac{1}{ne} = 1.1775\times0.044 = 0.05181$ m^3/C (1 M)

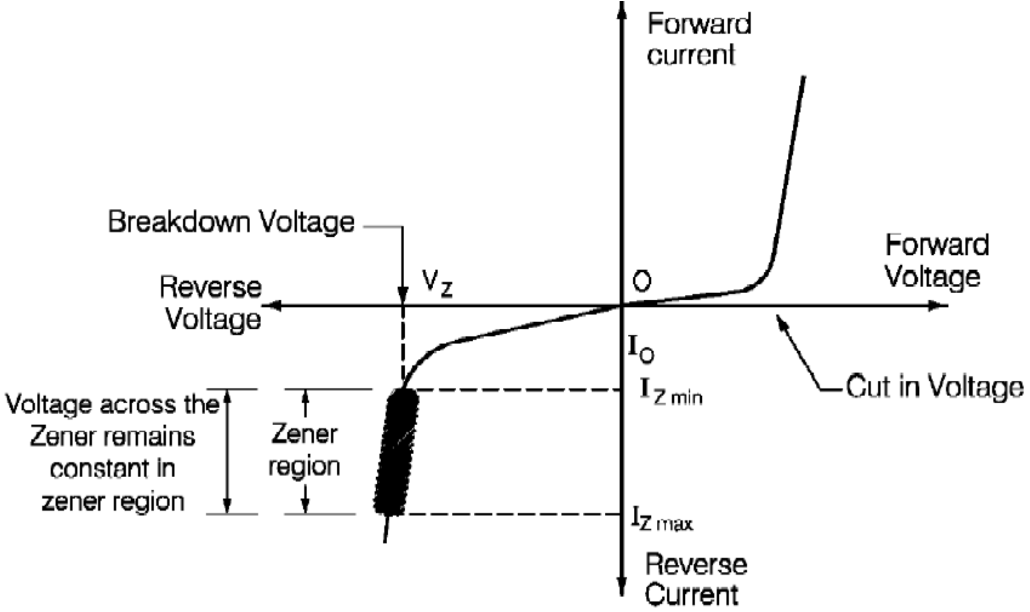
Electron mobility $\mu_e = \frac{R_H}{\rho} = \frac{0.05181}{0.135} = 0.3838\ m^2V^{-1}s^{-1}$

Answer: $R_H = 0.05181\times10^{-6}m^3C^{-1}$ and $\mu_e = 0.3838m^2V^{-1}s^{-1}$ (1 M)

8. **Detail the occurrence of zener and avalanche breakdown in p-n – junction. (12 M)** BTL2

Answer Page: 2.57 D. P. MANI

Occurrence of Zener Breakdown (5 M)
Occurrence of avalanche Breakdown (5 M)

	Diagram  (2 M)
9.	**(i) Describe the principle, theory and V-I characteristics of Tunnel diode. (10 M)** BTL2 **(ii) Give its advantages and applications of tunnel diode in engineering field. (4 M)** BTL2 (i) **Answer Page : 2.67 Dr. P. Mani** **P**rinciple : (2 M) Theory (3 M) V-I characteristics Diagram (2 M) Explanation (2 M) (ii) **Answer Page :2.70 Dr. P. Mani** Advantages (2 M) Applications (2 M)
10.	**With a neat sketch, describe the principle, construction and working of a Schottky diode. Compare the V-I characteristics of Schottky diode. (12M+4M)** BTL2, BTL4 **Answer Page : 2.60 Dr. P. Mani** Principle : (2 M) Theory (3 M) V-I characteristics Diagram (2 M) Explanation (2 M) Comparison of V-I characteristics (4 M)
11.	**Explain in detail the operation of MOS capacitor under various gate voltages. (8 M)** BTL2 **Answer Page : 2.71 Dr. P. Mani** Structure (2 M) Principle of operation Below the flat-band voltage (1M) Between the flat-band voltage and threshold voltage (1M) Larger than the threshold voltage (4 M)

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetization - magnetic permeability and susceptibility–types of magnetic materials – microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown – high-k dielectrics.

Q.No.	**PART * A**
1.	**Give Curie-Weiss law and its importance.**BTL1(May 2003) Curie-Weiss law is given by $\chi_m \propto \frac{1}{T} \quad i.e. \quad \chi_m = \frac{C}{T-\theta}$ Where C- Curie constant & T-Absolute temperature & θ- Curie temperature Importance: It determines the susceptiplity of magnetic materials in terms of temperatures (i.e.) If the temperature is less than curie temperature; a paramagnetic material becomes diamagnetic and if the temperature is greater than curie temperature, a ferromagnetic material becomes paramagnetic materials.
2	**Define dia, para, ferro, antiferro and ferri magnetic materials. Give examples.** BTL1(June 2009, June 2011) **Dia Magnetic material:** In dia magnetic materials, there are equal numbers of electron spins and randomly oriented hence the net magnetic moment is zero. Susceptibility doesn't depend on temperature. Eg. Gold, antimony, bismuth, water, hydrogen, alcohol, Si, Ge. **Para Magnetic material:**In para magnetic materials, there are unequal numbers of electron spins and hence there exists a permanent magnetic dipole moment. Susceptibility depends on temperature. Eg. Platinum, chromium, aluminium, Copper Sulphate. **Ferro Magnetic material:**In ferro magnetic materials, there are large numbers of unequal electron spins and hence there exists enormous permanent magnetic dipole moment. They exhibit hysteresis. Susceptibility depends on temperature. Eg. Iron, Nickel, Cobalt, Steel. **Antiferro Magnetic material:**In antiferro magnetic materials, the adjacent magnetic dipoles are aligned antiparallel. Susceptibility depends on temperature. Eg. Iron, Nickel, Cobalt, Steel. **Ferri or Ferrite Magnetic material:**In ferrite magnetic materials, the spin alignment is antiparallel of different magnitudes. Susceptibility depends on temperature. Eg. $Mg^{2+}Fe_2^{3+}O_2^{2-}$, $Mn^{2+}Fe_2^{3+}O_2^{2-}$, $Ni^{2+}Fe_2^{3+}O_2^{2-}$, $Co^{2+}Fe_2^{3+}O_2^{2-}$

3

What are soft and hard magnetic materials? (or) Compare soft and hardmagnetic materials on the basis of hysteresis loop. Give examples. (or) Discriminate soft and hard magnetic materials. BTL4

S. No.	**Soft Magnetic Materials**	**Hard Magnetic Materials**
1.	They can be easily magnetized and demagnetized	They cannot be easily magnetized or demagnetized.
2.	Movement of domain wall is easy and hence even for a small applied field large magnetization occurs	Moment of domain wall is easy due to the presence impurity and hence large filed is required for magnetization
3.	The hysteresis loop is steep	The hysteresis loop is broad.
4.	Loop area is less and hysteresis loss is minimum	The loop area is maximum and hence the hysteresis loss is maximum
5.	Ex: Iron, Silicon alloys, ferrites &garnets etc	Ex: steel, Tungsten, steel chromium steel, Cu-Ni-Fe (Cunfie), Cu-Ni-Co (Cunico), Al-Ni-Co (Aalnico)
6.	Susceptibility and permeability is very high	Susceptibility and permeability is very low
7.	Retentivity and coercivity are small	Retentivity and coercivity are large
8.	They have low eddy current loss	They have high eddy current loss
9.	These materials are free from irregularities like impurities and strain	These materials are free from irregularities like impurities and strain

4.

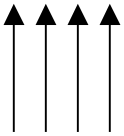
What are Ferrites (Ferri magnetic material)? BTL2

- The uncompensated ferromagnetic materials are called as Ferri magnetic material or ferrites.
- They have the magnetic moments are unequal magnitudes.
- Ferrites are compounds of iron oxides with oxides of other metals.
- Its general formula is given by $X^{2+}Fe_2^{3+} O_4^{2-}$. Where, X^{2+} is a divalent metal ion such as Mg^{2+}, Zn^{2+}, Fe^{2+}, etc.
- Susceptibility is large and positive. ($\chi = C / T \pm \theta$ for $T > T_N$)
- Above curie becomes para, below curie ferro behaviors.

5

Define magnetic susceptiplity and magnetic permeability. (or) Comment on magnetic susceptiplity and magnetic permeability. BTL1

	Magnetic susceptiplity (χ_m): The ratio between intensity of magnetization (*I*) and magnetic field intensity (*H*) (i.e.,) $\chi_m = I / H$ **Magnetic permeability (μ_m);** The ratio between Magnetic flux density (B) and magnetic field intensity (H). (i.e.,) $\mu_m = B / H$.
6	**Define residual magnetism (or) Retentivity and Coercive force (or) coercivity with its unit.**BTL1. **Residual magnetism or Retentivity:**The amount of magnetic induction retained in the material after removing the magnetizing field. Unit: Wb m^{-2} **Coercive force (or) coercivity:**The amount of magnetizing field applied in the reverse direction to remove the residual magnetism completely from the material. Unit: Ampere-turn / m.
7.	**Define Curie temperature and Neel temperature.**BTL1 **Curie temperature:** The critical temperature at which a ferromagnetic material changes into a paramagnetic material. **Neel temperature:** The critical temperature at which the antiferro magnetic material changes into paramagnetic material.
8.	**What are the four types of energies involve in the growth of magnetic domains?**BTL1(June 2009) • Exchange Energy (or)Spin Exchange Interaction Energy (or) Interaction Energy • Anisotropy Energy (or) Crystal Anisotropic Energy • Magneto-static energy (or) Magnetic Potential Energy • Magnetostrictive energy (or) Magneto-Elastic energy
9	**Define Hysteresis. (or) What is hysteresis? (or) Appraise the term hysteresis.** BTL1 The lagging of induced magnetic induction (B) behinds the applied magnetizing field (H) is known as hysteresis. i.e. Lagging of B behind H.
10	**Define Bohr Magneton.**BTL1 The orbital magnetic moment and spin magnetic moment of an electron in an atom can be expressed in terms of atomic unit of magnetic moment is called Bohr Magneton. $\mu_B = e\hbar / 2m = 9.27 \times 10^{-24} Am^2$
11.	**What is ferromagnetism? Give examples. (or) What are ferromagnetic materials?** BTL1 These materials show spontaneous magnetization. They exhibit permanent magnetic dipole moment even in the absence of magnetic field. There is a strong internal field within the material which makes the atomic magnetic moments align with each other. This phenomenon is ferromagnetism. Examples: Fe, Co, Ni, Steel etc…
12.	**List the properties of ferromagnetic materials.** BTL1 • Relative permeability is very much greater than one. i.e, $\mu_r >> 1$ • They have positive and high value of susceptibility and it depends on temperature. It obeys Curie-Weiss law. • i.e. $\chi = \frac{C}{T-\theta}$ • Due to spin exchange interaction, it exhibits strong magnetization even in the absence of magnetic field. • They have permanent dipole moment. • Ferro magnetic materials consists of small spontaneously magnetized regions called domains.

	• Ferromagnetic material become paramagnetic material if the temperature is greater than curie temperature. • Magnetic moments of these materials are orderly oriented. • i.e.,  • They have hysteresis properties. • Examples: Fe, Co, Ni, Steel etc…
13	**Define anti-ferromagnetism. Mention two materials that exhibit anti- ferromagnetism. BTL1** In anti-ferromagnetism, electron spin of neighbouring atoms are align antiparallel. Antiferromagnetic susceptibility is small and positive and it depends greatly on temperature. Example: Manganese Oxide and Chromium Oxide.
14	**State the applications of ferrites. BTL1. (Dec 2011)** (i) They are used in transformer cores for high frequencies upto microwaves. (ii) They are used in ratio receivers to increase the sensitivity and selectivity of the receiver.
15	**What ate hard magnetic materials? BTL1 (June2010)** Materials which retain their magnetism and are difficult to demagnetize are called hard magnetic materials.
16	**State the properties of hard magnetic materials. BTL1(May 2013)** They possess high value of B-H product They have high retentivity They have high coercivity They have low permeability.
17	**What is Anisotropy energy? BTL1** Crystals are anisotropic, the energy arises from the difference of energy required for magnetization along any two different directions in a single crystal. These are two directions of magnetization.
18	**What is Magnetostriction energy? BTL1** When the domain is magnetized in different directions, they will either expand or shrink. **i.e.,**Change in dimension when it is magnetized. The energy produced in this effect is called Magnetostriction energy. It is the energy due to the mechanical stresses generated by domain rotations.
19	**What is GMR?** If the charge in electrical resistance is very high compared to the magnetization, it is called as Giant Magneto-resistance (GMR) and this effect is called GMR effect.
20	**Illustrate hysteresis loop and what do you infer from it? BTL2**

	The hysteresis loop of ferromagnetic materials refers to the lag of magnetization behind the magnetizing field. It is an irreversible B-H characteristic curve of ferromagnetic or ferromagnetic materials. i) If hysteresis curve is broad and has a large area, it is known as hard magnetic material. ii) If hysteresis curve is sharp and has a small area, the hysteresis loss is small and is known as soft magnetic material.
21	**Recall the term magnetic storage device? Give examples. BTL2** Ferro and ferric magnetic materials which are used to store the data in form of zeros and ones are called magnetic storage devices. Examples: Floppy disk, Audio cassettes, magnetic tapes etc.
22	**What is meant by magnetic bubble? How they are formed.** Magnetic bubbles are soft magnetic materials with magnetic domains of few micrometers in diameter. **Formation:** When a magnetic field is applied to magnetic garnets like Gadolinium and Gallium garnet, small cylindrical domain area known as magnetic bubble is formed. These bubbles have a magnetic region of one polarity surrounded by the other polarity.
23	**Mention few soft magnetic materials and their applications. Soft magnetic materials: BTL1(Jan 2012)** (i) Pure or ingot iron (ii) Cast iron (carbon above 2.5%) (iii) Carbon steel **Applications:** (i) Cast iron used in the structure of electrical machinery and frame work of d.c.machine (ii) Carbon steel has high mechanical strength used in making motor of turbo alternators.
24	**What ate hard magnetic materials? BTL1(June 2010)** Materials which retain their magnetism and are difficult to demagnetize are called hard magnetic materials.
	PART-B
1.	**(i) State the origin of magnetic moment. (4 M)** BTL2 **(ii) How magnetic materials are classified based on magnetic moments? Explain their properties. Give also their characteristics and examples. (16 M)** BTL3(May 2011) **(i) Answer Page: 3.1 Dr. P. MANI** • All materials are basically composed of atoms. • The property of certain magnetic materials is associated with the magnetic property of its constituent atoms. **<u>The magnetic dipole moment of an atom depends on</u>**

- The **orbital magnetic moment** due to the orbital motion of electrons around the nucleus and its magnitude is very small.
- The **spin magnetic moment** due to the spin motion of electrons about their own axes.
- The magnetic moment due to the nuclear spin.

The magnetic moment due to the electron spin only is taken into consideration neglecting the orbital and the nuclear magnetic moments because of their small magnitudes. (4M)

(ii) Answer Page: 3.23 Dr. P. MANI

Properties of Dia magnetic materials

i) Relative permeability is always less than one. i.e, $\mu_r < 1$ for these materials.

ii) They have negative value of magnetic susceptibility and it is independent to temperatrure.

iii) Since there is no permanent magnetic dipole moments, they are called as weak magnets.

iv) They are magnetised in a direction opposite to the external magnetizing field.

v) They repel the magnetic lines of forces.

vi) Induced magnetic moment is proportional to the applied magnetic field.

vii)The induced dipoles and magnetization vanishes as soon as the applied field is removed**.**

viii) When temperature is less than critical temperature they become normal material.

Examples; Ge, Si, Ag, Hydrogen, Bi, Niobium etc.. (4 M)

Properties of Para magnetic materials

i) Relative permeability is greater than one. i.e, $\mu_r > 1$ for these materials.

ii)They have positive value of magnetic susceptibility.

iii) Magnetic susceptibility is inversly proportional to the temperature.

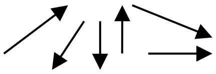
i.e., $\chi \alpha \frac{1}{T} \Rightarrow \chi = \frac{C}{T}$ **(Curie law)**

(or) $\chi = \frac{C}{T-\theta}$ **(Curie-Weiss law)**

where C-Curie constant; T-Asolute temperature; θ- Curie temperature

iv) They are magnetised along the direction of the external magnetizing field.

vi) They posses permanent magnetic dipole moments in random directions.



vii) Magnetic lines of forces can penetrate through these materials.

viii) When the temperature is than curie temperature, these materials become diamagnetic nature.

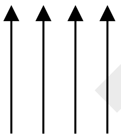
Examples: Alkali metals, Transition metals, Rare earth elements, $CuSo_4$, $MnSo_4$, Pt, Al etc. (4 M)

Properties of ferromagnetic materials

i) Relative permeability is very much greater than one. i.e, $\mu_r = 1$.
ii) They have positive and high susceptibility and it depends on temperature. It obeys **Curie-Weiss law.**

i.e., $\chi = \frac{C}{T-\theta}$

iii) Due to spin exchange interaction, it exhibits strong magnetization even in the absence of magnetic field.
iv) They have permanent dipole moment.
v) Ferro magnetic materials consists of small spontaneously magnetized regions called domains.
vi) Ferromagnetic material become paramagnetic material if the temperature is greater than curie temperature.
vii) Magnetic moments of these materials are orderly oriented.

i.e., 

viii) They have hysteresis properties. Examples: Fe, Co, Ni, etc… (4 M)

Properties of Ferrites orferri-magnetic materials

i) Ferrites possess non-zero magnetic moment.
ii) They exhibit paramagnetic property above Curie temperature and ferromagnetic character below Curie temperature.
iii) The susceptibility of a ferrite is very large and positive. It is temperature dependent
iv) and it is given by $\chi = \frac{C}{T \pm \theta}$ *for* T > T_N
v) They have high permeability and high resistivity
vi) They have low eddy current losses, low hysteresis losses and low coercivity. (4 M)

2 **(i) Describe about the origin and exchange interaction in ferromagnetism. (6 M)** BTL2
(ii) Discuss about saturation magnetisation and Curie temperature. (6 M) BTL2(May 2012)

(i) Answer Page: 3.12 Dr.P. MANI

Origin of ferromagnetism and exchange interaction explanation with diagram (3M +3 M)

(ii) Answer Page: 3.14 Dr. P. MANI

Saturation magnetism and curie temperature definition, explanation with diagram (2M +4 M)

3

Explain domain theory of ferromagnetism, domain magnetization and different types of energy involved in the process of domain growth in detail. (16 M) BTL2(June 2010, May 2011)

Principle: The total energy of a system is minimum at thermal equilibrium.

The total internal energy of the domain in a ferromagnetic material is the sum of the following energies.

- Magnetostatic energy or magnetic field energy or exchange energy
- Crystalline energy or anisotropy energy
- Domain wall energy or Bloch wall energy
- Magnetostriction or magneto-strive energy. (2M)

(i) Exchange energy

- The energy which makes the adjacent dipoles align themselves in a particular direction
- Arises from the interaction of electron spins
- Depends upon the interatomic distance.
- The energy required in assembling the atomic magnets into single domain and this work done is stored as potential energy. (2M)

(ii) Anisotropy energy

- In ferromagnetic crystals, there are two directions of magnetization namely easy direction and hard direction.
- The excess energy required to magnetize a specimenin particular direction over that required to magnetize it along the easy direction (2M)

(iii) Domain wall energy or Block wall energy

- **Domain wall or Bloch wall:** A thin boundary line or region which separates adjacent domains magnetized in different directions
- The size of the Bloch walls are about 200 to 300 lattice constant thickness.
- In going from one domain to another domain, the electron spin changes gradually as shown in fig.
- When the exchange energy is high change occurs abruptly. But, the anisotropy energy is less only when spin changes abruptly.

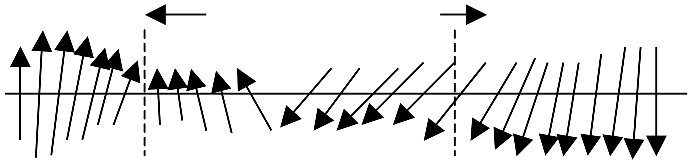


Figure. The change of electron spin in the transition region of Bloch wall (2 M)

(iv) Magnetostriction energy

- **Magnetostriction:**The change in the dimension of a ferromagnetic material when it is magnetized
- The energy involved in this change in dimension is known as magnetostriction energy
- The deformation is different along different crystal directions but it is independent of the direction of the field
- The magnetostriction energy is the energy due to the mechanical stresses generated by domain rotation (2 M)

Domain magnetization

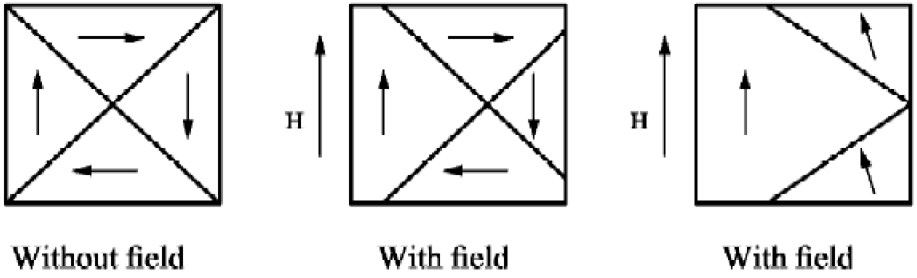
i. By the movement of domain walls.

ii. By rotation of domains.

i. Movement of Domain Walls :

The movement of domain walls takes place in weak magnetic fields.

When a small magnetic field is applied, the domains with magnetisation direction parallel to the field, grow at the expense of others.



(a) Random domain alignment(without field) (b) Domain wall movement (with weak field) (c) Domain rotation (with strong field)

ii. Rotation of Domains

If the magnetic field is increased further, domain growth becomes impossible. Rotation of magnetic moment takes place. Finally, completely grown domains and very small domains appear in a direction parallel to the applied field.

(3M+ 3M)

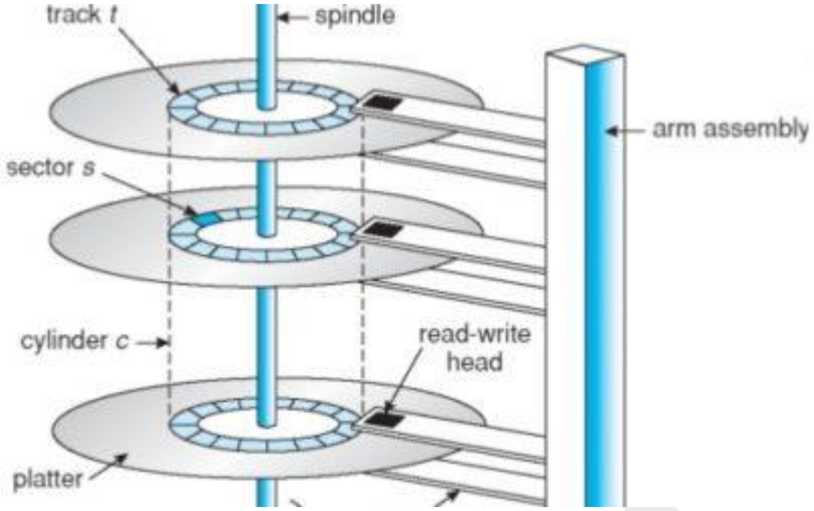
4 **Write short notes on Magenetic HDD .BTL2**

Definition (2M)

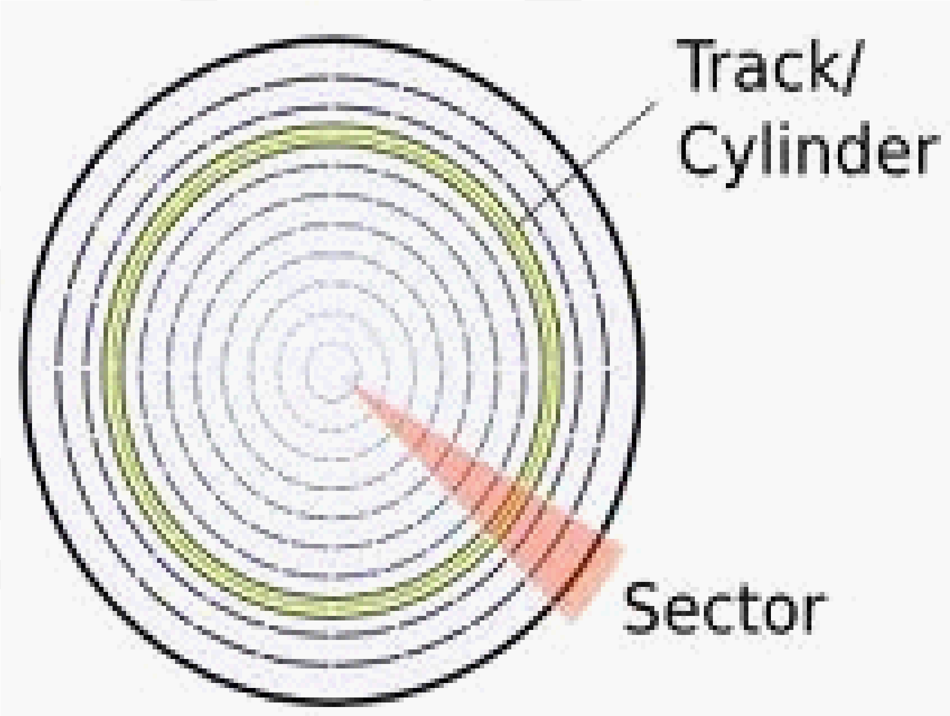
- The Hard disk is used for storing a large amount of information.This disk is available in different size.

- The hard disk is completely sealed and it is protected from dust particles.

Construction (10M)



- It consists a number of disks(3 to 5).All these platters are packed together and mounted on a common shaft.
- The central shaft rotates at a speed of 3600.All the disks rotates in the same direction.
- A number of access arms and read/write heads are used,to access two surface of the disk.
- They are sealed in a dust free container.



- Each disk has two slides on which information is stored on both the side of disks.

	• The disk consists of number of tracks.A set of corresponding tracks in all sides is called a cylinder. • Each track is divided into sectors.The presence of magnetized spot represents 1 bit and its absence represent 0 bit. • The storage capacity of the disk depends on the number of disk surface . Advantage (2M) • It has very large storage space. • More file can be permanently stored. • It is prevented from dust particles,since they are sealed in a special chamber. Disadvantages. (2M) • Hard disk are not easily portable. • Its cost is more. • More chance for errors.
5	**Explain magnetic principle in data storage.BTL2** **Storage Devices (2M)** ⦿ Magnetic materials are used for recording and reading of the audio and video signals. They are also used in storage devices such as magnetic tapes, floppy disks and hard disk. ⦿ Generally ferro or ferrimagnetic materials are used in the storage devices. **Storage of Magnetic Data (2M)** ⦿ The storage capacity of the main memory of a computer system is limited. It is known as RAM. It is not a permanent storage. ⦿ As a result, additional memory called secondary storage is needed. **Purpose of Secondary Storage (2M)** ⦿ To increase the memory capacity ⦿ To store the data permanently **Common Secondary Storage Devices (2M)** ⦿ Magnetic tapes (Cassettes) ⦿ Magnetic disk (Floppy disk and hard disk) ⦿ Ferrite core memories ⦿ Magnetic bubble memories **Magnetic Tape (6M)** ⦿ It consists of a plastic tape coated with magnetic materials such as ferrous or ferric oxide. ⦿ 0.5 inch wide and 9 tracks. ⦿ These are available in the form of large reels or cassettes **Representation of magnetic tape and heads**

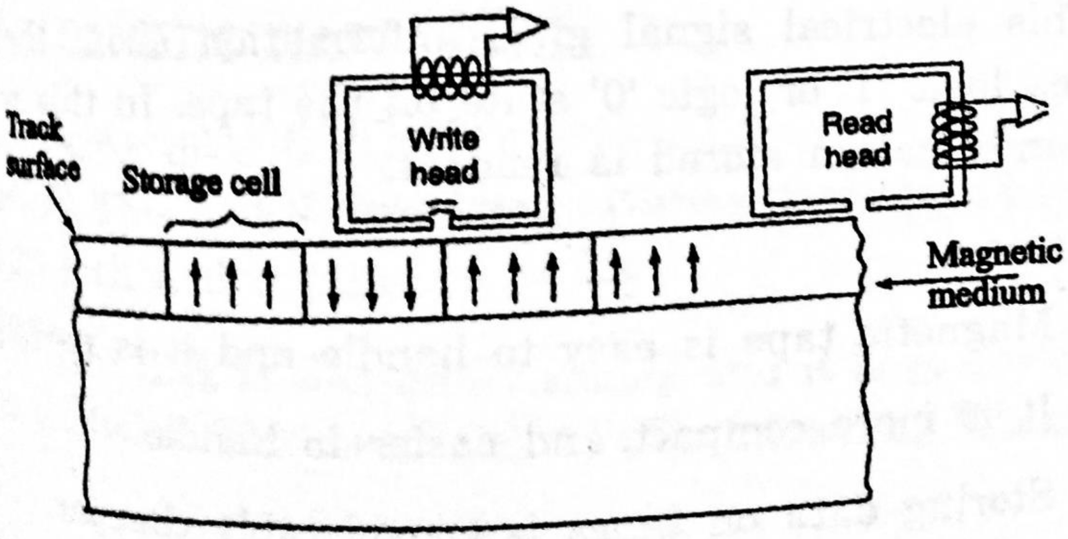


Fig. 3.24 Representation of magnetic tape and heads

Process

- When the data (0 and 1) in the form of electrical signal is applied to the write head, it stores the data on magnetic tape as logic 1 in one direction.
- Similarly the next data is stored as logic 0 in the next storage cell in opposite direction.
- The data stored is read out by write head when tape moves.

Advantages& Disadvantages (2M)

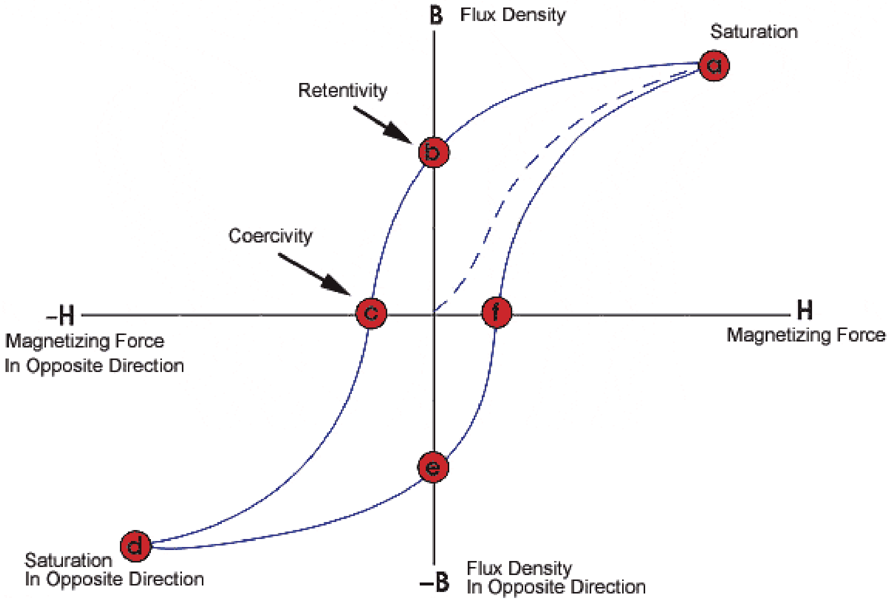
5.

Explain the phenomenon of Hysteresis in ferromagnetic materials.BTL2 (Oct 2009)

Definition (2M)

The lagging of induced magnetic induction (B) behinds the applied magnetizing field (H) is known as hysteresis. i.e. Lagging of B behind H.

Diagram (3M)



Explanation (3M)

UNIT IV OPTICAL PROPERTIES OF MATERIALS **9**

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes – excitons - quantum confined Stark effect – quantum dot laser.

Q.No	**PART * A**
1.	**What are Opticalmaterials?**BTL2 The materials which are sensitive to light are known as Optical materials. These optical materials exhibit a variety of optical properties.
2	**What are the types of opticalmaterials?**BTL2 i) Transparent. ii) Translucent. **iii)** Opaque.
3	**Define scattering of light.**BTL2 Process by which the intensity of the waves attenuates as it travels through a medium.
4.	**Define carrier generation and recombination.**BTL2 The carrier generation is the process whereby electrons and holes are created. The recombination is the process whereby electrons and holes are annihilated.
5	**What are the types of carriergeneration?**BTL2 i) Photogeneration. ii) Phonongeneration. **iii)** Impactionization.
6	**What are the types of recombinationprocess?**BTL2 a) Radiative Recombination. b) Shockley-Read-HeadRecombination. **c)** AugerRecombination.
7.	**What is exciton? Mention its types.**BTL2 The combination of an electron in an excited stage (below conduction band) and the associated hole in valence band (electron – hole pair) is known as an exciton. a) Frenkel excitons - strongly bound excitons. **b)** Mott and wannier excitons – weakly boundexcitons.
8.	**Give the basic principle of photodiode.**BTL2

	When light is incident on the depletion region of the reverse-biased pn junction, the concentration of minority carriers increases. Therefore, reverse saturation current increases.
9	**What is photodiode?**BTL2 Photo diode is a reverse biased p-n junction diode which responds to light absorption
10	**Give the importance ofexcitons.**BTL4 a) The excitons play an important role in luminescence ofsolids. b) Excitons are unstable and they will separate at hightemperature. c) The excitons can move through the semiconductor and transportenergy **d)** The excitons does not transport any charge as it is electricallyneutral.
11.	**What is solarcell?**BTL2 Solar cell is a p-n junction diode which converts solar energy (light energy) into electrical energy.
12.	**What is photodetector?**BTL2 Photo detector is a semiconductor device which is used to detect the presence of photons. This device is known as photo detector. It converts optical signals into electrical signals**.**
13.	**Specify the types of photodetector?**BTL4 a) Photoemissive. b) Photoconductive. c) Photovoltaic.
14.	**List out the types of photo-voltaic devices?** BTL2 a) PIN photodiode. b) Avalanche photo diode(APD). c) P-N junction photodetector.
15	**What is LED?**BTL2(Jan 2006) LED is a p-n junction diode which emits light when it is forward biased.
16	**What are the disadvantages ofLEDs?**BTL2 **a)** They require highpower. **b)** Their preparation cost is high when compared toLCD
17	**What are the applications used ofLEDs?**BTL2 a) They are used as indicatorlamps. b) Infrared LEDs are used in burglaralarms. c) They are used in image sensing circuits used for picturephone
	PART-B
1	**Describetheopticalabsorptioninmetals,dielectrics(insulators)and semiconductors.(or) Explain the carrier generation and recombination processes in metal, semiconductors and insulators. (16 M)** BTL2

	Answer: Page: 4.5 to 4.11 P.MANI carrier generation and recombination processes (1 M) Absorption and emission of light in metal (or) conductors(5M) Absorption and emission of light in dielectrics (Insulators)(5M) Absorption and emission of light in semiconductors(5M)
2	**Describe the principle, construction and working of a photodiode. Mention its advantages, disadvantages and uses. (16 M)** BTL2 **Answer: Page: 4.18 to 4.20 P.MANI** Principle (2 M) Construction diagram (3 M) Construction description (3 M) Working (4 M) Advantages, disadvantages and uses (4 M)
3	**Discuss the principle, construction and working of solar cell. Mention its advantages, disadvantages and uses. (16 M)** BTL2 **Answer: Page: 4.20 to 4.23 P.MANI** Principle (2 M) Construction diagram (3 M) Construction description (3 M) Working (4 M) Advantages, disadvantages and uses (4 M)
4	**Describe the principle, construction and working of a photo detector. Mention its advantages, disadvantages and uses. (16 M)** BTL2 **Answer: Page: 4.24 to 4.27 P.MANI** Principle (2 M) Construction diagram (3 M) Construction description (3 M) Working (4 M) Advantages, disadvantages and uses (4 M)
5	**Describe the principle, construction and working of a GaAlAs diode laser. (or) Describe the principle, construction and working of a homo-junction diode laser (or) Describe the principle, construction and working of hetero-junction diode laser. Mention its advantages, disadvantages and uses. (16 M)** BTL2(Jan.2009, Jan.2010, Jan.2011) **Answer: Page: 4.31 to 4.35 P.MANI** Principle (2 M) Construction diagram (3 M) Construction description (3 M) Working (4 M) Advantages, disadvantages and uses (4 M)
6	**Describe the principle, construction and working of Light Emitting Diode. Mention its advantages, disadvantages and uses. (or) Explain how p-n junction diode acts as light emitting diode. (16 M)** BTL2(May 2003, Apr 2003) **Answer: Page: 4.27 to 4.31 P.MANI**

	Principle (2 M) Construction diagram (3 M) Construction description (3 M) Working (4 M) Advantages, disadvantages and uses (4 M)
7	**Describe the principle, construction and working of OLED. Mention its advantages, disadvantages and uses. (16 M) BTL2** **Answer: Page: 4.35 to 4.38 P.MANI** Principle (2 M) Construction diagram (3 M) Construction description (2 M) Working (2 M) Types (3 M) Advantages, disadvantages and uses (4 M)
8	**What is quantum dot? Describe the principle, construction and working of quantum dot laser. Mention its advantages, disadvantages and uses. (16 M) BTL2** **Answer: Page: 4.42 to 4.45 P.MANI** Quantum dot (2 M) Principle (2 M) Construction diagram (3 M) Construction description (3 M) Working (3 M) Advantages, disadvantages and uses (3 M)
9	**Write short noteson (i) Excitons (8 M) (ii) Quantum Confined Stark Effect (QCSE).(4 M)(iii) Quantum dots (4 M)**BTL2 (i) **Answer: Page: 4.15 to 4.18 P.MANI** Definition and explanation of excitons (2 M) Types of excitons Frenkel Exciton (2 M) Motti and Wannier exciton (2 M) Importance of excitons (2 M) (ii) **Answer: Page: 4.39 to 4.40 P.MANI** Definition and explanation of QCSE (2 M) Uses of QCSE (2 M) (iii) **Answer: Page: 4.40 to 4.42 P.MANI** Definition and explanation of quantum dot (2 M) Applications of quantum dot (2 M)

UNIT V NANOELECTRONIC DEVICES **9**

Introduction - electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures –Zener-Bloch oscillations – resonant tunneling – quantum interference effects – mesoscopic structures: conductance fluctuations and coherent transport – Coulomb blockade effects - Single electron phenomena and Single electron Transistor – magnetic semiconductors– spintronics - Carbon nanotubes: Properties and applications.

Q.No.	**PART * A**
2.	**What is meant byTunneling?** BTL1 The phenomenon in which a particle, like an electron, encounters an energy barrier in an electronic structure and suddenly penetrates is known as tunnelling.
2	**What is meant by quantumconfinement?**BTL1 Quantum confinement is a process of reduction of the size of the solid such that the energylevels inside becomes discrete.
3	**Infer the term quantumstructure.**BTL2 When bulk material is reduced in its size, at least one of its dimensions, in the order of few nanometres, then the structure is known as quantum structure
4.	**Define Zener-Blochoscillation.**BTL2 Zener-Bloch oscillation denotes the oscillation of a particle confined in a periodic potential when a constant force is acting on it.
5	**What is resonant tunnelingdiode?**BTL2 Resonant tunnelling diode refers to tunnelling in which the electron transmission coefficient through a structure is sharply peaked about certain energies.
6	**Define quantuminterference.** BTL2 When two or more particles that are space and time independent have an interaction, construction or destructing their wave function is known quantum interference.
7.	**Recall the term Blochoscillations.** BTL2 A particle in a periodic potential with an additional constant force performs osciallations and these oscillations are called Bloch oscillations
8.	**What are Zener – Blochoscillations?**BTL2 The dynamics of quantum particles shows a coherent superposition of Bloch oscillations and Zener tunnelling between the sub-bands which is called as Zener-Bloch oscillation.
9	**DefineMesoscopic**. BTL2 Mesoscopic means intermediate between the macroscopic and microscopic scales.
10	**Define Coulombblockade effect.**BTL2 The resistance to electron transport caused by electrostatic coulomb forces in certain electronic structures, including quantum dots and single electron transistors is called coulomb blockade.

11.	**What is single electronphenomena?**BTL2 A transistor made from a quantum dot that controls the current from source to drain one electron at a time is called single electron transistor.
12.	**What are magneticsemiconductors?**BTL2 Magnetic semiconductors are semiconducting materials that exhibit both ferromagnetism and semiconductor properties.
13.	**What isspintronics?**BTL2 Spintronics is nano technology which deals with spin dependent properties of on electron instead of charge dependent properties.
14.	**What are the applications ofspintronics?**BTL2 a) Solid state non-volatilememories. b) Quantum information processing and c) Quantumcomputation d) Spin basedtransistors.
	PART-B
1	**Explaintheelectrondensityinbulkmaterialandsizedependenceof Fermi energy. (8 M)**BTL2 **Answer: Page: 5.4 to 5.7 P.MANI** Electron density in bulk materials definition and equation with explanation (4 M) Fermi energy definition and size dependence of Fermi energy equation with explanation (4 M)
2	**Explain quantum confinement and quantum structures in nano materials. (OR) Discussdensityofstatesinquantumwell,quantumwireandquantumdot. (16 M)** BTL2 **Answer: Page: 5.7 to 5.11P.MANI** Definition of quantum confinement and quantum structure (4 M) Definition of quantum well and diagram with equation (4 M) Definition of quantum wire and diagram with equation(4 M) Definition of quantum dot and diagram with equation(4 M)
3	**Writenote(i)Zener–Blochoscillations(ii) Resonanttunnellingand(iii) Quantum interference effect. (5M+5M+6M)** BTL2 **(i) Answer: Page: 5.11 to 5.13P.MANI** Definition of Zener-Bloch oscillation (2 M) Derivation of Zener-Bloch oscillation equation (3 M) **(ii) Answer: Page: 51.4 to 5.16P.MANI** Definition of resonant tunnelling (2 M) Explanation of resonant tunnelling with diagram and equation (3 M) **(iii) Answer: Page: 5.29 to 5.32P.MANI** Definition of quantum interference effect (2 M) Explanation of quantum interference effect with diagram and equation (3 M) Applications of quantum interference effect (1 M)
5	**Explain mesoscopic structure of conductance fluctuations and coherent transport. (14 M)** BTL2

	Answer: Page: 5.4 to 5.7P.MANI Definition of mesoscopic structure (2 M) Explanation of de-Broglie wavelength, Mean free path, diffusion length (6 M) Conductance fluctuations and factors influencing conductance fluctuations (2 M) Definition of coherent transport (2 M) Explanation of coherent transport (2 M)
6	**Describe Coulomb blockade effect and single electron phenomena. (6M +6 M)** BTL2 **Answer: Page:** 5.17 to 5.20**P.MANI** Definition of Blockade effect (2 M) Explanation of Blockade effect with diagram and equation (4 M) Definition of single electron phenomenon (2 M) Explanation of single electron phenomenon with diagram and equation (4 M)
7	**Explain the phenomena of single electron which is used in single electron transistor. (or) Describe the construction and working of single electron transistor. Mention its advantages, disadvantages and uses. (16M)** BTL2 **Answer: Page: 5.20 to 5.24P.MANI** Principle (2 M) Construction diagram (3 M) Construction description (3 M) Working (4 M) Advantages, disadvantages and uses (4 M)
8	**What are magnetic semiconductors? List out the properties and applicationsof magnetic semiconductors. (2M + 4M +4M)** BTL2 **Answer: Page: 5.33 to 5.36P.MANI** Definition of magnetic semiconductors (2 M) Properties of magnetic semiconductors (4 M) Applications of magnetic semiconductors (4 M)
9	**Explain the concept of spintronics and its applications. (12 M) (or) Discuss on spintronics and also on spin based Field Effect Transistor (12M) (or) Write a short note on (i) GMR (6 M) (ii) Spin valve (6M)**BTL2 **Answer: Page: 5.35 to 3.38 P.MANI** Concept of spintronics (4 M) Applications of spintronics (8 M)
10	**What is CNT? Describe the types, structure, properties and applications of CNTs. (15 M)** BTL2(May 2018) **Answer: Page: 5.39 to 5.47 P. MANI** Definition of CNT (2 M) Types of CNT (2 M) Structure of CNT (2 M) Properties of CNT (5 M) Applications of CNT (5 M)

GE8291 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- ✓ To study the nature and the facts about environment.
- ✓ To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- ✓ To study the interrelationship between living organism and environment.
- ✓ To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- ✓ To study the dynamic processes and understand the features of the earth's interior and surface.
- ✓ To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT-II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- ✓ Public awareness of environmental is at infant stage.
- ✓ Ignorance and incomplete knowledge has lead to misconceptions
- ✓ Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

Subject Code: GE8291 **Year/Semester: I /02**
Subject Name: ENVIRONMENTAL SCIENCE AND ENGINEERING
Subject Handler: Dr. C. KAVITHA & Dr. N. BHUVANA

UNIT I - ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

Q. No.	PART – A
1.	**State the significance and scope of environmental education. May 2011** BTL1 • People will understand the concept of need of development without destruction of environment. • Motivate the active participants in environmental protection and improvement. • Develop a concern and respect for the environment.
2	**Give some important physical hazards and their health effects.** BTL2 • The substance (or) activities that threaten your physical safety. **E.g**. Heat, Cold, Radiation, noise. • **Health effects** – Damage of cells, Skin cancer, Damage of ear drum etc.
3	**Define environment and ecosystem. April 2011** BTL1 • **Environment**: The sum of total of all the living and non-living things around us influencing one another. • **Ecosystem**: A group of organisms interacting among themselves and with environment for exchanging energy and matter.
4	**Explain the concept of an ecosystem. (Chen AU Jun 2007, Apr 2011, Dec2013)** BTL2 A group of organism interacting among themselves and with the environment. May be natural like a pond, a lake, a river, an ocean, or a forest or may be manmade like an aquarium, cropland, garden, dam etc.
5	**What are the components of ecosystem?** BTL1 i) Abiotic or Non-living component - Physical components and Chemical components **ii)** Biotic or Living component – Autotrophs (Producers), Heterotrophs (Consumers), Saprotrophs (Decomposers-Microconsumers)
6	**Define Ecological succession. (NOV/DEC 2013)** BTL1

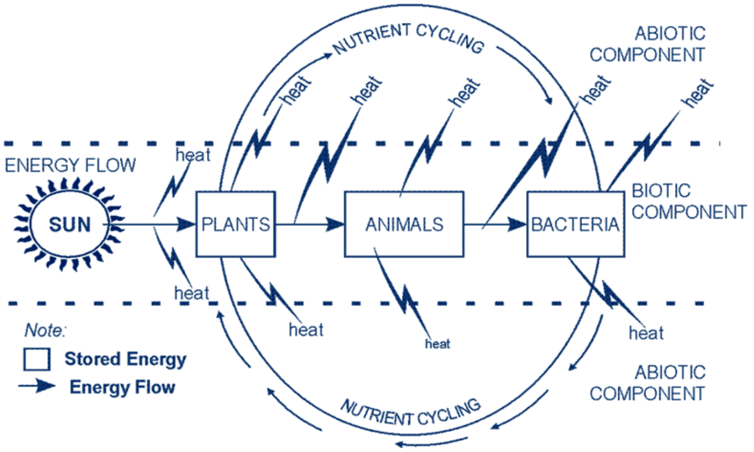
	The progressive replacement of one community by another till the development of stable community in a particular area.
7	**Name the types of consumers.** BTL4 • Herbivores (or) Primary Consumers (plant eater) • Carnivores (or) Secondary Consumers (meat eater) • Omnivores (or) Tertiary Consumers (meat + plant eater)
8	**What are Decomposers?** BTL1 Organisms which feed on dead organisms, plants and animals and decompose them into simpler compounds. Examples – Bacteria, fungi etc.
9	**What are autotrophic and heterotrophic components of an ecosystem? Give examples (Coim. A.U. Dec 2009)** BTL1 • **Autotrophic components** Self-nourishing organisms. The members of autotrophic components are producers. They derive energy from sunlight and make organic compounds from inorganic substances. Examples: Green plants, algae, bacteria, etc., • **Heterotrophic components** Components that dependent on others for food. The members of heterotrophic components are consumers and decomposers. Herbivores, carnivores (or) omnivores. • **Saprotrops:** They are decomposers - bacteria, fungi, etc.
10	**Define the terms producers and consumers. (A.U. May 2008, Dec 2011)** BTL1 • **Producers**-Synthesize their food themselves through photosynthesis. • **Consumers**-Organisms which cannot prepare their own food and depends directly or indirectly on the producers.
11	**Define primary production and secondary production. (Chen A.U. Dec 2008)** BTL1 • **Primary production** - The conversion of radiant energy into organic substances by photosynthesis by producers (Plants). • **Secondary production**- Distribution of energy in the form of food to the consumer (or) the energy stored by the consumer.
12	**What is Ecological pyramids?** BTL1 Graphical representation of structures and function of tropic levels of an ecosystem, starting with producers at the bottom and each successive tropic level forming the apex is known as ecological pyramids.
13	**Name different types of ecosystems. (Chen AU Jan 2006)** BTL1 • Natural ecosystem: 1) Terrestrial ecosystem 2) Aquatic ecosystem a. Forest ecosystems b. Grassland ecosystems c. Desert ecosystems d. Pond ecosystem. e. Lake ecosystem f. River ecosystem g. Marine ecosystem • Man-made ecosystem
14	**What are the characteristics of desert ecosystem? (Chen A.U. Dec 2008)** BTL1 • The desert air is dry and the climate is hot.

	- Annual rainfall is less that 25cm. - The soil is very poor in nutrients and organic matter. - Vegetation is poor
15	**What is meant by keystone species? (Chen A.U. Dec 2008)** BTL1 Within a habitat each species connects and depends on other species. But, while each species contribute to habitat functioning, some species do more than others in the overall scheme of things. Without the work of these key species, the habitat changes significantly. These species are called keystone species. When a keystone species disappears from its habitat, that habitat changes drastically.
16	**What are the types of grassland ecosystem? (Chen A.U. Dec 2010)** BTL1 There are three types of grassland ecosystem based on the climate condition. i) Tropical grassland ii)Temperate grassland iii) Polar grassland
17	**What are food chains? Mention their type. (Chen A.U. Dec 2010)** BTL1 **Food chain-**The sequence of eating and being eaten in an ecosystem. **Types :** i) Grazing food chain (from the living green plants goes to grazing herbivores, and on to carnivores) **ii)** Detritus food chain (Primary source of energy is dead organic matter called 'detritus' which are fallen leaves, plant parts or dead animal bodies)
18	**Define Biodiversity (or) What is biodiversity and its significance? (Chen AU Dec 2005, Jun 2006,Apr 2011,Apr 2015)** BTL1 - The variety and variability among all groups of living organisms and the ecosystem in which they occur. **Significance:** - Very important for human life, as we depend on plants, micro-organisms, earth's animals for our food, medicine and industrial products. - Also important for forestry, fisheries and agriculture, which depend on rich variety of various biological resources available in nature. - Protects the fresh air, clean water and productive land. - Loss of biodiversity has serious economic and social costs for any country
19	**Define genetic diversity, species diversity and ecosystem diversity. (TNV AU Dec 2008, Chen AU Dec 2007, May 2008, Dec2010, 2011)** BTL1 - **Genetic diversity**-Diversity of genes within a species. - **Species diversity**–Diversity among species in an ecosystem. - **Ecosystem diversity**-Diversity at the ecological or habitat level.
20	**What are biodiversity hot-spots? (Chen AU Apr 2011)** BTL1 The geographic areas which possess the high endemic species. The two important biodiversity hot spots in India- 1. Eastern Himalayas 2. Western Ghats.
21	**What are the criteria for recognizing hot spots? (Chen AU Dec 2011)** BTL1

	• The Richness of the endemic species is the primary criterion for recognizing hot spots • The hot spots should have a significant percentage of specialized species. • The site is under threat. • It should contain important gene pools of plants of potentially useful plants.
22	**India is a mega diversity nation–Account. (Chen A.U. Dec 2008, Dec 2009)** BTL4 India is one among the 12 mega diversity countries in the world. It has 89,450 animal species accounting for 7.31% of the global faunal species and 47,000 plant species which accounts for 10.8% of the world floral species. The loss of biodiversity or endemism is about 33%.
23	**Give few examples for endangered and endemic species of India. (Chen A.U. Dec 2008)** BTL3 **Endangered species** i) **Reptiles:** Tortoise, python; ii) **Mammals:** Indian wolf, Red fox, Tiger; iii) **Primates:** Hoolock gibbon, Golden monkey; iv) **Plants :** Rauvol serpentina, Santalum **Endemic Species** i) **Flora:** Sapria Himalayan, Ovaria lurida ; **ii) Fauna:** Monitor lizards, Indian salamander
24	**Define endangered and endemic species. (Chen A.U. Dec 2006, Apr 2011, Dec 2014)** BTL2 **Endangered Species**-Species which number has been reduced to a critical level. Unless protected and conserved, it becomes immediate danger of extinction. **Endemic species**-The species which found only in a particular region.
25	**Define in-situ conservation and ex-situ conservation** BTL1 **In-situ conservation** - Protection of fauna and flora within their natural habitat, where the species normally occurs is called in-situ conservation. **Ex-situ conservation** - Protection of fauna and flora outside their natural habitats
26	**Enumerate the human activities which destroy the biodiversity**. **(Chen AU Jan 2006)** BTL2 • The farmers prefer hybrid seeds; as a result many plant species become extinct. • For the production of drugs the pharmaceutical companies collect wild plants, so several medicinal plants now become extinct. • Tropical forest is the main sources of world's medicine. Every year these forests are disappearing due to agriculture, mining and logging
27	**Define food web.** BTL1 A network of food chains where different types of organisms are connected at different tropic levels.
28	**Write the food chain in forest ecosystem.** BTL4 Grasshopper→ Woodpecker →Snake → Owl
29	**Write the food chain in lake ecosystem.** BTL4 Algae → Ciliates →Small fish → Large fish
30	**What is biome?** BTL1 Set of ecosystems which are exposed to same climatic conditions and having dominant species with similar life cyclic, climatic adoptions and physical structure.

31	**What is photosynthesis? (or) How the carbohydrates are produced by plants?** BTL1 Chlorophyll present in the leaves of plants converts CO_2 and H_2O in the presence of sunlight into carbohydrates. $6CO_2 + 12H_2O \overset{hr}{\rightarrow} C_6H_{12}O_6 + 6O_2 + 6H_2O$
32	**List the different processes of ecological succession.** BTL1 i) Nudation ii) Invasion iii) Competition iii) Reaction iv) Stabilizations
33	**Define extinct, threatened and vulnerable species. (Chen A.U. Dec 2006, Apr 2011, Dec 2014)** BTL2 • **Extinct species –** The species no longer found in the world. • **Threatened Species** Becoming rare and that may become in danger of extinction if current trends continue. • **Vulnerable Species-** Species which population facing continuous decline due to habitat destruction or over exploitation.
34	**Mention the types of lakes.** BTL4 • **Oligotrophic lakes:** Have low nutrient concentrations. • **Eutrophic lakes**: Over nourished by nutrients like N and P. • **Dystrophic lakes**: Have low pH, high humic acid content and brown waters. • **Volcanic lakes**: Receive water from magma after volcanic eruptions. • **Meromictic lakes**: Rich in salts. • **Artificial lakes:** Created due to construction of dams
35	**List the different zones of oceans.** BTL4 • **Coastal zone:** Relatively warm, nutrient rich shallow water, High primary productivity. • **Open sea**: Deeper part of the ocean. Vertically divided into three regions. i) **Euphotic zone:** Receives abundant light and shows high photosynthetic activity ii) **Bathyal zone:** Receives dim light and is usually geologically active. iii) **Abyssal zone:** Dark zone and is very deep (2000 to 5000 meters)
36.	**How do the desert plants adopt to the climate? (MAY 2018)** BTL4 Most of the plants have the ability to lack of rainfall. They have widespread roots which are close to the surface. This enables the roots to absorb water quickly, before it evaporates. Plants like cactus survives because of their thick waxy layer on the outside of its stems and leaves. This helps to retain water and protect tissues severe sunlight.
37.	**Define nitrogen cycle and oxygen cycle.** BTL1 **Nitrogen cycle**-Exchange of nitrogen between the lithosphere and atmosphere in cyclic manner. **Oxygen cycle**-Exchange of O_2 between the lithosphere and atmosphere and hydrosphere in a cyclic manner. Cyclic process of Photosynthesis and respiration.
38.	**What is an indicator species? (MAY 2018)** BTL1

	An indicator species is an organism whose presence, absence or abundance reflects a specific environmental condition. Indicator species can signal a change in the biological condition of a particular ecosystem, and thus may be used as a proxy to diagnose the health of an ecosystem**.** Example: Plants or lichens sensitive to heavy metals or acids in precipitation may be indicators of air pollution**.**
PART – B	
1.	**What is environment? List its types. Explain its scope and significance of environment studies. (13M)** BTL2 **Answer: Page: 1.2–1.4-A. Ravikrishnan** **Definition-** The sum of all living and non-living things around us influence one another. (2 M) **Types-** i) Natural environment – naturally created all biotic and non-biotic components. ii) Man-made environment- Created by man. (2 M) **Scope of environmental studies** i) Awareness and sensitivity + related problems. ii) Motivate active participation. iii) Identification and solving environmental problems. iv) Awareness on conservation of natural resources. (4 M) **Significance or importance** i) Environment issues being of internal importance. ii) Problems cropped in the wake of development. iii) Explosively increase in pollution. iv) Need for an alternative solution. v) Need to save Humanity from extinction. vi) Need for Wise planning of development. (5 M)
2.	**Explain the flow of energy through the atmosphere and its utilities in an ecosystem. (8M)(AU Dec. 2008)** BTL2 **Answer: Page:** 2.10–2.11-**A. Ravikrishnan** Atmosphere → Sunlight major source of energy → Plants (Photosynthesis) Primary Consumer → Secondary consumer → Decomposer First law of thermodynamics. Plants (Photosynthesis) Second law of thermodynamics. Primary Consumer → Secondary consumer → Decomposer • Loss of energy takes place through respiration, running, hunting etc • Biotic components and abiotic components are linked together through energy flow and nutrient cycling. (5 M)



(3 M)

3. **Explain abiotic and various biotic components of an Ecosystem with neat sketch. (13M) (A.U. Dec 2007)** BTL2 **Answer: Page:**2.6–2.8**-A. Ravikrishnan**

Abiotic-Nonliving components-Physical and chemical components. (2 M)

Biotic components-Living organisms.

i) **Autotrophs-Producers (Plants)**–Self nourishing Organisms. (3 M)

ii) **Consumers (Animals) (Heterotrophs)**–Cannot make their own food. Herbivores-Carnivores-Omnivores. (3 M)

iii) **Decomposers (Micro-Organisms) (Saprotrops)-** Feed on dead organisms. (3 M)

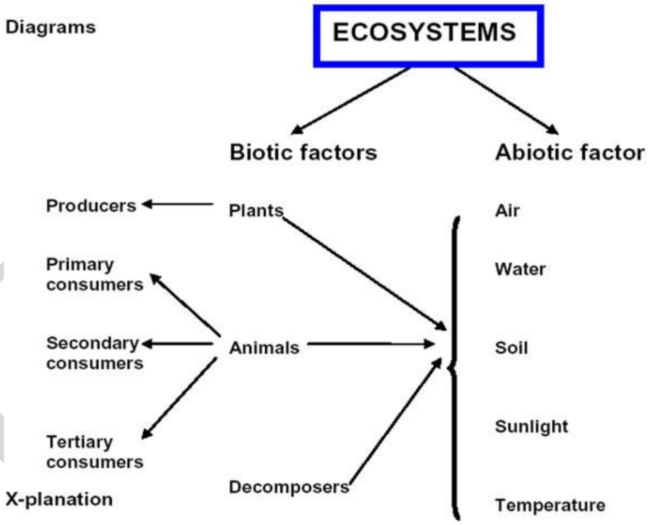
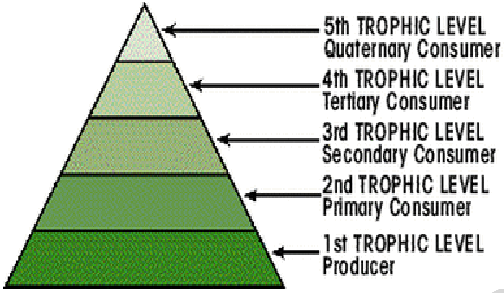


Diagram – (2M)

4. **Write down the ecological succession and ecological pyramid. (13M) (A.U. Dec 2010, Apr 2015, May 2006)** BTL1 **Answer: Page: 2.16 – 2.17-A. Ravikrishnan**

- **Ecological succession-** The progressive replacement of one community by another till the development of stable community in a particular area. (1 M)
- **Stages of ecological succession** (1 M)
- (i) Pioneer community – First group of organism established their community in the area.
- Seral or seres stage- Variuos developmental stages of a community.

- **Types of ecological succession:** (4M)
- **Primary succession**– Gradual establishment of biotic communities on a lifeless ground
- (a) Hydrarch (or) Hydrosere: Establishment starts in a watery area like pond and lake.
- (b) Xerarch or Xerosere: Establishment starts in a dry area like, desert and rock.
- **Secondary succession**: Establishment of biotic communities in an area, where some type of biotic community is already present.
- **Process of Ecological Succession:** i) Nudation ii) Invasion–migration and establishment iii) competition iv) Reaction and v) Stabilization. (4 M)
- **Ecological Pyramids-**Graphic representation of tropic structure and function of an ecosystem



(3 M)

5. **Explain the structure and function of the following. (i) Forest ecosystem (ii) Grassland ecosystem (iii) Desert ecosystem (iv) Aquatic ecosystem (13M)**
(A.U. May2011, May 2006) BTL2 **Answer: Page: 2.30 – 2.44 - A. Ravikrishnan**

(i) Structure and Function of forest ecosystem:

- **Abiotic components** - Physical components found in the soil and atmosphere. Exs: Climatic factors (temperature, light, rainfall) and minerals.
- **Biotic components-Producers**-Plants-Photosynthesis-Trees, shrubs and ground vegetation.
- **Consumers**-Primary consumers (herbivores)-Ants, flies, insects, mice, deer, squirrels.
- **Secondary consumers** (primary carnivores)- Snakes, birds, fox.
- **Tertiary consumers**-Tigre, lion, etc.
- **Decomposers**–Bacteria and fungi. (3M)

(ii) Structure and Function of Grassland Ecosystem.-

- **Abiotic**–C, H, O, N, P, S etc.–Supplied by rates, nitrates, phosphates and sulphates.
- **Biotic**–Producers–Grasses, forbs and shrubs
- **Consumers**–Cows, cows, buffaloes, deer, sheep
- **Decomposers**–Fungi and bacteria. (3M)

(iii) Structure & Function of Desert Ecosystem-

- **Abiotic**–temperature, rainfall, sunlight, water,
- **Biotic** – Producers – shrubs, bushes, grasses,
- **Consumers**–Squirrels, mice, foxes;
- **Decomposers** – fungi and bacteria. (3M)

(iv) Structure and Function of Aquatic Ecosystem-Pond–Temporary-Fresh water body.

- **Abiotic**– Temperature, light, water, organic and inorganic compounds.

	• **Biotic**–Producers–green photosynthetic organisms, • **Consumers**–Protozoa, small fish, ciliates, flagellates • **Decomposers**–Fungi, bacteria and flagellates. (2M) **Structure and Function of Aquatic Ecosystem-Lakes**–Natural shallow water bodies • **Abiotic**–Temperature, light, proteins and lipids, turbidity, oxygen and carbon dioxide. • **Biotic–Producers**–Phytoplanktons, algae, flagellates, • **Consumers**–Protozoans, insects, small fishes, large fish; • **Decomposers**–Bacteria, fungi and actinomycetes. (2M)
6.	**Classify and explain the values of biodiversity. (13M) (A.U. Dec 2010, May 11)** BTL2 **Answer: Page: 3.5 – 3.9-A. Ravikrishnan** **Classify values biodiversity** – Consumptive use values; Productive use values; Social values; Ethical values; Optional values. (1M) **Consumptive use values**–Direct use values; products are harvested and consumed directly. Food, Drugs, Fuel. (2 M) **Productive use values**–Products derived from the animals and plants-commercial value. (2M) **Social values**–Bio-resources used to the society. Associated with the social life, religion and spiritual aspects of the people. (2M) **Ethical values**–"All life must be preserved". In India biodiversity have great value on religious and cultural basis. (2M) **Optional values**–Any species may be proved to be a valuable species after someday. (2M) **Aesthetic values-** Beautiful nature of plants and animals insist us to protect the biodiversity. "Eco-tourism" (2M)
7.	**Explain the role of biodiversity at global, national and local levels. (13M)** **(A.U. May 07, Apr 10, May 11)** BTL2 **Answer: Page: 3.9 – 3.14-A. Ravikrishnan** **Role of Global biodiversity**- Total number of living species in the world are about 20 million. But, of which only about 1.5 million species are found and given scientific names. Tropical deforestation alone is reducing the biodiversity by 0.5% every year. **Terrestrial biodiversity or biomass** i) Largest ecological units present in different geographic areas named in different ways ii) Tropical rain forests –About 50 to 75% of global biodiversity lies in these tropical rain forest. iii) More than 25% of the world's prescription drugs are extracted from plants in tropical rain forest iv) Nearly 1,30,000 flowering plants are found available v) Temperate rain forests - Have much less biodiversity. 1,70,000 flowering plants, 30, 000 vertebrates, 2,50,000 other group of species are found. (3 M) **Marine diversity** i) Much higher than terrestrial biodiversity ii) Estuaries coastal waters and oceans are biologically diverse but the diversity is very low iii) Out of 35 existing phyla of multicellular animals, 34 are marine

	iv) List of few living species (2 M) **National level biodiversity**: i) India is second largest nation containing 5% of world's biodiversity and 2% of the earth surface. The second largest nation containing 50% of world's biodiversity and 2% of earth surface. ii) 10th rank among the plant rich countries of the world. iii) 11th rank among the endemic species of higher vertebrates. iv) 6th rank among the centers of diversity and origin of agricultural crops. v) An agricultural country and its economic growth depend on the production of many crops. vi) India "mega - diversity" nation because it is rich in both fauna and flora. vii) Many species in India has Medicinal value and Commercial value (5M) **Biodiversity at local level** -1. Point richness 2. Alpha richness 3. Beta richness 4. Gamma richness. (3M)
8.	**(i) Give the various hot spots of biodiversity.(ii) Explain the various threats to biodiversity along with the means to conserve them. (13M) (May 2008, MAY/JUNE 2013)** BTL4 **Answer: Page: 3.18 – 3.25-A. Ravikrishnan** (i) **Biodiversity hotspot-**The geographic areas which possess high endemic species. Eastern Himalayas, Western Ghats. (2M) **(ii)Threats to biodiversity** • **Habitat loss-**The loss of populations of interbreeding organisms. Threatened a wide range of animals and plants. Factors influencing habitat loss and any two remedies. (3M) • **Poaching-**Killing of animals (or) commercial hunting. Leads to loss of animal biodiversity. Factors influencing poaching loss and any two remedies to overcome. (3M) • **Man-Wild life conflict-** Arise when wildlife starts causing immense damage and danger to the man. Factor influencing man-wild life conflict and two conserve methods. (3M) • **Over exploitation of natural resources** i) Serious threat to the wildlife. ii) Disturbance in migratory routes of animals. iii) Cause of destruction of many species. (2M)
9.	**Explain in-situ and ex-situ conservation along with their merits and limitations. (A.U. May 2008, Dec 2010, May 11, Dec 11) (13M)** BTL2 **Answer: Page: 3.34 – 3.40-A. Ravikrishnan** **Conservation of Biodiversity:** management of biosphere so that it will yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs of future generation. (1M) **In-Situ Conservation (within habitat)** - Protection of wild flora and fauna within their habitat nature. (1 M) Biosphere reserves, National Parks, Sanctuaries, Reserve forests etc. (Each 1 M = 4M) **Advantages:** Cheap and convenient method. Species gets adjusted the natural disasters like drought, floods, forest fires. (1 M)

Limitations: Large surface area of the earth required – shortage of staff and pollution may lead to improper maintenance of the habitat. (1 M)

Ex-Situ Conservation (outside habitat) – Protection of flora and fauna outside their habitat nature. (1 M)

Gene banks, seed banks, zoos, botanical gardens, culture collections. (2 M)

Advantages: Special care and attention lead, Assured food, water, shelter and security, Longer life span. (1 M)

Limitations: Expensive method- Loss of freedom of wild life – Animals cannot survive in such environments. (1 M)

10. **Write a note on endangered and endemic species of India. (13M) (A.U. Dec 2009)** BTL2

Answer: Page: 3.28 – 3.33-A. Ravikrishnan

Endangered Species – Species number has been reduced to a critical level. Unless it is protected and conserved, it is in immediate danger of extinction.

i) In India 450 plant species identified as endangered species.
ii) About 100 mammals and 150 birds are endangered species.
iii) India biodiversity threatened due to habitat destruction, degradation and over exploitation.
iv) No. of endangered species in India

Group of Threatened species	Number of Threatened species
Plants	250
Birds	70
Mammals	86
Reptiles	25
Amphibians	3
Fishes	3
Molluscs	2

(6M)

Factors affecting endangered species

- Pollution
- Over exploitation
- Climate change

Remedial measures

- International Treaties on Endangered Species (ITES) (1M)

Endemic Species-Species found only in a particular region

i) In India, Out of 47,000 species 7,000 plants are endemic.
ii) About 62% endemic flora found in Himalayas, Khasi Hills and Western Ghats.
iii) **Fauna-**Animals present in particular region or period. E.g. Sapriya Himalayan, Ovaria lurida, Nepenthes Khasiana, Pedicularis parroter, Pitcher plants and Orchids etc.
iv) Out of 81,000 animal species–Large number of species are described to be endemic
v) 62% amphibians, 50% Lizards are endemic to Western Ghats
vi) No. of endemic species in India
vii)

Group	No. of Species
Land	878
Freshwater	89
Insecta	16214
Amphibia	110
Reptilia	214
Aves	69
Nannakua	38

viii) **Flora**–Plants present in a particular region or period. Friendly bacteria which helps to protect the human body against invasion by pathogens. E.g. Monitor lizards, reticulated python, Indian Salamander, Viviparous toad

Group	No. of Species
Pteridophyta	200
Angiosperms	4950

(5M)

Factor affecting endemic species

- Habitat loss and fragmentation
- Pollution (1M)

11. **What are the major causes of Man- wild life conflict? Discuss the remedial steps that can curb the conflict. (13M) (A.U. Dec 2011, Apr 2015)** BTL4

Answer: Page: 3.26–3.28-A. Ravikrishnan

Man-Wildlife Conflicts-Causes:

i) Shrinking of forest
ii) Human encroachment into forest areas
iii) Animals suffering from illness, weak and injured take humans
iv) Lack of alternate cultivation practices by forest department
v) Electric fencing causes injury to animals, which in return turn violent
vi) Poor cash compensation by govt. to farmers
vii) Food crops near forest areas attract wild animals. (10 M)

Remedies to curb the conflict

i) Adequate crop and cattle compensation schemes must be started.
ii) Solar powered fencing must be provided along with electric current proof trenches.
iii) Cropping pattern should be changed near the forest borders.
iv) Adequate food and water should be made available within the forest areas.
v) The development and constructional work near the forest area must be avoided. (3 M)

PART – C

1. **(i) Elaborate about the different biological zones of India. (5M)** BTL6

(ii) Discuss a case study on (a) Man and wild life conflicts (b) Productive use of biodiversity. (10M) BTL6

Answer: Page: 3.4 – 3.5, 3.26–3.28, 3.8-3.9 A. Ravikrishnan

(i) Biogeographically Classification of India: (5 M)

i) Division of India according to biogeographic characteristics. The study of the distribution of species, organisms, and ecosystems in geographic space and through geological time. The biogeographic zones of India are as follows:
ii) Himalayan zone; Desert zone; Semiarid zone; Western Ghats zone; Deccan plateau zone; Gangetic plain zone; North east zone; Coastal zone; Islands present near the shore line; Trans Himalayan zone.

(ii) Case study on Man-Wildlife Conflicts:

i) Wildlife causing damage and danger to humans and properties – crops/houses
ii) In Samalpur (Orissa) 195 humans were killed in the last 5 years by elephants.
iii) Humans responded by killing 98 elephants and injuring 30 elephants.
iv) In Nepal, 17 peoples were killed in the Royal Chitwan National Park by a man-eating tiger.
v) Electrical fencing, explosives were some of the methods adopted by villages to kill wild animals.

Causes:

i) Shrinking of forest
ii) Human encroachment into forest areas
iii) Animals suffering from illness, weak and injured take humans
iv) Lack of alternate cultivation practices by forest department.
v) Electric fencing causes injury to animals, which in return turn violent
vi) Poor cash compensation by govt. to farmers
vii) Garbage near human settlements or food crops near forest areas. (7 M)

Productive use of biodiversity

Products derived from the animals and plants have obtained a commercial value.

Plant product	Industry
Wood	Paper and pulp industry, plywood industry Railway sleeper industry.
Cotton	Textile industry
Fruits, vegetables	Food industry
Leather	Leather industry
Ivory	Ivory – works
Pearl	Pearls industry

(3M)

2. **Inspect about the characteristic features of a pond, river and marine ecosystem and also quote a typical food chain based on that respective ecosystem. (15M)** BTL4

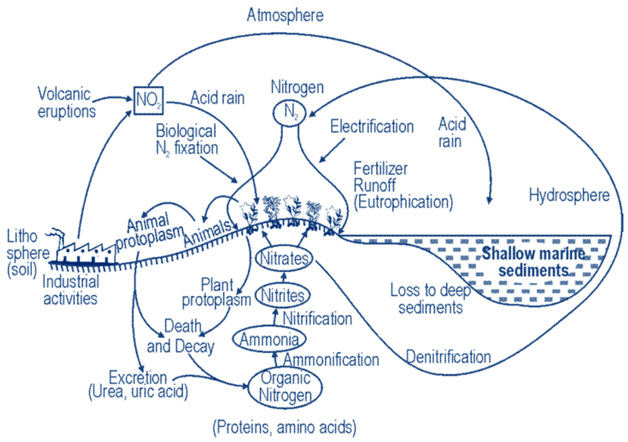
Answer: Page: 2.27 – 2.29, 2.33 – 2.36-A. Ravikrishnan

Pond Ecosystem

i) Small bodies of freshwater with shallow and still water, marsh, and aquatic plants.
i) Temporary, only seasonal.
ii) Stagnant fresh water body.
iii) Get polluted easily due to limited amount of water
iv) The size and depth of ponds often varies greatly
v) Diverse array of aquatic life
vi) Top predators may include large fish, herons, or alligators. (3 M)

	Food Chain–Producers- Green plants, phytoplanktons like hydrilla, vallisneria, pistia, sagittaria →**Primary consumers**- Zooplanktons like insects, dragon fly larvae, crustaceans, Larvae of insects, beetles, fishes, molluscs → **Secondary consumers**- Insects like water beetles, frogs, fishes → **Tertiary Consumers-**Big fishes, kingfisher, water birds → **Decomposers**–Fungi, bacteria. (2M) **River Ecosystem:** i) River viewed as a system operating in its natural environment includes biotic as well as abiotic. i) Fresh water and free flowing water systems. ii) Due to mixing of water, dissolved oxygen content is more. iii) River deposits large amount of nutrients iv) Unidirectional flow. v) State of continuous physical change. High degree of spatial and temporal heterogeneity at all scales. (3M) **Food Chain**–**Producers**-Phytoplankton, algae, water grasses, aquatic masses, amphibious plants →**Primary consumers**-Water insects, snails, fishes → **Secondary consumers**-Birds and mammals → **Decomposers**–Fungi, bacteria. (2M) **Ocean Ecosystem:** i) Largest of Earth's aquatic ecosystems. ii) Include oceans, salt marsh and intertidal ecology estuaries and lagoons, mangroves and coral reefs, the deep sea and the sea floor. iii) Since ship, submarines can sail in ocean, commercial activities may be carried out. iv) Rich in biodiversity. v) Moderates the temperature of the earth vi) Contrasted with freshwater ecosystems. vii) Very important for the overall health of both marine and terrestrial environments. (3M) **Food Chain**–**Producers**-Phytoplanktons, marine plants → **Consumers-Primary consumers**-Crustaceans, moiluscs, fish → **Secondary consumers**-Herring sahd, mackerel→**Tertiary Consumers**-Cod, Haddock → Decomposers–Fungi, bacteria and flagellates. (2M)
3.	**What is forest ecosystem? List the types of forest ecosystem. Explain the features, characteristics, structure and function forest ecosystem. (15M)** BTL1 **Answer: Page: 2.17–2.21-A. Ravikrishnan** **Definition -** Contains tall and dense trees grow that support many animals and birds. (2M) **Types of Forest ecosystem** i) Tropical rain forests. ii) Tropical deciduous forests. iii) Tropical scrub forests. iv) Temperate rain forests. v) Temperate deciduous forests. (2M) **Features of Forest ecosystems** i) **Tropical rain forests:** Found near the equator. High temperature. Broad leaf trees and lion, tiger and monkey are present.

	ii) **Tropical deciduous forests:** Found little away from the equator. Warm climate and rain only during monsoon. Have deciduous trees and deer, fox, rabbit and rat. iii) **Tropical scrub forests:** Dry climate for longer time. Have small deciduous trees and shrubs and deer, fox, etc., iv) **Temperate rain forests:** Found in temperate areas with adequate rainfall. Coniferous trees and squirrels, fox, cats, bear etc., v) **Temperate deciduous forests:** Found in areas with moderate temperatures. Broad leaf deciduous trees and deer, fox, bear, etc (4M) **Characteristics of forest ecosystem:** i) Warm temperature and adequate rainfall →Generation of number of ponds, lakes etc., ii) Maintains climate and rainfall. iii) Supports many wild animals and protects biodiversity. iv) The soil is rich in organic matter and nutrients, which support the growth of trees. v) The conversion of organic matter into nutrients is very fast. (2M) **Structure and Function of forest ecosystem:** i) **Abiotic components** - Physical components found in the soil and atmosphere. E.g. Climatic factors and minerals. ii) **Biotic components-Producers**-The plants absorb sunlight and produce food through photosynthesis–E.g. Trees, shrubs and ground vegetation. iii) **Consumers**-Herbivores-E.g. Ants, flies, insects, mice, deer, squirrels. Secondary consumers -primary carnivores-E.g. Snakes, birds, fox. Tertiary consumers- Tiger, lion, etc. iv) **Decomposers**–E.g. Bacteria and fungi. (5M)
4.	**(i) Survey the following topics with a neat diagram. (a) Nitrogen cycle b) Oxygen cycle c) Energy flow in the ecosystem. (12M)** BTL4 **(ii) Analyze in detail about hydrosere and xerosere (3M)** BTL4 **Answer: Page: 2.13 - 2.15 and 2.9 – 2.11 and 2.16-A. Ravikrishnan** **(i)(a) Nitrogen cycle**-Exchange of nitrogen between the lithosphere and atmosphere in cyclic manner. Atmosphere nitrogen → Plants (protein, vitamin, amino acids) → Consumer → Decomposer Nitrates→ammonia by anaerobic bacteria → nitrites by Nitrosomonas → nitrates by Nitrobacter -→ Rhizobium fixing N_2 in the roots. (3M)

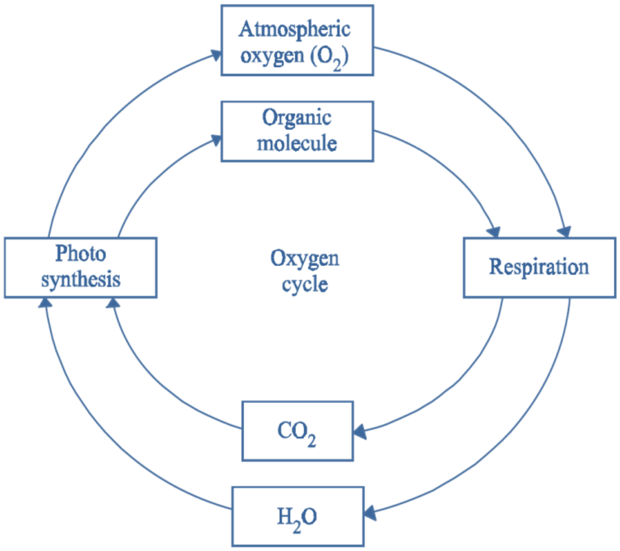


(2 M)

(i)(b) Oxygen cycle – Exchange of O_2 between the lithosphere and atmosphere and hydrosphere in a cyclic manner. Cyclic process of Photosynthesis and respiration. (4M)

$$6CO_2 + 6H_2O + Energy \rightarrow C_6H_{12}O_6 + 6O_2\ (Photosynthesis)$$

$$6O_2 + C_6H_{12}O_6 \rightarrow 6O_2 + 6H_2O + Energy\ \ (Respiration)$$



(1 M)

(i)(c)Energy Flow In The Ecosystem

Sunlight → Plants (photosynthesis) → Primary Consumer → Secondary consumer → decomposer

- Loss of energy takes place through respiration, running, hunting etc
- Biotic components and abiotic components are linked together through energy flow and nutrient cycling. (2 M)

(ii) **Hydrosere**–Establishment starting in a watery area; **Xerarch**–Establishment starting in a dry area like, desert and rock. (3 M)

<table>
<tr><th colspan="2">UNIT – II ENVIRONMENTAL POLLUTION</th></tr>
<tr><td colspan="2">Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.</td></tr>
<tr><td>Q. No.</td><td>PART * A</td></tr>
<tr><td>1.</td><td>Define the term pollution. List its types. BTL1
Pollution-The unfavorable alteration of our surroundings
Types of Pollution-
Air Pollution
Water Pollution
Soil Pollution
Marine Pollution
Noise Pollution
Thermal Pollution and
Nuclear hazards</td></tr>
<tr><td>2.</td><td>What is air pollution? BTL1
The presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings, plants and animals.</td></tr>
<tr><td>3.</td><td>Define bio-degradable pollutant and non-biodegradable pollutant. BTL1
Bio-degradable pollutant - Decompose rapidly by natural processes
Non-biodegradable pollutant - Do not decompose or decompose slowly in the environment</td></tr>
<tr><td>4.</td><td>State the composition of atmospheric air. BTL1<table><tr><td>Constituents</td><td>%</td></tr><tr><td>Nitrogen</td><td>78</td></tr><tr><td>Oxygen</td><td>21</td></tr></table></td></tr>
</table>

Argon (Ar)	< 1
CO_2	0.037
Water vapour	Remaining
O_2, He, NH_3	Trace amount

5. **State the Indian ambient air quality standards.** BTL1

Category	Area	Concentration in µg/m3			
		SPM	SO_2	NO_X	CO
A	Industrial and mixed use	500	120	120	5,000
B	Residential and rural	200	80	80	2,000
C	Sensitive (hill stations, tourist resorts, monuments	100	30	30	1,000

6. **Outline the causes of air pollution?** BTL2

- Incomplete burning of fossil fuels, liberate CO, NO_2, Suspended Particulate Matter (SPM) etc.
- Coal burning in power plants, liberate SO_2
- Ozone
- Agriculture, decay of plants, liberate hydrocarbons.

7. **Define photochemical smog. (NOV/DEC 2006)** BTL2

It is not related to smoke (or) fog. It is formed by the combination of NO, NO_2, CO_2, H_2O, CO, SO_2 and unburnt hydrocarbon particles. The important reaction is dissociation of NO_2 in sunlight. It is also named as los Angeles smog.

8. **What are the effects of various air pollutants on human health?** BTL1

Name of the Pollutant	Name of the Diseases
NO_2	Lung irritation and damage
CO	Reacts with hemoglobin in red blood cells and reduces the ability of blood to bring oxygen to body cells and tissues, which causes headaches and anemia. At high levels it causes coma, irreversible brain cell damage and death.
SO_2	Breathing problems for healthy people.
SPM	Nose and throat irritation, lung damage, bronchitis, asthma, reproductive problems and cancer
Hydrocarbon	Carcinogenic

9. **What are oxygen demanding wastes? (APR/MAY 2011)** BTL1

Oxygen demanding wastes is the one to reduce amount of oxygen water in water is known as oxygen demanding wastes. The oxygen demanding wastes are BOD and COD

BOD is the amount of oxygen required for the biological decomposition of organic matter present in the water.

COD is the amount of oxygen required for chemical oxidation of organic matter using some oxidizing agent like $K_2Cr_2O_7$ and $KMnO_4$

10. **What Is PAN? Give Its Detrimental Effects.** BTL1

PAN

- Peroxy Acetyl Nitrates - Secondary Pollutant Present In Photochemical Smog.
- It is a lachrymatory substance.
- It is thermally unstable and decomposes into peroxy ethanol radicals and nitrogen dioxide gas.
- It is an oxidant and more stable than ozone

Detrimental Effects

- It is a powerful respiratory and eye irritants, toxic in nature.
- Cause extensive damage to vegetation, causing skin cancer
- Damages plants and art.
- React explosively.
- Plays a very large role in photochemical smog

11. **How CFC's are accumulated in atmosphere. (MAY/JUNE 2006)** BTL1

CFC's are accumulated in atmosphere through

- Propellant in Aerosol spray cans
- Cleaning solvents
- Refrigerants (Freon) in refrigerators, air conditioners
- Foam plastic blowing agent
- Blowing agent

12. **Define primary air pollutant and secondary air pollutant.** BTL1

Primary air pollutants - Those emitted directly in the atmosphere in harmful form. E.g. CO, NO, SO_2,

Secondary air pollutant – New pollutants formed by the reaction of some of the primary air pollutants with one another or with the basic components of air.

E.g. $NO / NO_2 \rightarrow HNO_3 / NO_3$

13. **State the composition of soil.** BTL1

Components	%
Mineral matter (inorganic)	45
Organic matter	5
Soil water	25
Soil air	25

14. **State the water quality standards.** BTL1

S. No.	Parameter	WHO standard in mgs/litre	ISI standard in mgs/litre.
1.	Colour, odour and taste	Colourless, odourless and tasteless	Colourless, odourless and tasteless
2.	p^H	6.9	6.9
3.	Total dissolved solids	1500	-
4.	Dissolved oxygen	-	3.0
5.	Chloride	250	600
6.	Sulphate	400	1000

7.	Nitrate	45	-
8.	Cyanide	0.2	0.01
9.	Fluoride	1.5	3.0
10.	Chromium	0.05	0.05
11.	Lead	0.05	0.1
12.	Arsenic	0.05	0.2

15.	**List the self-cleaning processes of atmosphere.** BTL4 • Dispersion • Gravitational settling • Flocculation • Absorption • Rain washout and so on
16.	**What are point and non-point sources of water pollution?** BTL1 Point sources are discharged pollutants at specific location through pipes, ditches or sewers into bodies of surface water. Non-point sources: They cannot be traced at any single site of discharge. They are usually large land areas or air sheds that pollute water by runoff, subsurface flow or deposition from the atmosphere.
17.	**Write any four major water pollutants. (MAY/JUNE 2006)** BTL1 • Infectious agents • Oxygen demanding wastes • Inorganic chemicals • Organic chemicals • Plant nutrients • Sediments • Radioactive materials • Heat (any four)
18.	**What is marine pollution? Name the sources and effects of marine pollution. (MAY/JUNE 2005, NOV/DEC 2014)** BTL1 The discharge of waste substances into the sea resulting in harm to living resources, hazards to human health, hindrance to fishery and impairment of quality for use of sea water. • Dumping the wastes - Marine birds ingest plastic which causes gastrointestinal disorders • Oil - Damage to marine fauna and flora, retard the rate of O_2 uptake by water.
19.	**Define noise pollution. When a sound does cause noise pollution? (NOV/DEC 2013, APR/MAY 2015)** BTL1 • Noise pollution is defined as the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings. • The sound intensity is measured in decibel (dB), which is tenth part of the longest unit Bel. One dB is equal to the faintest sound, a human ear can hear. If the intensity of the sound exceeds 80 dB, noise pollution occurs. Noise above 140 dB becomes painful.
20.	**Give any four methods to control noise pollution. (MAY/JUNE 2007)** BTL1 • Source Control • Transmission Path Intervention

	• Receptor control • Oiling
21.	**Define thermal pollution. (NOV/DEC 2005, NOV/DEC 2008)** BTL1 The addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life or otherwise causes significant departures from the normal activities of aquatic communities in water.
22.	**What are the causes of thermal pollutions?** BTL 1 • Nuclear power plants • Coal-fired power plants • Industrial effluents • Domestic sewage • Hydro-electric power
23.	**Define hazardous wastes. Why nuclear hazards are so dangerous? (NOV/DEC 2006)** BTL1 • Wastes like toxic chemicals, radioactive or biological substances which contribute to an increase in mortality or in serious irreversible illness to human health and environment are called hazardous wastes. • Radioactive radiation, liberated by nuclear hazards, affects the cells in the body and the function of glands and organs. People suffer from blood cancer and bone cancer if exposed to doses around 100 to 1000 roentgens. Unlike the other pollution, radioactive pollution can cause genetic disorders even in the subsequent generations.
24.	**What are the various sources of radioactive pollution? (NOV/DEC 2008, APR/MAY 2015)** BTL1 • Natural sources. The very important natural source is space, which emit cosmic rays. Soil, rocks, air, water, food, radioactive radon-222 etc. also contain one or more radioactive substances. • Man-made sources Man-made sources are nuclear power plants, X-rays, nuclear accidents, nuclear bombs, diagnostic kits, etc., where radioactive substances are used.
25.	**List any four causes of floods. (NOV/DEC 2010)** BTL4 • Heavy rain, rainfall during cyclone causes flood. • Sudden snow melt also raises the quantity of water in streams and causes flood. • Clearing of forests for agriculture has also increased severity of floods. • Reduction in the carrying capacity of the channel, due to accumulation of Sediments cause floods
26.	**What are the types of solid wastes? (NOV/DEC 2006, MAY/JUNE 2007)** BTL2 a. Municipal wastes ; b. Industrial wastes ; c. Hazardous wastes
27.	**Mention the sources of solid wastes. (NOV/DEC 2009)** BTL1 • Domestic wastes – cloth, waste papers • Commercial wastes – cans, bottle, polythene bags • Construction wastes – Wood, Concrete • Biomedical wastes – Infectious wastes

	• Industrial wastes – Nuclear and thermal power plants • Hazardous wastes – Toxic wastes, chronic toxicity
28.	**Differentiate between recycling and reuse. (NOV/DEC 2007, APR/MAY 2011)** BTL4 • Reuse The refillable containers, which discarded after use can be reused. Rubber rings can be made from the discarded cycle tubes which reduces the waste generation during manufacturing of rubber bands. • Recycling Recycling is the reprocessing of the discarded materials into new useful products Example • Old aluminum cans and glass bottles are melted and recast into new cans and bottles • Preparation of cellulose insulation from paper.
29.	**What are the roles of women in environmental pollution? (NOV/DEC 2008)** BTL1 In rural areas women plant trees and grass, grow vegetables with the drip-irrigation method on order to save water. b. In urban areas they go shopping using cloth bags to reduce white pollution.
30.	**What are the effects of thermal pollution? (APR/MAY 2011)** BTL1 • Reduction in dissolved oxygen • Increase in toxicity • Interference with biological activity • Interference with reproduction • Direct mortality • Food storage for fish
31.	**What do you meant by soil pollution? Or Define soil pollution. (NOV/DEC 2010) Write the causes of soil pollution.** BTL1 The pollution affects and alter the chemical and biological properties of soil. As a result, hazardous chemical can enter into human food chain from the soil or water disturbs the biochemical process and finally lead to serious effects on living organism.
32.	**What are causes of noise pollution? (NOV/DEC 2010)** BTL1 • By machine like mechanical saws and pneumatic drill. • From transport, rail, air craft, road vehicles like scooters, cars, motorcycles, buses. • Common noise makers are musical instruments, TV, VCR, radios, transistors, • Telephone and loudspeakers.
33.	**What is a Dobson unit? (MAY/JUNE 2007)** BTL1 The amount of atmospheric ozone is measured by “Dobson spectrometer” and is expressed in Dobson units (DU). 1 DU is equivalent to a 0.01 mm thickness of pure ozone at the density it possesses if it is brought to the ground level (1atm) pressure • In temperate latitude its concentration is 350 DU • In tropics its concentration is 250 DU • In sub polar region its concentration is 450 DU
34.	**What are the harmful effects of landslides?** BTL1 • Landslides block the roads and diverts the passage • Erosion of soil increases. • Sudden landslides damage the houses, crop yield, live stock etc.

35.	**What do you know about particulate? (MAY/JUNE 2018)** BTL1 Particulate refers to all atmospheric substances that are not gases. They can be suspended droplets or solid particles or mixtures of the two. Particulates can be composed of materials ranging in size from 100mm to 0.1mm and less. The chemical composition of particulate pollutants is very much dependent upon the origin of the particulate.
36.	**What are landslides? (MAY/JUNE 2018)** BTL1 The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region due to gravitational pull is called landslides.
37.	**Define the term Tsunami.** BTL2 A tsunami is a large wave that is generated in a water body when the sea floor is deformed by seismic activity. This activity displaces the overlying water in the ocean.
PART * B	
1	**Discuss the causes, effects and control of marine pollution. (7 M) (NOV/DEC 2009, APR/MAY 2010, NOV/DEC 2011)** BTL6 **Answer : Page: 4.32 - 4.34- A. Ravikrishnan** • Definition- The discharge of waste substances into the sea resulting in harm to living organisms, hazards to human health, hindrance to fishery and impairment of quality for use of sea water. (1 M) • Sources (Causes) of marine pollution Dumping the wastes-large amount of sewage, garbage, agricultural discharge, pesticides and huge amount of plastics. (1 M) Oil pollution of marine water-Imposed by petroleum and its products. (1 M) • Effects of marine pollution on human health and environment – Oil spilling in sea inhibit the photosynthesis-damage to marine fauna and flora including algae, fish, birds, invertebrates-hydrocarbons and benzpyrene accumulate in food chain and consumption of fish by man cause cancer. (2 M) • Control measures – Plans for conserving marine biodiversity-education about marine ecosystems-industrial units on the coastal lines equipped with pollution control instruments-urban growth should be regulated-fisherman needs should be accommodated. (2 M)
2	**What is an earthquake? Write about its causes, effects and measures to face the earthquake. (8 M) (APR/MAY 2008, NOV/DEC 2008, NOV/DEC 13, NOV/DEC 2014)** BTL4 **Answer : Refer : 4.78 – 4.80 - A. Ravikrishnan** • Definition: An earthquake is a sudden vibration caused on the earth's surface due to the sudden release of tremendous amount of energy stored in the rocks under the earth's crust. (2 M) • Causes- disequilibrium in any part of the earth crust-volcanic eruption, hydrostatic pressure and manmade activities-underground nuclear testing-decrease of groundwater level. (2M) • Effects- hilly and mountains cause landslides-collapses houses due to poor construction, peoples die increases depending on the severity-seismic waves caused by earth quakes under the sea. (2 M)

	• Preventive measures-constructing earthquake resistant buildings, wooden houses are preferred – information about magnitude of intensity should give by seismic hazard map by Seismologist. (2 M)
3	**Describe the sources, effects and various measures to control of noise pollution. (7 M) (NOV/DEC 2009, MAY/JUNE 11, NOV/DEC 2014)** BTL4 **Answer : Page: 4.37 to 4.40 - A. Ravikrishnan** • **Definition** – The unwanted , unpleasant or disagreeable sound that causes discomfort for all the living beings (1 M) • **Types and sources** Industrial noise-by machines, particularly mechanical saws and pneumatic drill is unbearable and is a nuisance to public. (1 M) Transport noise-road traffic noise, rail traffic noise and craft noise. (1M) Neighborhood noise-household gadgets and community like musical instruments, transistors, telephones, TV, VCR, radios, etc. (1M) • **Effects** (2M) Interferes communication Hearing damage (90 dB) Physiological and Psychological disorders • **Control and preventive measures** (1M) Reduction in source of noise Noise making machines should be kept in containers with sound absorbing media Proper oiling will reduce noise from machinery Using silencers – fibrous material Planting trees Legislation can prevent excess sound production, unnecessary horn blowing etc.
4	**What are types, sources and the effects of improper municipal solid waste management? State the measures recommended for proper management for the solid wastes. (7M + 6M) (MAY/JUNE 2005, APR/MAY 2010, NOV/DEC 2010, MAY/JUNE 2011, NOV/DEC 2011, NOV/DEC 2013, APR/MAY 2015)** BTL1 **Answer : Page: 4.61 to 4.70 - A. Ravikrishnan** • Effects of solid wastes (2 M) • Types Urban or municipal wastes Industrial wastes Hazardous wastes (1 M) • Sources Urban or municipal wastes Domestic wastes Commercial wastes Construction wastes Biomedical wastes (1 M) Industrial wastes Nuclear power plants Chemical industries

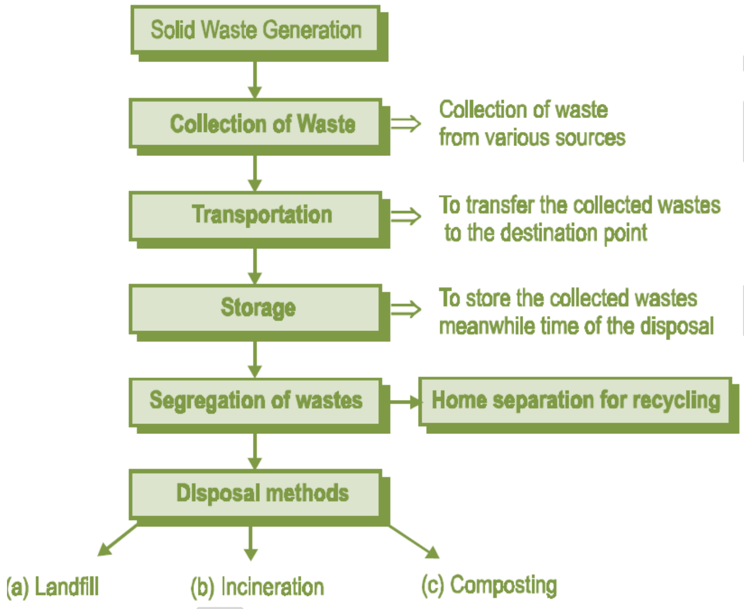
Other industries (1 M)

Hazardous wastes

Toxic wastes
Reactive wastes
Corrosive wastes
Radioactive wastes
Infectious wastes
Heavy metals (2 M)

- Process of solid waste management

Flow chart



(2 M)

Reduce the usage of raw materials
Reuse of waste materials
Recycling of material (1 M)

- Discarding wastes

Landfill – Advantages - Disadvantages (1 M)
Incineration - Advantages - Disadvantages (1 M)
Composting - Advantages - Disadvantages (1 M)

5 **Mention any five air pollutants with their source, effects and control measures. (7 M) (NOV/DEC 2005, APR/MAY 2006, NOV/DEC2005, MAY/JUNE 2013)** BTL1

Answer : Page: 4.4 to 4.11 - A. Ravikrishnan

- Any five air pollutants (1 M)
- Sources, health effects, environmental effects and control measures

Carbon monoxide (CO) (1 M)
Nitrogen dioxide (NO_2) (1 M)
Sulphur dioxide (SO_2) (1 M)

	Suspended Particulate Matter (SPM) (1 M) Ozone (1 M) Hydrocarbons (Aromatic and aliphatic) (1 M) Any five (5 M) • Control measures (1 M)
6	**How can you, as an individual, prevent environmental pollution? Why such an effort at an individual level is important. (6 M) (NOV/DEC 2009, NOV/DEC 2010,MAY/JUNE 2014, NOV/DEC 2014, APR/MAY 2015)** BTL4 **Answer : Page: 4.61 to 4.62 - A. Ravikrishnan** **Role and responsibility of individual participation:** Use stairs instead of elevators Use public transportation walk or ride a bicycle Plant trees around building Turn off lights, television sets and computer when not in use. Pay immediate attention to leaks in pipes. Install waste saving equipments. Recycle glass metal and paper. Compost garden waste Segregate waste and recycle Buy locally made long losing material Buy environmentally degradable products. Take some bag from home to market to purchase.
7	**Explain the causes, effects and control measure of water pollution. (13 M) (MAY/JUNE 2013) (NOV/DEC 2013)** BTL42 **Answer : Page: 4.12 to 4.24 A. Ravikrishnan** • **Definition** – The alteration and physical, chemical and biological characteristics of water which may cause harmful effects on humans and aquatic life (1 M) • **Causes:** (4M) Infectious agents Oxygen demanding wastes Inorganic chemicals Organic chemicals Plant nutrients Sediments Radioactive materials Heat Point and non-point sources **Effects of water pollution** (4M) 1. Objectionable colour and odour is unacceptable and unsuitable for drinking and other purposes. 2. highly turbid and very hard water is unpleasant to drink, food processing 3. acid and alkaline water cause serious health problem

	4. water borne infectious enteric disease like typhoid, cholera, dysentery, are the predominant health hazard arising from drinking contaminated water 5. radioactive pollution enter human body through food and get accumulated in thyroid gland, liver, bones and muscles 6. biodegradable waster deplete D O in the receiving stream, affect the flora cause creates anaerobic conditions 7. non biodegradable waste and pesticides travel the food chain and ultimately reach human where they accumulate in fatty tissues 8. thermal discharge in stream depletes D O 9. phosphate, nitrate, promote the growth of algae and encourage eutrophication 10. Industrial effluents result in addition of poisonous chemicals such as arsenic, mercury, lead may reach human body through contaminated food. **Control measures of water pollution** (4M) a) lay down standard for a. drinking water b. disposal of waste water into watercourse/sewer/land monitoring b) Waste water treatment • preliminary treatment • primary treatment • secondary treatment • advanced treatment
8	**Explain the sources, effects and various measures to control of thermal pollution. (13 M) (MAY/JUNE 2013, NOV/DEC 2013)** BTL4 **Answer : Page: 4.40 to 4.46 - A. Ravikrishnan** • Definition The addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life of otherwise causes significant departures from the normal activities of aquatic communities in water (1 M) • Sources of thermal pollution Nuclear power plants Coal-fired power plants Industrial effluents Domestic sewage Hydro-electric power (5 M) • Effects of thermal pollution on human health Reduction in dissolved oxygen Increase in Toxicity Interference with biological activities Interference with reproduction Direct mortality

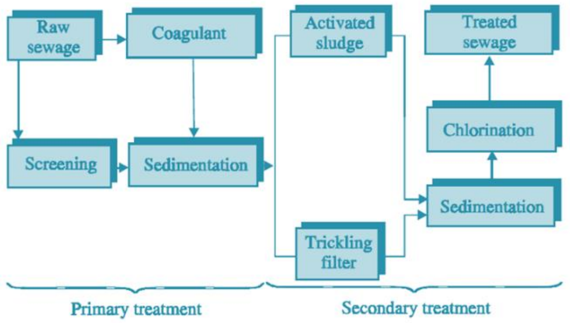
	Food storage for fish (3 M) • Control measures Cooling towers Cooling ponds Spray ponds Artificial lakes (4 M)
9.	**Give a note on** **(a) Floods** **(b) Cyclone** **(c) Landslides** **(13M)** BTL2 **Answer : Refer : 4.72 – 4.77 - A. Ravikrishnan** • Definition of flood: Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks, the excess of water over flows on the surroundings causes floods (1 M) • Causes and effects (2 M) • Preventive measures of floods (1 M) • Definition: Cyclone is a meteorological phenomenon, intense depressions forming over the open oceans and moving towards the land. On reaching the shores, it move into the interior of the land or along the shore lines. (1 M) • Causes and effects (2 M) • Preventive measures of cyclone (1 M) • Definition: The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region due to gravitational pull is called landslides. (1 M) • Causes and effects (2 M) Preventive measures of landslides (2 M)
10.	**Discuss the significance of parameters of drinking water quality standards. (7 M) (Dec. 2008)** BTL2 **Answer : Page: 4.22 to 4.23 - A. Ravikrishnan** • Physical parameters Colour Tastes and Odours Turbidity and Sediments (2 M) • Chemical parameters P^H Acidity Alkalinity Flouride Nitrogen Chlorides Sulphates Nitrates Arsenic (6 M)

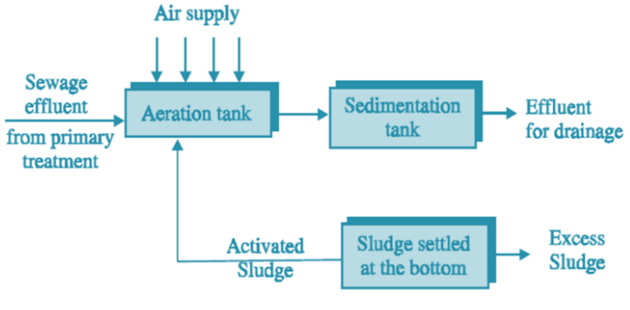
11.

With a flow diagram explain the waste water treatment. (7 M) (Dec. 2007) BTL2

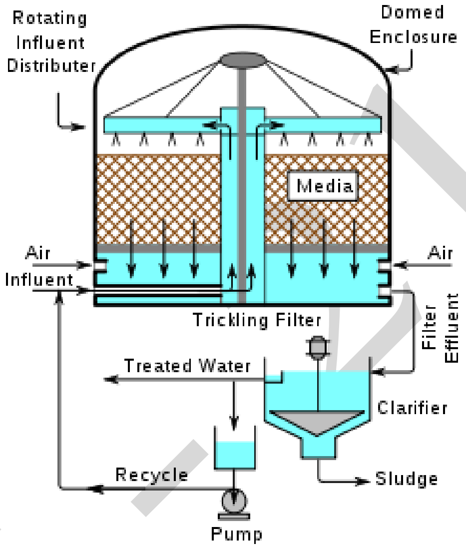
Answer : Page: 4.20 to 4.22 - A. Ravikrishnan

Flow charts and Diagrams





Activated Sludge Process



(1 + 1M)

Step-I Preliminary treatment (1 M)

Step-II Primary Treatment or Settling Process (1 M)

Step-III Secondary or Biological Treatment

Trickling Filter Process (1 M)

Activated Sludge Process (1 M)

Step-IV Tertiary Treatment (1 M)

Step-V Disposal of Sludge (1 M)

12.

Write a note on nuclear hazards (Nuclear pollution). (or) Explain the sources, effects and control measures of radioactive pollution. (7 M) (Dec. 2006) BTL2

Answer : Page: 4.48 to 4.50 - A. Ravikrishnan

Definition – The presence of radioactive elements in the environment (1M)

Causes:- (2M)

a)Natural Sources:

Solar rays

Radio nuclides in earth‟s crust

Environmental radiation

b)Manmade Sourse:

Medical X-rays
Radio isotopes
Nuclear test
Nuclear installations
Nuclear reactor

Effects:- (2M)
Causes skin burns, loss of teeth, vomiting anemia
Blood cancer
Brain damage

Control measures:- (2M)
Radiation exposure protection
Radiation contamination protection
Controlled area
Disposal of radioactive waste

13. **Explain the sources, effects and control measures of soil pollution. (8 M)** BTL2

Answer : Page: 4.54 - A. Ravikrishnan

Definition- The contamination of soil which may cause harmful to environment (1 M)

Sources and effects
- Industrial wastes (1 M)
- Urban wastes (1 M)
- Agricultural practices (1 M)
- Radioactive pollutants (1 M)
- Biological agents (1 M)

Control Measures
- Control of soil erosion
- Proper dumping of unwanted materials
- Production of natural fertilizers
- Proper hygienic conditions
- Public awareness
- Recycling and reuse of wastes
- Ban on toxic chemicals (2M)

PART – C

1 **Discuss about the following case study (a) Bhopal gas tragedy (b) Gulf War (c) Mercury wastes (15 M)** BTL6

Answer : Page: 4.65,4.68 to 4.69 - A. Ravikrishnan

- **Causes and effects of Bhopal gas tragedy:** (5M)
  Pesticide factory-Union Carbide- corporation leak large volume of methyl iso cyanate – atmosphere Bhopal- India-midnight on December 3,1984-city- change- gas chamber-within a week 10,000 people died – 1000 people turned blind-lakhs of people still continue to suffer various diseases
- **Causes and effects of Gullf War**: (5 M)
  Gulf war was fought between Iraq and US-Period of 6 weeks in 1991-American fighters dropped a lakh of bombs-force the Iraq army to withdraw from Kuwait- retreat of Iraq-burning of 700 oil wells-near sea shore –oil from well spills out into the sea-the floating oil

	oversea water nearly 80 km long-burning of oil wells nearly 10 months-released huge amounts of pollutants likeCO_2 and SO_2 into the atmosphere-1 million birds killed. • **Causes and effects of mercury wastes**: (5 M) Minamata- Small hostel village in Japan –Chicago-chemical company produces Venyl polymer plastics-industry release its effluent into Minamata sea-Effluents by fishes –affect human being through food chain-damage central nervous system-loss of vision and hearing-loss of muscular coordination and severe headache- nervous disorders.
2	**Discuss about the following case study (a) Palar river pollution (b) Textile and dye industries (c) Chernobyl nuclear disaster. (15 M)** BTL4 **Answer : Page: 4.66, 4.69 - A. Ravikrishnan** **Explanation of Palar river pollution** (5 M) Palar river originates in Nandidurgam of Karnataka state and flows for about 350 km through Karnataka, Andra Pradesh and Tamil Nadu.Palar supply drinking water for several municipalities, towns and villages in Vellore district, Tamil Nadu**.** The effluent from the above industries affect the surface and underground water and make the water unfit for domestic work. The effluent also increase the pH of the soil and affect the cultivation. The rivers like Bhavani, Noyyal and Cauvery get polluted due to mixing of effluent from the above industries. Tamil Nadu Pollution Control Board (TNPCB) has directed all textile printers and dyers of Thirupur to not allow the effluent to mix in the river systems. **Explanation of Textile and dye industries** (5 M) There are nearly 500 dying units and 195 bleaching units operating in and around Tirupur. They consume large quantity of water for processing and later discharge waste water. The effluent from the above industries affect the surface and underground water and make the water unfit for domestic work. The effluent also increase the pH of the soil and affect the cultivation. The rivers like Bhavani, Noyyal and Cauvery get polluted due to mixing of effluent from the above industries. Tamil Nadu Pollution Control Board (TNPCB) has directed all textile printers and dyers of Thirupur to not allow the effluent to mix in the river systems. **Explanation of Chernobyl nuclear disaster** (5 M) Occur at Chernobyl in USSR 28 th April,1986-the reactor exploded- result of uncontrolled nuclear reactions-radioactive fuel spread out in to the surrounding areas –killed at least 20,000 people-damage to soil, water and vegetation around 60 km.
3.	**Compare the physical and chemical characteristics of Marine water with terrestrial water. (15 M) (May 2018)** BTL4 **Answer : Page: 4.23 to 4.25 and 2.44 to2.46 - A. Ravikrishnan** **Physical and Chemical Characteristics of terrestrial water: (8M)** **1. The common specifications recommended by the U.S Public Health for Drinking Water are given below.** Water should be clear and odourless. 2. It should be cool. 3. It should be pleasant to taste. 4. Turbidity of the water should not exceed 10 ppm.

5. pH of the water should be in the range of 7.0 - 8.5.
6. Chloride and sulphate contents should be less than 250 ppm.
7. Total hardness of the water should be less than 500 ppm.
8. Total dissolved solids should be less than 500 ppm.
9. Fluoride content of the water should be less than 1.5 ppm.
10. The water must be free from disease-producing bacteria.
11. Water should be free from objectionable dissolved gases like H_2S.
12. Water should be free from objectionable minerals such as lead, chromium, manganese and arsenic salts.

Physical and Chemical Characteristics of marine water: (7M)

Marine Ecosystem.

UNIT III – NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

Q.No.	PART * A
1.	**How are forest classified?** BTL2 1. Evergreen forests; 2. Deciduous forests; 3. Coniferous forests
2	**What are the preventive measures of deforestation?** BTL1 • Steps should be taken by the government to discourage the migration of people into the islands from mainland. • To counter the depletion of forest areas, tree plantation programs have been started. • Education and awareness programmes must be conducted. • Strict implementation of law of Forest Conservation Act • Forest fire must be controlled by modern techniques • Use of wood for fuel should be discouraged
3	**Define sustainable forestry (Chen AU Dec 2005)** BTL1 Sustainable forestry is the optimum use of forest resources, which meet the needs of the present without compromising the ability of future generations to meet their own needs.
4.	**Write the functions of forests**. **(Chen A.U. Jun 2006)** BTL2 • Forests perform very important functions both to humans and nature. • They are habitats to millions of plants, animals and wildlife. • They recycle rainwater and remove pollutants from air. They control water quality and quantity • They moderate temperature and weather and help to maintain humidity. • They influence soil Conditions and prevent soil erosion and perform watershed functions. • They promote tourism and contribute aesthetic beauty
5	**Define deforestation. What are the causes of deforestation? (Chen A.U. Jun 2006, Dec 2010)** BTL1 **Deforestation:** The process of destruction of forest (or) process of removal of or elimination of forest resources due to many natural or man-made activities. The process of removal **Causes of deforestation:** 1. Developmental projects. 2. Mining operations. 3. Raw-materials for industries. 4. Fuel requirements. 5. Shifting cultivation. 6. Forest fires

6

Differentiate between deforestation and forest degradation. (Chen A.U. Dec 2007, Dec2010) BTL4

Forest Degradation	**Deforestation**
It is the process of deterioration forest materials.	It is the process of destruction of forest materials.
Slow process	Rapid process.
Can be removed.	Cannot be recovered.

7.

What are the consequences of timber extraction? BTL1

- Large scale timber extraction causes deforestation.
- Timber extraction leads to soil erosion, loss of fertility, landslides and loss of biodiversity.
- Timber extraction also leads to loss of tribal culture and extinction of tribal people.
- Timber extraction reduces thickness of the forest

8.

List the adverse effects of mining. (TNV A.U. Dec 2009, 2013) BTL1

- During mining operations, the vibrations are developed, which leads to earthquake.
- When materials are disturbed in significant quantities during mining process, large
- quantities of sediments are transported by water erosion
- Noise pollution is another major problem from mining operations.
- Mining reduces the shape and size of the forest areas.
- Destruction of natural habitat at the mine and waste disposal sites.

9

State the problems caused by the construction of Dam. (Chen AU Jan 2006) BTL3

- ▪ Displacement of tribal people.
- ▪ Loss of non-forest land.
- ▪ Loss of forests, flora and fauna.
- ▪ Landslips, sedimentation and siltation occur.
- ▪ Stagnation and water logging around reservoirs retards plant growth.
- ▪ Breeding of vectors and spread of vector-borne diseases.
- ▪ Reservoir induced seismicity (RIC) causes earthquakes.
- ▪ Navigation and aquaculture activities can be developed in the dam area.

10

What are the effects of dams on tribal? BTL1

- The greatest social cost of big dam is the widespread displacement of tribal people, such a biodiversity cannot be tolerated.
- Displacement and cultural change affects the tribal people both mentally and physically. They do not accommodate the modem food habits and life styles
- Tribal people are ill-treated by the modem society.
- Many of the displaced people were not recognized and resettled or compensated.
- Tribal people and their culture cannot be questioned and destroyed.
- Generally, the body conditions of tribal people (lived in forest) will not suit with the new areas and hence they will be affected by many diseases.

11.

Compare merits and problems of dams. **(Chen A.U. Jun 2007)** BTL4

Merits of dams	**Problems of dams**
Dams are built to control flood and store flood water.	Displacement of tribal people.

Sometimes dams are used for diverting part or all of the water from river into	Loss of non-forest land.
Dams are used mainly for drinking and agricultural purposes.	Loss of forests, flora and Fauna.
Dams are built for generating electricity.	Water logging and salinity due to over irrigation.
Dams are used for recreational purposes.	Reduced water flow and silt deposition in rivers.
Navigation and fishery can be developed in the dam areas.	Salt water intrusion at river mouth.

12. **Explain flood management**. BTL2

- Floods can be controlled by constructing dams or reservoirs.
- Channel management and embankments also control the floods.
- Encroachment of flood ways should be banned.
- Flood hazard may also be reduced by forecasting or flood warning.

13. **Write short note on mineral resources of India**. **(Coim A.U. Dec 2009)** BTL3

India has the following mineral resources

S. No.	Mineral	Place
1.	Iron	Bihar, Orissa, Tamil Nadu, Goa
2.	Coal	A.P, Bihar, MP, West Bengal
3.	Manganese	MP, Orissa, A.P, Rajasthan
4.	Copper	Bihar, A.P, MP, Orissa
5.	Gold	Karnataka, A.P
6.	Aluminum	MP, TN, Bihar, Orissa
7.	Tin	Bihar, Orissa and Rajasthan
8.	Chromium	Bihar, Orissa, MP, TN

14. **State the environmental effects of (mining) extracting and using mineral resources. (Chen AU Jun 2005)** BTL1

- Devegetation and defacing of landscape
- Ground water contamination
- Surface water pollution
- Air pollution
- Subsidence of land
- During mining operations, the vibrations are developed, which leads to earthquake.
- When materials are disturbed in significant quantities during mining process, large
- quantities of sediments are transported by water erosion
- Noise pollution is another major problem from mining operations.
- Mining reduces the shape and size of the forest areas.
- Destruction of natural habitat at the mine and waste disposal sites.

15 **What do you mean by environmental impact? (Chen A.U. Dec 2006) (or) Define environmental impact statement. (Coim. A.U. Dec 2009)** BTL1

	Environmental impact is nothing but the effect on the natural environment caused by various human actions. It includes two types (j) Indirect effects. Example: Pollution. (ii) Direct effects. Example: Cutting down trees
16	**Define overgrazing**. **Write the adverse effects caused by overgrazi**ng. (**TNV A.U. Dec 2008, A.U. May 2008 ,Dec 2013, Chen AU Dec 2006)** BTL1, BTL3 **Overgrazing:** Process of "eating away the forest vegetation without giving it a chance to regenerate". **Effects of overgrazing:** (i) Land degradation (ii) Soil erosion (iii) Loss of useful species
17	**What is water logging? List the effects of water logging.** (**Coim A.U. Dec 2009, Chen AU Dec 2006, Apr 11)** BTL1 Water logging is the land where water stand for most of the year or time. **Problems in water logging**: During water-logged conditions, pore-voids in the soil get filled with water and the soil-air gets depleted. In such a condition the roots of the plants do not get adequate air for respiration. So, mechanical strength of the soil decreases and crop yield falls.
18.	**Enumerate the desired qualities of an ideal pesticide**. (**A.U. Dec 2007)** BTL3 • An ideal pesticide must kill only the target species. • It must be a biodegradable. • It should not produce new pests. • It should not produce any toxic pesticide vapour. Excessive synthetic pesticide should not be used. • Chlorinated pesticides and organophosphate pesticides are hazardous, so they should be used.
19	**Define desertification, land degradation and land slide.** BTL1 **Desertification:** A progressive destruction or degradation of arid or semiarid lands to desert **Land degradation or Soil degradation:** The process of deterioration of soil or loss of fertility of the soil **Land slide:** Landslides are the downward and outward movement of a slope composed of earth materials such as rock, soil, artificial fills.
20	**What are the advantages in conjunctive use of water? (Chen A.U. Dec 2006)** BTL3 • Control of water logging. • Use of saline water, especially for cooling purposed. • Control of salt intrusion in coastal aquifers. • Controlled withdrawal of water from ground water aquifer
21	**What are renewable and non-renewable energy resources? (Chen. A.U. Dec 2009, TCY A.U. Dec 2008, Dec 2009,Apr 2015)** BTL1 Renewable energy resources are natural resources which can be regenerated continuously by the ecological process within a reasonable time period and are inexhaustible. They can be used again and again in an endless manner. Examples: solar energy, wind energy, tidal energy, ocean thermal energy Non-Renewable energy resources are natural resources which cannot be regenerated. E.g. coal, petroleum, minerals, oils, ground water
22	**Differentiate renewable and non-renewable sources of energy. (TNV A.U. Dec 2008, 11**) BTL4

Renewable energy	Non-renewable energy
It is regenerated continuously	Cannot be regenerated.
In exhaustible	Exhaustible
It can be used again and again	Cannot be used again
It is pollution free	It pollutes the atmosphere
Available in unlimited amount in nature	Available in limited amount
It is developed in a short period	It is developed in a long period It is developed in a long period

23	**What are the conventional sources of energy for the mankind? (Chen AU Jan 2006)** BTL1 Non-renewable energy resources are natural resources, which cannot be regenerated once they are exhausted. They cannot be used again.
24	**What is geothermal energy? (Coim A.U. Dec 2009)** BTL1 The energy harnessed form the high temperature present inside the earth is called geothermal energy
25	**What is meant by soil erosion? List its types. (Chen A.U. Jun 2007)** BTL1 Soil erosion is the process of removal of superficial layer of the soil from one place to another. Soil erosion also removes the soil components and surface litter. 1. Normal erosion 2. Accelerated erosion
26	**Explain soil leaching**. **(Chen A.U. Dec 2006)** BTL2 1. It removes valuable nutrients from the soil. 2. It may catty buried wastes into ground water and contaminates it.
27	**Mention the factors causing soil erosion**. (**TCY A.U. Dec2008**) BTL4 1. Water 2. Wind 3. Biotic agents 4. Landslides 5. Construction
28.	**What are the present food problems of the world? (Chen A.U. Dec 2010)** BTL4 We know that 79% of the area is covered with water and rest is land, of which most of the areas are forest, desert, mountain, barren area only less percentage of land is cultivated. So the food supplied from the rest of the land is not enough to feed all the people. The problem of population explosion has made it worse. The world population increases and cultivable land area decreases therefore the world food problem arises. Urbanization is another problem in developing countries which deteriorates the agricultural lands.
29.	**What are the effects of over utilization of groundwater? (Chen A.U. Dec 2010)** BTL1 1. Decrease ground water 2. Ground subsidence 3. Lowering of water table 4. Intrusion of salt water 5. Earthquake and landslides 6. Drying up of wells 7. Pollution of water
30.	**Define the term Nuclear energy. (A.U DEC2014, A.U.Apr.2015)** BTL1 Energy released during a nuclear reaction is called nuclear energy. Nuclear reactors produce the nuclear energy either by nuclear fission (or) nuclear fusion. The nuclear power (or) nuclear energy is clean and safe
31.	**Define sustainable life style and bio gas.** BTL1 **Sustainable life style:** Sustainable development is the development of healthy environment without damaging the natural resources. In other words, all the natural resources must be used in such a way that it must be available for the future generation also. **Bio gas:** Mixture of various gases formed by anaerobic degradation of biological matter in the absence of oxygen

PART * B

1 **Discuss the causes, ill effects and preventive measures of deforestation. (13M) (A.U. Dec 2005, Dec 2014, Apr 2015, A.U. Jan 2006, Dec 09, Apr 2015, A.U. Dec 2006, June 2007, A.U. May 2008)** BTL2

Answer :Page : 5.7 – 5.9 - A. Ravikrishnan

Causes (Sources) of Deforestation

Developmental Projects: (6 M)

Development projects cause deforestation in two ways.
(i) Through submergence of forest area underwater.
(ii) Destruction of forest area.
Examples. Big dams, hydroelectric projects, construction (1 M)

Mining operations

Mining have a serious impact on forest areas. Mining operation reduces the forest area. Examples Mica, coal, manganese, limestone, etc. (1 M)

Raw materials for industries

Wood is the important raw material for so many purposes.
Example - For making boxes, furniture, match-boxes, pulp, etc., (1 M)

Fuel requirements

In India both rural and tribal population depend on the forest for meeting their daily need of fuel wood, which leads to the pressure on forest, ultimately to deforestation. (1 M)

Shifting cultivation: Replacement of forest ecosystem for monospecific tree plantation can lead to disappearance of number of plant and animal species.
Examples: India is the richest nation with more than 15,000 species of plants, many of which is endangered due to deforestation (1M)

Forest fires: Forest fire is one of the major causes for deforestation. Due to human interruption and rise in ambient temperature, forest fire is happened often nowadays. Thus, due to forest fire thousands of forest area gets destructed. (1 M)

Ill effects of deforestation on the environment (6 M)

Global warming: Cutting and burning of forest trees increases the CO_2 content in the atmosphere, which in turn changes the global climatic pattern, rising sea levels and depletion of the protective ozone layer.

Loss of genetic diversity: Destruction of our forest destroys the greatest storehouse of genetic diversity on earth, which provides new food and medicines for the entire world

Soil erosion: Deforestation also causes soil erosion, landslides, floods and drought. Natural vegetation acts as a natural barrier to reduce the wind velocity, this in turn reduces soil erosion. 6000 million tons of soil gets eroded every year in India

Loss of biodiversity: Most of the species are very sensitive to any disturbance and changes. When the plants no longer exist, animals that depend on them for food and habitat become extinct.

Loss of food grains: As a result of soil erosion, the countries lose the food grains

Unemployment problems: The people living around forest areas lose their livelihood

Flood and Landslides: Frequent floods, landslides in hilly areas and wind speed are heavy.

Preventive measures (or) avoid of deforestation (or) methods of conservation of forest (1 M)

	• New plants of more or less the same variety should be planted to replace the trees cut down for timber. • Use of wood for fuel should be discouraged. • Forest pests can be controlled by spraying pesticides by using aeroplanes. • Forest fire must be controlled by modem techniques. • Over grazing by cattle must be controlled. • Steps should be taken by the government to discourage the migration of people into the islands from mainland. • Education and awareness programmes must be conducted. • Strict implementation of law of Forest Conservation Act
2	**What are the measures recommended for conservation of natural resources? (7 M)** **(A.U. June 2005, Jan 2006, A.U. Apr 2010, Dec 2013)** BTL2 **Answer : Page : 5.76 – 5.80 - A. Ravikrishnan** **Measures recommended for (Role of Individual)conservation of natural resource** **Conservation of Energy (2 M)** • Switch off lights, fans and other appliances when not in use. • Use solar heater for cooking your food on sunny . days, which will cut down your LPG expenses. • Dry the clothes in sunlight instead of driers. • Grow trees near the houses and get a cool breeze and shade. This will cut off your electricity charges on AC and coolers. • Use always pressure cooker. • Ride bicycle or just walk instead of using car and scoot. **Conservation of water (2 M)** • Use minimum water for all domestic purposes. • Check for water leaks in pipes and toilets and repair them promptly. • Reuse the soapy water, after washing clothes, for washing off the courtyards, drive ways, etc., • Use drip irrigation to improve irrigation efficiency and reduce evaporation. • The wasted water, coming out from kitchen, bath tub, can be used for watering the plants. • Build rainwater harvesting system in your house. **Conservation of soil (2 M)** • Grow different types of plants, herbs, trees and grass in your garden and open areas, which bind the soil and prevent its erosion. • While constructing the house don't uproot the trees as far as possible. • Don't irrigate the plants using a strong flow of water, as it will wash off the top soil. • Soil erosion can be prevented by the use of sprinkling irrigation. • Use green manure in the garden, which will protect the soil. • Use mixed cropping, so that some specific soil nutrients will not get depleted **Conservation of Food Resources (1 M)** • Eat only minimum amount of food. A void over eating. • Don’t wastes the food instead gives it to someone before getting spoiled.

	• Cook only required amount of the food. • Don't cook food unnecessarily. • Don't store large amounts of food grains and protect them from damaging insects. **Conservation of Forest (1 M)** • Use non-timber products. • Plant more trees and protect them. • Grassing, fishing must be controlled. • Minimise the use of papers and fuel wood. • Avoid of executing developmental work like dam, road, construction in forest areas.
3	**What are the effects, causes of soil erosion and the methods of preventing it? (7 M) (A.U. Dec 2005,11)** BTL3 **Answer : Page : 5.70 – 5.73 - A. Ravikrishnan** **Soil erosion-** Damage or removal of top soil renders the soil infertile. Erosion may occur in many ways **Effects of soil erosion** (1M) **Causes of (factors causing) soil erosion** Water ; wind; biotic agents; landslides; construction (1 M) **Control of soil erosion (Soil conservation practices)** • Conservation of till farming or no-till-farming (1 M) • Contour farming (1 M) • Terracing (1 M) • Alley cropping or agro forestry (1 M) • Wind breaks or shelter belts (1 M) Decreasing soil pollution is also a method which helps in soil conservation
4	**Discuss briefly on the consequences of overdrawing of ground water. (13 M) (A.U. Dec 2006)** BTL2 **Answer : Page : 5.19 – 5.21 - A. Ravikrishnan** **Decrease of Ground Water : (2 M)** Due to increased usage of ground water, the ground water level decreases. Reason (a) The erratic and inadequate rainfall results in reduction in storage of water in reservoirs. (b) The building construction activities are sealing the permeable soil zone, reducing the area for percolation of rain water and increase in surface runoff **Ground subsidence: (2 M)** When the ground water withdrawal is more than the recharge rate, the sediments in the aquifer get compacted which results in sinking of over lying land surface. This process is known as ground subsidence. **Lowering of water table (2 M)** Over utilization of ground water in arid and semi-arid regions for agriculture disturbs the state of equilibrium of the reservoir (disturb the hydrological cycle) in the region. This causes following problems. **Intrusion of salt water: (1 M)**

In coastal areas, over exploitation of ground water would lead to rapid intrusion of salt water from sea.

Earthquake and landslides: (2 M)

Over-utilization of ground leads to decrease in water level, which cause earth quake, landslides and famine

Drying up of wells: (2 M)

As a result of over utilization of ground water, the level of ground water getting depleted at much faster rates than they can be regenerated. This leads to drying up of dug as well as bore wells.

Pollution of water : (2 M)

When ground water level near the agricultural land decreases, water, containing the nitrogen as nitrate fertilizer, percolates rapidly into the ground and pollute the ground water.

5 **Write a brief note on changes caused by agricultural and overgrazing. (7 M) (A.U May 2007, Dec 2014)** BTL2

Answer : Page : 5.36 – 5.38 - A. Ravikrishnan

Overgrazing: Process of, "eating away the forest vegetation without giving it a chance to regenerate"

Agriculture: An art, science and industry of managing the growth of plants and animals for human use. (1 M)

Effects (or) impacts of overgrazing

Land degradation

- Overgrazing removes the cover of vegetation over the soil and the exposed soil gets compacted.
- So the roots of plant cannot go much deep into the soil and the adequate soil moisture is not available.
- Thus, overgrazing leads to organically poor, dry, compacted soil, this cannot be used for further cultivation. (1 M)

Soil erosion

- Due to overgrazing by livestock, the cover of vegetation gets removed from the soil.
- The roots of the grass are very good binders of the soil.
- The soil becomes loose by the action of wind and rainfall. (1 M)

Loss of useful species

- Overgrazing also affects the composition of plant population and other regeneration capacity.
- When livestock grazes the grasses heavily, the root stocks, which carry the food reserve gets destroyed. (1 M)

Traditional agriculture:

- It involves small plot, simple tools, surface water, organic fertilizers and a mix of crops.
- They produce enough and a mix of crops. They produce enough food for their families and to sell it for their income

Effects (or) impacts of Traditional agriculture

Deforestation:

- Cutting and burning of trees in forests to clear the land for cultivation results in loss of forest cover.

Soil erosion:

	✓ Clearing of forest cover exposes the soil to wind and rainfall, resulting in loss of top fertile soil layer. **Loss of nutrients:** ✓ During cutting and burning of trees, organic matter in the soil gets destroyed and most of the nutrients are taken up by the crops within a short period (each 1M)
6	**Explain how the alternate energy sources play an important role in environmental impact. (8 M) (A.U. May 2007)** BTL4 **Answer : Page : 5.63 – 5.64 - A. Ravikrishnan** **Need of Alternate (Renewable) Energy Sources (or) Role of Alternate (Renewable) Energy sources in environmental impact** 1. The importance of solar energy can be emphasized particularly in view of the fact that fossil fuels and other conventional sources are not free from environmental implications. 2. Energy sources which have least pollution, safety and security snags and are universally available have the best enhance of large scale utilization in future. 3. Hydro-electric power generation is expected to upset the ecological balance existing on earth. 4. Besides space heating, hydroelectric power plants critically pollute the aquatic and terrestrial biota 5. Radioactive pollutants released from nuclear power plants are chronically hazardous. The commissioning of boiling water power reactors (BWRS) have resulted in the critical accumulation of large number of long lived radionuclides in water. 6. The dangerous radio waste cannot be buried in land without the risk of polluting soil and underground water. Nor the waste can be dumped into the rivers without poisoning aquatic life and human beings as well. 7. The burning of coal, oil, wood, dung cakes and petroleum products have well debated environmental problems. The smoke so produced causes respiratory and digestive problems leading to lungs, stomach and eye diseases. 8. The disposal of fly ash requires large ash ponds and may pose a severe problem considering the limited availability of land. So, the non conventional sources of energy needed (8 M)
7	**Discuss the effects of timber extraction, effects of dams on forests and tribal people. (7 M) (A.U. May 2008, Dec 2013)** BTL2 **Answer : Page : 5.11, 5.13 – 5.15 - A. Ravikrishnan** **Consequences (or) effects of timber extraction** 1. Large scale timber extraction causes deforestation. 2. Timber extraction leads to soil erosion, loss of fertility, landslides and loss of biodiversity. 3. Timber extraction also leads to loss of tribal culture and extinction of tribal people. 4. Timber extraction reduces thickness of forest (1M) **Effects of dam on Forest** 1. Thousands of hectares of forest have been cleared for executing river valley projects. 2. In addition to the dam construction, the forest is also cleared for residential accommodation, office buildings, storing materials, laying roads, etc., 3. Hydroelectric projects also have led to widespread loss of forest in recent years. 4. Construction of darns under these projects led to killing of wild animals and destroying aquatic life. 5. Hydroelectric projects provide opportunities for the spread of water borne diseases.

6. The big river valley projects also cause water logging which leads to salinity and in tum reduces the fertility of the land. (3M)

Effects of dam on tribal people

1. The greatest social cost of big dam is the widespread displacement of tribal people, such a biodiversity cannot be tolerated.
2. Displacement and cultural change affects the tribal people both mentally and physically. They do not accommodate the modem food habits and life styles.
3. Tribal people are ill-treated by the modem society.
4. Many of the displaced people were not recognized and resettled or compensated.
5. Tribal people and their culture cannot be questioned and destroyed.
6. Generally, the body conditions of tribal people (lived in forest) will not suit with the new areas and hence they will be affected by many diseases (3 M)

8

(i) Discuss the problems of fertilizer and pesticide on modern agriculture. (7 M) (A.U. May 2008, Dec 2010) BTL2

(ii) List the desired qualities of pesticide. (2M) BTL4

(i) Answer : Page : 5.38 – 5.40 - A. Ravikrishnan

Problems in using fertilizer

(a) Micronutrient imbalance

- ✓ Most of the chemical fertilizers, used in modem agriculture, contain nitrogen, phosphorus and potassium (N, P, K), which are macronutrients.
- ✓ When excess of fertilizers are used in the fields, it causes micronutrient imbalance.
- ✓ Examples: Excessive use of fertilizer in Punjab and Haryana has caused deficiency of the micronutrient zinc in the soil, which affects the productivity of the soil. (1M)

(b) Blue Baby syndrome (Nitrate pollution)

- ✓ When Nitrogenous fertilizers are applied in the fields, they leach deep into the soil and contaminate the ground water.
- ✓ The nitrate concentration in the water gets increased.
- ✓ When the nitrate concentration exceeds 25 mg / lit, they cause serious health problem called "Blue Baby syndrome".
- ✓ This disease affects infants and leads even to death. (1M)

(c) Eutrophication.

- ✓ A large proportion of N and P fertilizers, used In crop field is washed off by the runoff water and reaches the water bodies causing over nourishment of the lake. This process is known as Eutrophication.
- ✓ Due to eutrophication lake gets attacked by algal bloom.
- ✓ These algal species use up the nutrients rapidly and grow very fast.
- ✓ Since the time of algal species is less they die quickly and pollute the water, which in turn affect the aquatic life. (1M)

Problems in using pesticides

In order to improve the crop yield, lot of pesticides are used in the agriculture.

(i) First generation pesticides - Sulphur, arsenic, lead or mercury are used to kill the pests.
(ii) Second generation pesticides - DDT (Dichloro Diphenyl Trichloromethane) kill the pests.

Although these pesticides protect our crops from huge losses due to pests, they produce number of side-effects.

i. Death of non-target organisms

- ✓ Some pest species usually survive even after the pesticide spray, which generates highly resistant generations.
- ✓ They are immune to all type of pesticides and are called super pests. (1 M)

i. Producing new pests

- ✓ Some pest species usually survive even after the pesticide spray, which generates highly resistant generations.
- ✓ They are immune to all type of pesticides (1 M)

(c)Bio-magnification

- ✓ Many of the pesticides are non-biodegradable and keep on concentrating in the food chain.
- ✓ This process is called bio-magnification.
- ✓ These pesticides in a bio-magnified form are harmful to the human beings. (1 M)

(d)**Risk of cancer**

- ✓ Pesticides enhance the risks of cancer in two ways.
- ✓ It directly acts as carcinogens.
- ✓ It indirectly Suppress the immune system. (1 M)

(ii) Answer : Page : 5.40 - A. Ravikrishnan

Desired qualities of an ideal pesticide

- ✓ An ideal pesticide must kill only the target species.
- ✓ It must be a biodegradable.
- ✓ It should not produce new pests.
- ✓ It should not produce any toxic pesticide vapour.
- ✓ Excessive synthetic pesticide should not be used.
- ✓ Chlorinated pesticides and organophosphate pesticides are hazardous, so they should not be used (2 M)

9 **Explain the environmental impacts of mineral extraction (mining) and uses (8 M) (A.U. Dec 2009, Apr 2015)** BTL2

Answer : Page : 5.29 – 5.31 and 5.24 – 5.26 - A. Ravikrishnan

Mining: Mining is the process of extraction of metals from a mineral deposit. (1 M)

Types of mining: (1 M)

(a) **Surface mining:** Surface mining is the process of extraction of raw materials from the near surface deposits

(b) **Underground mining**: The process of extraction of raw materials below the earth's surface. It includes,

(c) **Open-pit mining**: Open-pit mining machines dig holes and remove the ores.
Example: Iron, copper, limestone, and marble etc

Environmental damage, caused by mining activities: (4 M)

Devegetation and defacing of landscape: Topsoil as well as the vegetation are removed from the mining area. Large scale deforestation or devegetation leads to several ecological losses and also landscape gets badly affected**.**

Groundwater contamination: Mining disturbs and also pollutes the ground water. Usually sulphur, present as an impurity in many ores, gets converted into sulphuric acid due to microbial action, which makes the water acidic. Some heavy metals also get leached into groundwater.

Surface water pollution: Drainage of acid mines often contaminates the nearby streams and lakes. The acidic water is harmful to many aquatic lives. Radioactive substances like uranium also contaminate the surface water and kill many aquatic animals.

Air pollution: Smelting and roasting are done to purify the metals, which emits enormous amounts of air pollutants damaging the nearby vegetation. The suspended particulate matter (SPM), SOx arsenic particles, cadmium, lead, etc., contaminate the atmosphere and public suffer from several health problems.

Subsidence of land: It is mainly associated with underground mining. Subsidence of mining area results in cracks in houses, tilting of buildings, bending of rail.

Effects of over exploitation of Mineral resources: (1 M)

1. Rapid depletion of mineral deposits.
2. Over exploitation of mineral resources leads to wastage and dissemination of mineral deposits.
3. Over exploitation of mineral resources causes environmental pollution.
4. Over exploitation needs heavy energy requirement

Uses of mining: (1 M)

The extraction of metals and other materials from a mineral deposit by mining has verity of uses.

1. Development of industrial plants and machinery. Examples - Iron, aluminium, copper, etc.,
2. Construction, housing, settlements. Example - Iron, aluminium, nickel, etc.,
3. Jewellery – Example - Gold, silver, platinum and diamond
4. Generation of energy. Example – Coal, Lignite, Uranium etc
5. Designing of defence equipments, weapons, ornaments
6. Agriculture purposes, as fertilizers, seed dressings and fungicides. Example Zineb – containing zinc and Maneb - containing manganese.

10 **Explain the various food resources. (7 M) (A.U. Apr 2010, Apr 2015, Dec 2010)** BTL2

Answer : Page : 5.33 – 5.36 - A. Ravikrishnan

Food Resources (1 M)

Food is an essential requirement for the human survival. Each person has a minimum food requirement. The main components of food are carbohydrates, fats, proteins, minerals and vitamin

Types of Food Supply: (3 M)

Historically humans have dependent on three systems for their food supply.

1. Croplands:

It mostly produces grains and provide about 76% of the world's food. (1 M)

Examples: Rice, wheat, maize, barley, sugarcane, potato, etc

2. Rangelands:

It produces food mainly from the grazing livestock and provide about 17% of the world’s food. Examples: Meat, milk, fruits, etc., (1 M)

3. Oceans:

Oceanic fisheries supply about 7% of the world's food. Examples: Fish, prawn, crab, etc. (1 M)

Major Food Sources: (2 M)

Earth is provided with more than thousands of edible plants and animals. However only 15 plants and 8 terrestrial animal species supply 90% of our global intake of calories. Examples: Rice, wheat, maize, potato, barley, sugarcane, pulses, fruits, vegetables, milk, meat, fish and sea food.

	Rice, wheat and maize are the major grains, provide more than 50% of the calories people consume. **World food problem** (1 M)
11	**Explain the various conventional (nonrenewable) energy resources. (7 M) (A.U. Dec 2010)** BTL2 **Answer : Page : 5.56 – 5.60 - A. Ravikrishnan** Coal – (1 M), Petroleum – (2 M) LPG - (1 M) Natural gas - (1 M) Nuclear energy - (2 M)
12	**Discuss in detail the over-exploitation of forests. (7 M) (A.U. Dec 2010)** BTL2 **Answer : Page : 5.6 – 5.7 - A. Ravikrishnan** **Over Exploitation of Forest (3 M)** • Due to overpopulation the materials supplied by the forest like food, medicine, shelter, wood and fuel is not sufficient to meet the people's demand. • Hence exploitation of forest materials is going on increasing day by day. • With growing civilization, the demand for raw materials like timber, pulp, minerals, fuel wood, etc., increases resulting in large scale logging, mining, road building and cleaning of forests. **Reason for over exploitation in India: (2 M)** It has been estimated that in India the minimum area of forests required to maintain good ecological balance is about 33% of total area. But, at present it is only about 22%. So over exploitation of forest materials occur. **Causes of over exploitation: (2 M)** (a) Increasing agricultural production. (b) Increasing industrial activities. (c) Increase in demand of wood resources.
13	**Discuss any four factors responsible for land degradation. (8 M)** **(A.U. Dec 2010,May 11,Dec 2013, A.U. Dec 2014)** (BTL2 **Answer : Page : 5.69 – 5.70 - A. Ravikrishnan** **Causes of (or factors influencing) land degradation** 1. **Population:** As population increases, more land is needed for producing food, fibre and fuel wood. Hence there is more and more pressure on the limited land resources, which are getting degraded due to over exploitation. (2 M) 2. **Urbanization:** The increased urbanization due to population growth reduce the extent of agricultural land. To compensate the loss of agricultural land, new lands comprising natural ecosystems such as forests are cleared. Thus urbanization leads to deforestation, which intum affects millions of plant and animal species. (2 M) 3. **Fertilizers and pesticides:** Increased applications of fertilizers and pesticides are needed to increase farm output in the new lands, which again leads to pollution of land and water and soil degradation. (1 M) 4. **Damage of top soil:** Increase in food production generally leads to damage of top soil through nutrient depletion. (1 M) 5. Water-logging, soil erosion, salination and contamination of the soil with industrial wastes all cause land degradation. (2 M)
14	**What are the ecological services rendered by forests? Discuss. (7 M)** **(A.U. Dec 2010)** BTL2 and BTL1 **Answer : Page : 5.2 – 5.5 - A. Ravikrishnan**

List the ecological uses of forest (1 M)

Ecological Uses or services rendered by forest

Production of oxygen: During photosynthesis trees produce oxygen which is essential for life on earth. (1 M)

Reducing global warming: The main greenhouse gas carbon dioxide (CO_2) is absorbed by the trees (forests). Trees absorb the main greenhouse gas CO_2 which is a raw material for photosynthesis. Thus the problem of global warming, caused by greenhouse gas CO_2, is reduced. (1 M)

Soil conservation: Roots of trees (forests) bind the soil tightly and prevent soil erosion. They also act as wind breaks. (1 M)

Regulation of hydrological cycle: Watersheds in forest act like giant sponges, which absorb rainfall, slow down the runoff and slowly release the water for recharge of springs. (1 M)

Pollution moderators: Forests can absorb many toxic gases and noises and help in preventing air and noise pollution. (1 M)

Wildlife habitat: Forests are the homes of millions of wild animals and plants. (1 M)

15. **What is land degradation? Explain the causes and effects land (soil) degradation. (7 M)**
(AU A.U. Dec 2010,May 11,Dec 2013, A.U. Dec 2014) BTL2

Answer : Page : 5.69 – 5.70 - A. Ravikrishnan

Land degradation: The process of deterioration of soil or loss of fertility of the soil (1 M)

<u>Causes of land degradation (or) factors responsible for land degradation</u>

1. **Population:**
    - ✓ As population increases, more land is needed for producing food, fibre and fuel wood.
    - ✓ Hence there is more and more pressure on the limited land resources, which are getting degraded due to over exploitation. (1M)
2. **Urbanization:**
    - ✓ The increased urbanization due to population growth reduce the extent of agricultural land. To compensate the loss of agricultural land, new lands comprising natural ecosystems such as forests are cleared.
    - ✓ Thus urbanization leads to deforestation, which in turn affects millions of plant and animal species. (1M)
3. **Fertilizers and pesticides:**
    - ✓ Increased applications of fertilizers and pesticides are needed to increase farm output in the new lands, which again leads to pollution of land and water and soil degradation. (1M)
4. **Damage of top soil:**
    - ✓ Increase in food production generally leads to damage of top soil through nutrient depletion. (1M)
5. Water-logging, soil erosion, salination and contamination of the soil with industrial wastes all cause land degradation (1M)

<u>Harmful effects of land (soil) degradation</u>

- ✓ The soil texture and structure are deteriorated.
- ✓ Loss of soil fertility, due to loss of invaluable nutrients.
- ✓ Increase in water logging, salinity, alkalinity and acidity problems.
- ✓ Loss of economic social and biodiversity. (1 M)

16. **What is desertification? Describe the causes and effects of desertification. (7 M)**

(AU May 2015, Dec. 2016) BTL2

Answer : Page : 5.74 – 5.75 - A. Ravikrishnan

Desertification: A progressive destruction or degradation of arid or semiarid lands to desert (1M)

<u>Causes of desertification (or) reason for desertification</u>

1. **<u>Deforestation:</u>**
    - ✓ The process of denuding and degrading a forest land initiates a desert.
    - ✓ If there is no vegetation to hold back the rain water, soil cannot soak and groundwater level do not increases.
    - ✓ This also increases, soil erosion, loss of fertility.
2. **<u>Over grazing:</u>**
    - ✓ The increase in cattle population heavily graze the grass land or forests and as a result denude the land area.
    - ✓ The denuded land becomes dry, loose and more prone to soil erosion and leads to desert.
3. **<u>Water Management:</u>**
    - ✓ Over utilization of groundwater, particularly in coastal regions, resulting in saline water intrusion into aquifers, which is unfit for irrigation.
4. **<u>Mining and quarrying :</u>**
    - ✓ These activities are also responsible for loss of vegetal cover and denudation of extensive land area leading to desertification.
5. **<u>Climate change:</u>**
    - ✓ Formation of deserts may also take place due to climate change, ie., failure of monsoon, frequent droughts.
6. **<u>Pollution:</u>**
    - ✓ Excessive use of fertilizers and pesticides and disposal of toxic water into the land also leads to desertification (Each 1 M; any 5 = 5 M)

<u>Harmful effects of desertification</u>

- ✓ Around 80% of the productive land in the arid and semi-arid regions are converted into desert.
- ✓ Around 600 million people are threatened by desertification. (1 M)

17. **Describe the following effects and their remedies on modern agriculture. (a) Water logging (b) Salinity. (7 M)** BTL2

(a) Answer : Page : 5.40 - A. Ravikrishnan

<u>Water logging:</u> The land where water stand for most of the year.

<u>Causes of water logging</u>

- ✓ Excessive water supply to the croplands.
- ✓ Heavy rain.
- ✓ Poor drainage. (1 M)

<u>Problems (or) Effects in water logging</u>

- ✓ During water-logged conditions, pore-voids in the soil get filled with' water and the soil-air gets depleted.
- ✓ In such a condition the roots of the plants do not get adequate air for respiration. So, mechanical strength of the soil decreases and crop yield falls. (1 M)

<u>Remedy for water logging</u>

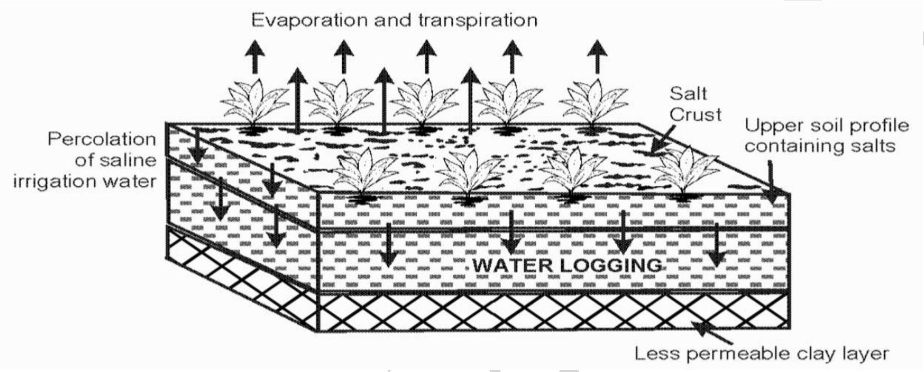
- ✓ Preventing excessive irrigation, sub surface draining technology and bio-drainage by trees like Eucalyptus tree are some method of preventing water logging. (1 M)

(b) Answer : Refer page : 5.41 - A. Ravikrishnan

Salinity: The water, not absorbed by the soil, undergo evaporation leaving behind a thin layer of dissolved salts in the topsoil**.** This process of accumulation of salts is called the salinity. (1 M)

Problems in Salinity

- ✓ Most of the water, used for irrigation comes only from canal or ground, which unlike rainwater contains dissolved salts. Under dry climates, the water gets evaporated leaving behind the salt in the upper portion of the soil.
- ✓ Due to salinity, the soil becomes alkaline and crop yield decreases. (1 M)



(1M)

Remedy for salinity

- ✓ The salt deposit is removed by flushing them out by applying more good quality water to such soils.
- ✓ Using sub-surface drainage system the salt water is flushed out slowly (1 M)

PART – C QUESTIONS

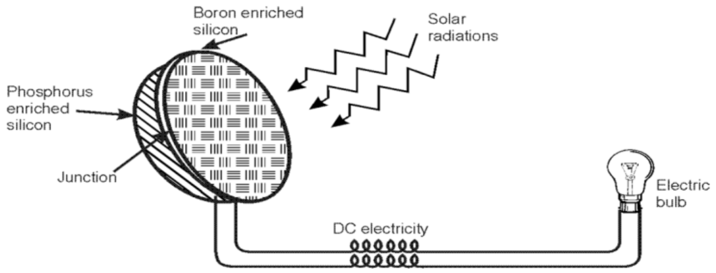
1 **Discuss the world food problems in detail and how does it affects other resources. (15 M) (A.U. May2011)** BTL4

Answer : Page : 5.34 – 5.42 - A. Ravikrishnan

World Food problems

1. We know that 79% of the total area of the earth is covered with water. Only 21% of the earth surface is land, of which most of the areas are forest, desert, mountains, barren areas, only less percentage of the land is cultivated. So the food supplied from the rest of the land is not enough to feed all the people. The problem of population explosion has made it worse. The world population increases and cultivable land area decreases. Therefore world food problem arises.
2. Environmental degradation like soil erosion, water logging, water pollution, salinity, affect agricultural lands.
3. Urbanisation is another problem in developing countries, which deteriorates the agricultural lands.
4. Since the food grains like rice, wheat, com and the vegetable like potato are the major food for the people all over the world, the food problem raises.
5. A key problem is the human activity, which degrade most of the earth's net primary productivity which supports all life (5 M)

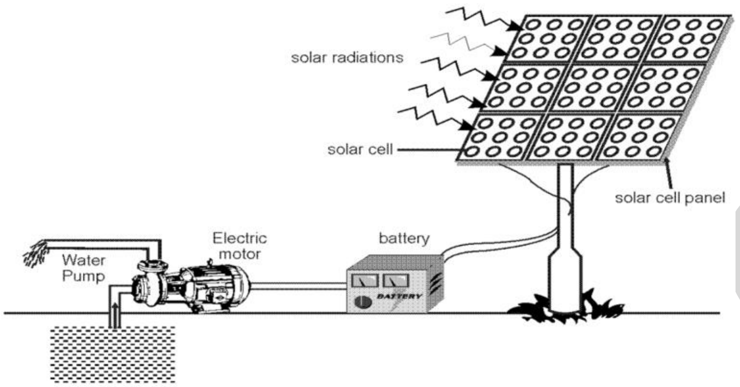
Effects (or) impacts of overgrazing

	1. Land degradation 2. Soil erosion 3. Loss of useful species (3 M) **Effects (or) impacts of agriculture** **Effects (or) impacts of Traditional agriculture** **a.** Deforestation: Cutting and burning of trees in forests to clear the land for cultivation results in loss of forest cover. b. Soil erosion: Clearing of forest cover exposes the soil to wind and rainfall, resulting in loss of top fertile soil layer. c. Loss of nutrients: During cutting and burning of trees, organic matter in the soil gets destroyed and most of the nutrients are taken up by the crops within a short period (2 M) **Effects (or) impacts of modern agriculture (or) adverse effects of agricultural practices (or) Environmental effects of agriculture** (a) Micronutrient imbalance (b) Blue Baby syndrome (Nitrate pollution) (c) Eutrophication. d) Water logging e) Salinity (5 M)
2	**What are the natural resources availability in India and discuss any two of them. (15 M) (A.U. May2011)** BTL4 List the natural resources available in India (5M) Any two natural resources available in India (Each 5M)
3.	(i) **Relate the role-play of Environmental Issues in the modern world. (5 M) (ii) Generalize the different methods to propagate environmental awareness. (10 M)** BTL6 **Answer: Page: 5.76 - A. Ravikrishnan** The role-play of environmental issues (5M) Different methods to propagate environmental awareness (10M)
4.	**Discuss the different types of renewable energy resources.(15 M) (A.U. June 2006)** BTL2 **Answer : Page : 5.43 – 5.58 - A. Ravikrishnan** **Renewable energy resources (or) Non-Conventional energy resources** Natural resources which can be regenerated continuously and are inexhaustible. They can be used again and again in an endless manner. Examples: Solar energy, wind energy, tidal energy, etc. (1M) **Renewable energy resources (or) Non-Conventional energy resources** **1. Solar energy -** The energy that we get directly from the sun is called solar energy. The nuclear fusion reactions occurring inside the sun release enormous amount of energy in the form of heat and light. - **Solar cells** **1. Solar cells (or) photovoltaic cells (or) PV cells**  Solar cell (PV cell)

When solar energy falls on the P-type semiconductor, the electrons in the conduction band transferred to conduction band so that a potential difference is developed across the PN junction. Therefore a current is flowing across the junction. (2M)

- **Solar battery**

  When solar cells are connected in series, a solar battery is formed. Using solar battery we can run electrical machines such as pump, fan, etc.



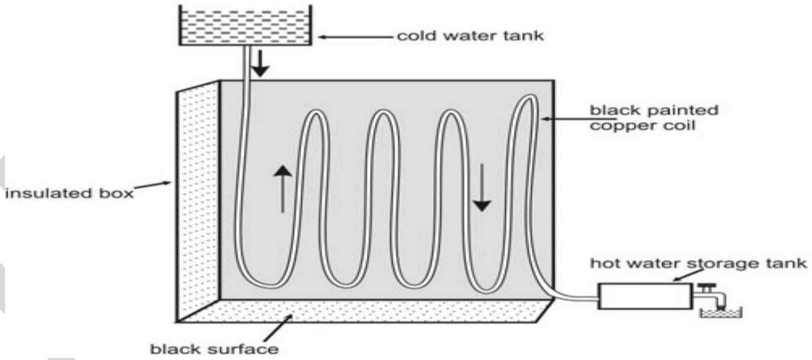
(2 M)

- **Solar Heat Collectors**

Solar heat collectors consist of natural materials like stones, bricks (or) materials like glass, which can absorb heat during the day time and release it slowly at night. (1M)

- **Solar water heater**

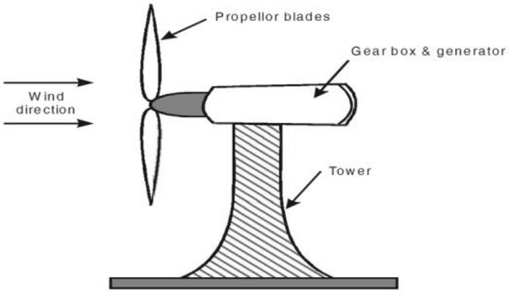
It consists of an insulated box inside of which is painted with black paint. It is also provided with a glass lid to receive and store solar heat. Inside the box it has black painted copper coil, through which cold water is allowed to flow in, which gets heated up and flows out into a storage tank. From the storage tank water is then supplied through pipes.



(2M)

2. **Wind energy :** Energy recovered from the force of wind (moving air) is wind energy

- **Wind mill:** When fast moving air strikes the wind mill blades, it starts to rotate. This rotational motion of the blades derives a number of machines like water pumps, flour mills and electric generators.



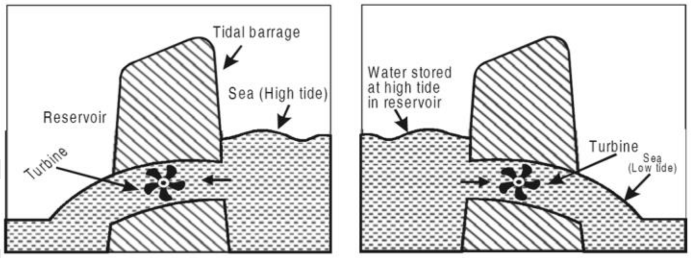
- **Wind Farms.**

When a large number of wind mills are installed and joined together in a definite pattern ir forms a wind farm. The wind farms, produce a large amount of electricity (2M)

3. **Ocean energy**

Ocean can also be used for generating energy of the following ways.

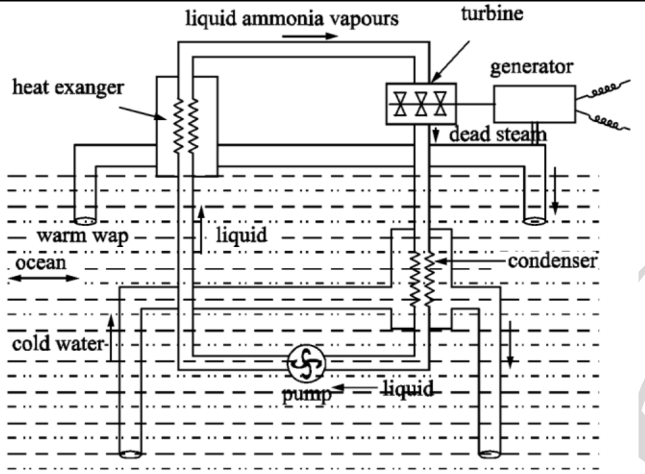
- **Tidal energy (or) Tidal power**
  - ✓ Ocean tides, produced by gravitational forces of sun and moon, contain enormous amount of energy.
  - ✓ The 'high tide' and 'low tide' refer to the rise and fall of water in the oceans.
  - ✓ The tidal energy can be harnessed by constructing a tidal barrage.
  - ✓ During high tide, the sea-water is allowed to flow into the reservoir of the barrage and rotates the turbine, which in turn produces electricity by rotating the generators.
  - ✓ During low tide, when the sea level is low, the sea water stored in the barrage reservoir is allowed to flow into the sea and again rotates the turbine.



(2M)

4. **Ocean thermal energy (OTE)**

Energy available due to the difference in temperature of water known as ocean thermal energy.



Warm surface water boils the liquid ammonia, thus high pressure steam is produced. This steam rotates the turbine which in turn produces electricity by a generator.

Dead steam passing through condenser condensed by the cold water at deep ocean. This liquid again pumped upwards using a pump. This process is repeated to produce the electricity using OTE. (3 M)

5. **Discuss the different types of nonrenewable energy resources.(15 M) (A.U. June 2006)** BTL2

Answer : Page : 5.43 – 5.58 - A. Ravikrishnan

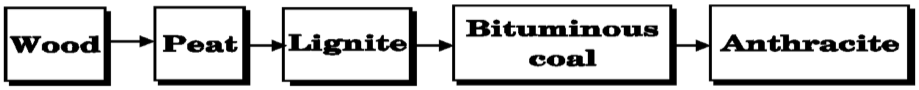
Non-renewable (Conventional) energy resources: Energy resources are natural resources, which cannot be regenerated once they are exhausted. They cannot be used again. Examples: Coal, petroleum, natural gas and nuclear fuels. (1M)

Non-renewable energy resources (or) Conventional energy resources

1. **Coal**

   Coal is a fossil fuel formed as several stages as buried remains of land plants that lived 300-400 million years ago.

   Various stages of coal formation



(1M)

The carbon content of Anthracite is 90% and its calorific value is 8700 k.cal. The carbon content of bituminous, lignite and peat are 80, 70 and 60% respectively.

Disadvantages of coal

- ✓ When coal is burnt it produces CO_2, causes global warming.
- ✓ Since it contains S, N, O, produces toxic gases during burning (1M)

2. **Petroleum**

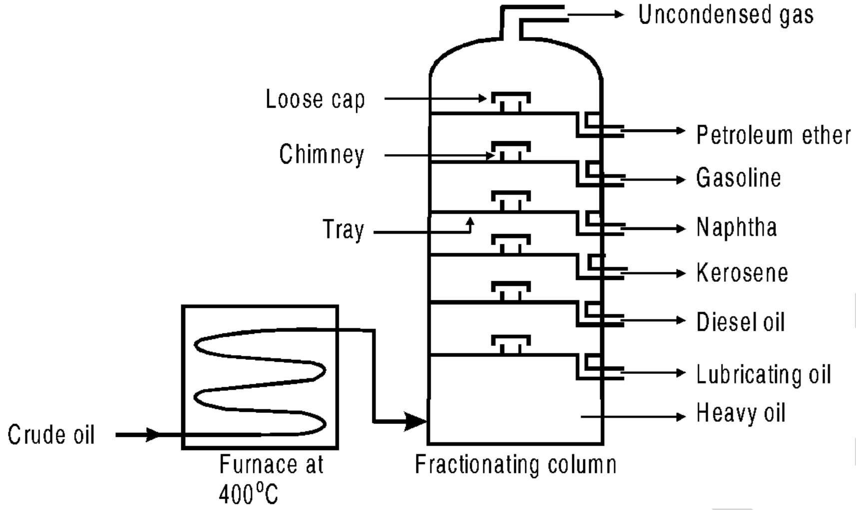
   Petroleum or crude oil is a thick liquid contains more than hundreds of hydrocarbons with small amount of S, N, O as impurities.

   <u>Occurrence of petroleum</u>

   Petroleum or Coal is formed by decomposition of dead animals and plants that were buried under lake and ocean at high temperature and pressure for millions of years. (1M)

Fractional distillation of petroleum

From petroleum various hydrocarbons are separated by purifying and fractionating using fractionating coloumn. (Fig.)



(2 M)

3. **LPG**

- ✓ Petroleum gas, obtained during cracking and fractional distillation, can be easily converted into liquid under high pressure as LPG.
- ✓ LPG is colourless and odourless gas.
- ✓ But during bottling some mercaptans is added, which produces bad odour, thereby any leakage of LPG from the cylinder can be detected instantaneously. (1M)

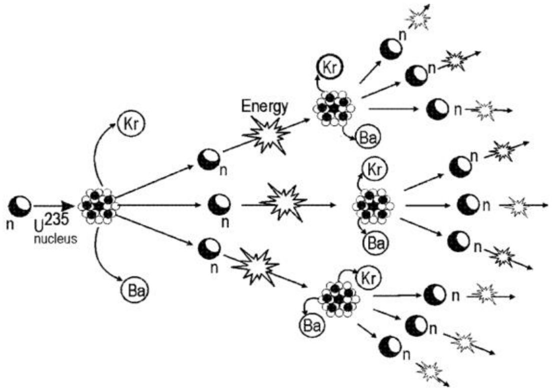
4. **Natural gas**

  - ✓ Natural gas is found above the oil in oil well.
  - ✓ It is a mixture of 50-90% methane and small amount of other hydrocarbons.
  - ✓ Its calorific value ranges from 12,000-14,000 k . cal/m3 (1M)

5. **Nuclear energy**

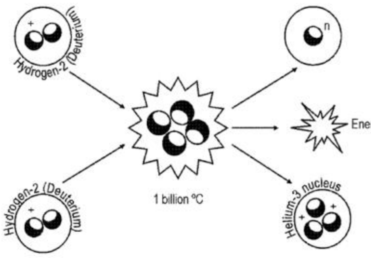
Energy released by nuclear fission or nuclear fusion.

Nuclear Fission: When a heavier nucleus split up in to two lighter nucli by bombardment of a fast moving neutron releases neutrons and tremendous energy.



(1 M)

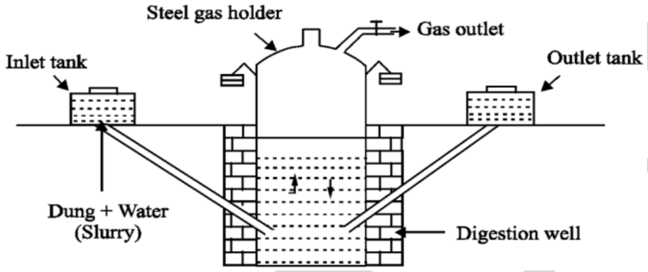
Nuclear Fusion: When two lighter nuclei combined together to form a heavier nucleus at very high temperature releases tremendous energy and neutrons.



Nuclear reactions are effectively used in nuclear power plants. (1M)

6. **Bio gas or Gobar Gas:** Mixture of various gases formed by anaerobic degradation of biological matter in the absence of oxygen. (1 M)

Production of bio gas



(1M)

Bio-gas plant or Gobar gas plant consists of a well like under ground tank (called digester) covered with dome shaped roof with a gas out let pipe. The dome of the digester acts as gas holder. On the left hand side of the digester there is a sloping inlet chamber through which cattle dung + water slurry is introduced. On the right hand side, there is a outlet chamber, through which spent dung slurry gets collected.

(1M)

Working

- ✓ Slurry (animal dung + water) is fed into the digester through the inlet chamber. The slurry, in the digester, is left for about two months for fermentation.
- ✓ Anaerobic micro-organisms are responsible for this action. As a result of anaerobic fermentation, bio-gas is collected in the dome.
- ✓ When sufficient amount of bio-gas is collected in the dome, it exerts a large pressure on the slurry and this in turn forces the spent slurry to the over flow tank through the outlet chamber.

(1M)

Uses of Bio Gas

1. Bio-gas is used for cooking food and heating water.
2. It is used to run engines.
3. It is also used as an illuminant in villages.
4. It is used for running tube-well and water pump-set engines.
5. It is directly used in gas turbines and fuel cells for producing electricity.

(1M)

5.	**Discuss the following case studies on** **(a) Deforestation (2 M)** **(b) Mining (8 M)** **(c) Food resources (3 M)** **(d) Renewable and Non-renewable energy resources (2 M)** BTL4 **Answer : Page : 5.10, 5.31, 5.42, 5.64 - A. Ravikrishnan** **(a)** Deforestation (2 M) (b) Mining (8 M) (c) Food resources (3 M) (d) Renewable and Non-renewable energy resources (2 M)

UNIT - IV SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

Q. No.	PART – A
1	**Define the term sustainable development. (NOV/DEC 2005, NOV/DEC 2007, NOV/DEC 2009, APR/MAY 2011)** BTL1 Sustainable development is defined as, "meeting the needs of the present without compromising the ability of future generations to meet their own needs".
2	**What are the advantages of rain water harvesting? (MAY/JUNE 2008)** BTL1 Reduction in the use of current for pumping water. • Mitigating the effects of droughts and achieving drought proofing. • Increasing the availability of water from well. • Rise in ground water levels. • Minimizing the soil erosion and flood hazards. • Upgrading the social and environmental status. • Future generation is assured of water.
3	**List the objectives of watershed management. (NOV/DEC 2009)** BTL4 • To minimize the risks, of floods, drought and landslides. • To develop rural areas in the region with clear plan for improving the economy of the region. • To manage the watershed for developmental activities like domestic water supply, irrigation, hydropower generation etc., • To generate huge employment opportunities in the backward rain- fed areas to ensure livelihood security. • 5. To promote social forestry and horticultural activity on all suitable areas of land.
4.	**Define the term environmental ethics. (NOV/DEC 2011, NOV/DEC 2013)** BTL1 Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment.
5.	**State a few drawbacks of pollution related acts. (NOV/DEC 2008)** BTL1 • The penalties in the act are very small when compared to the damage caused by the big industries due to pollution. • A person cannot directly file a petition in the court. • Litigation, related to environment is expensive, since it involves technical Knowledge. • For small unit it is very expensive to install Effluent Treatment – Plant • The position of chairman of the boards is occupied by political appointee. Hence it is difficult to implement the act without political interference.

6.	**What is meant by ISO 14000? (NOV/DEC 2008)** BTL1 ISO 14000 is the environmental management standards which exist to help Organizations minimize how their operations negatively affect the environment and Comply with applicable laws and regulations.
7	**What are the objectives of public awareness?** BTL1 • To create awareness among people of rural and city about ecological imbalances, local environment, technological development and various development plants. • To organize meetings, group discussion on development, tree plantation programmers, exhibitions. • To focus on current environment problems and situations • To train our planners, decision – makers, politicians and administrators. • To eliminate poverty by providing employment that overcome the basic environmental issues. • To learn to live simple and eco-friendly manner
8.	**What are the objectives of environmental impact assessment (EIA)?** BTL1 EIA is defined as a formal process of predicting the environmental consequences of any Development projects. It is used to identify the environmental, social and economic impacts of the Project prior to decision making. Objectives of EIA • To identify the main issues and problem of the parties. • To identify who is the party. • To identify what are the problems of the parties. • To identify why the problems are arise.
9.	**Define urbanization. (NOV/DEC 2010)** BTL1 Urbanization is the movement of human population from rural area to urban area for the want of better education, communication, health and employment.
10	**How can global warming be controlled? (NOV/DEC 2010, APR/MAY 2011)** BTL2 • By reducing the use of fossil fuels. • Utilize renewable resources such as wind, solar and hydropower. • Plant more trees. • Stabilize population growth. • Remove atmospheric CO_2 by utilizing photo synthetic algae.
11	**Mention any four fundamental rights of the individual. (NOV/DEC 2010)** BTL1 • Human right to freedom. • Human right to property. • Human right to religion. • Human right to culture and education. • Human right to equality.
12.	**What is E-Waste? (NOV/DEC 2011)** BTL2 The waste of electronic equipment like computers, printers and mobile phones, Xerox machines, calculators, etc. are e-waste.
13.	**What do we mean by environment refugees? (NOV/DEC 2011)** BTL2

	Environmental refugee is a person displaced due to environment causes, especially land loss, and degradation and natural disaster.
14.	**List the objectives of Forest Conservation act. (NOV/DEC 2013)** BTL1 • To protect and conserve the forest • To ensure judicious use of forest
15.	**What are the objectives of water act? (NOV/DEC 2014)** BTL1 • Prevention and control of water pollution. • Maintaining or restoring the wholesomeness of water. • Establishing central and state boards for the prevention and control of water pollution.
16	**Define consumerism and disaster. (NOV/DEC 2015)** BTL2 Consumerism refers to the interrelationship between sellers and buyer. Disaster is a geological process and is defined as an event concentrated in time and space, in which a society or sub-division of a society undergoes severe danger and causes loss of its members and physical property.
17	**What are landslides? (MAY/JUNE 2008, NV/DEC 2014)** BTL2 The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region due to gravitational pull is called landslides.
18	**What are the harmful effects of landslides?** BTL2 • Landslides block the roads and diverts the passage • Erosion of soil increases. • Sudden landslides damage the houses, crop yield, live stock etc.
19.	**Define the term Tsunami.** BTL2 A tsunami is a large wave that is generated in a water body when the sea floor is deformed by seismic activity. This activity displaces the overlying water in the ocean.
20	**Give comprehensive definition for air pollution. (NOV/DEC 2010, APR/MAY 2011)** BTL2 The presences of one are more contaminants like dust, smoke, mist and dour in the atmosphere, which are injurious to human beings, plants and animal.
21	**Mention four causes of floods. (NOV/DEC 2010)** BTL2 • Heavy rain, rainfall during cyclone causes flood. • Sudden snow melt also raises the quantity of water in streams and causes flood. • Clearing of forests for agriculture has also increased severity of floods. • Reduction in the carrying capacity of the channel, due to accumulation of Sediments cause floods.
22	**List the objectives of Forest Conservation Act. (NOV/DEC 2013)** BTL1 • Illegal non-forest activity within a forest area can be immediately stopped under this act. • Provides conservation of all types of forests. Non forest activities include clearing of forest land for cultivation of any types of crops.
23	**What are the important aspects of sustainable development?** BTL2 • Inter – generational equity It states that we should hand over a safe, healthy and resourceful environment to our future generations. • Intra – generational equity

	It states that the technological development of rich countries should support the economic growth of the poor countries and help in narrowing the wealth gap and lead to sustainability
24	**Explain the need for water conservation.** BTL2 • Though the resources of water are more, the quality and reliability are not high due to changes in environmental factors. • Better lifestyles require more fresh water. • As the population increases, the requirement of water is also more. • Due to deforestation, the annual rainfall is also decreasing. • Over exploitation of ground water, lead to drought. • Agricultural and industrial activities require more fresh water.
25	**Define the term environmental ethics. (NOV/DEC 2011, NOV/DEC 2013)** BTL2 "Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment".
26	**What is meant by environmental audit? (NOV/DEC 2008)** BTL2 Environmental audits are intended to quantify environmental performance and Environmental position. In this way they perform analogous function to financial Audits. It also aims to define what needs to be done to improve on indicators of such Performance and position.
27.	**What is consumerism? List any two objectives of consumerism.** BTL1 The consumption of resources by the people is known as consumerism. Objectives It improves the rights and powers of the buyer It forces the manufacturer to reuse and recycle the product after usage.
28.	**What is Eco-mark?** BTL1 Environmentally friendly products are generally indicated by the symbol called Eco-mark. Eco-mark is a certification mark issued by the Bureau of Indian Standard (BIS) to the environmental friendly products.
PART – B	
1	**What are the salient features of the Air pollution act, Water pollution act and Environment protection Act? Give the reason for why do we prefer environmental protection act as an Umbrella act. (13 M) (MAY/JUNE 2005, NOV/DEC 2005, JAN 2006, NOV/DEC 2006, NOV/JUNE 2007, NOV/DEC 2009, NOV/DEC 2010, MAY/JUNE 2011, NOV/DEC 2013, DEC 2014)** BTL4 **Answer : Refer : 6.34 – 6.38 - A. Ravikrishnan** • Objectives and features of environment protection act (5 M) • Objectives and features of air pollution act (4 M) • Objectives and features of water pollution act (4 M) i. Prevention and control ii. Estabilishment of State and Central boards. iii. Framing Guidelines and Standards. iv. Punishment for violations.
2	**Explain in detail the strategies adopted for conservation of water. (6 M) (NOV/DEC 2009, APR/MAY 2010, NOV/DEC 2010, APR/MAY 2011, NOV/DEC 2014)** BTL2 **Answer : Refer : 6.7 – 6.8 - A. Ravikrishnan** • Reducing evaporation loss (1 M)

	• Reducing irrigation loss (1 M) • Re-use of water (1 M) • Preventing wastage of water (1 M) • Decreasing run-off losses (1 M) • Avoid discharge of sewage (1 M)
3	**Discuss in detail about Wild life protection act 1972 and Forest conservation act 1980. (13 M) (NOV/DEC 2010, NOV/DEC 2014)** BTL4 **Answer : Refer : 6.38 – 6.40 - A. Ravikrishnan** • Objectives of Wildlife protection act (2 M) • features of wildlife protection act (4 M) • Objectives of Forest conservation act (2 M) • Features of Forest conservation act (5 M) . Prevention and control i. Estabilishment of State and Central boards. ii. Framing Guidelines and Standards. iii. Punishment for violations.
4	**Explain the following** **(a) Sustainable development (6 M)** BTL2 **(b) Urban problems related to energy. (7 M) (NOV/DEC 2005, NOV/DEC 2006, MAY/JUNE 2007, NOV/DEC 2010, NOV/DEC 2011, MAY/JUNE 2013)** BTL2 **i. Answer : Refer : 6.21 – 6.6 - A. Ravikrishnan** Sustainable development : • World summit (Agenda) (2 M) • Aspects (2 M) • Concept and significance (2 M) **ii. Answer : Refer : 6.21 – 6.6 - A. Ravikrishnan** Urban problems related to energy : • Definition of urbanization (2 M) Urbanization is the movement of human population from rural areas to urban areas for the want of better education, communication, health, employment, etc. • Energy demanding activities (3 M) • Solution for urban energy problem (2 M)
5	**Discuss the phenomenon of global warming and the factors contributing to it. (13 M)** BTL4 • Explanation of phenomenon of global warming (7 M) • Contributing factors (6 M)
6	**Give a note on nuclear accidents and holocausts. (6 +7 M) (MAY/JUNE 2013, NOV/DEC 2013)** BTL4 **Answer : Refer : 6.24 – 6.26 - A. Ravikrishnan** • Nuclear energy and nuclear accidents (2 M) • Types of nuclear accidents (4 M) • Effect of nuclear holocaust (4 M) • Control measures of holocausts (3 M)

7.	**State the 12 principles of green chemistry. (7 M)** BTL1 **Answer : Refer : - A. Ravikrishnan** • **Prevention.** It is better to prevent waste than to treat or clean up waste after it is formed. • **Atom Economy.** Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product. • **Less Hazardous Chemical Synthesis.** Whenever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment. • **Designing Safer Chemicals**. Chemical products should be designed to preserve efficacy of the function while reducing toxicity. • **Safer Solvents and Auxiliaries**. The use of auxiliary substances (solvents, separation agents, etc.) should be made unnecessary whenever possible and, when used, innocuous. • **Design for Energy Efficiency.** Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure • **Use of Renewable Feed stocks.** A raw material or feedstock should be renewable rather than depleting whenever technically and economically practical. • **Reduce Derivatives.** Unnecessary derivatization (blocking group, protection/deprotection, temporary modification of physical/chemical processes) should be avoided whenever possible . • **Catalysis**. Catalytic reagents (as selective as possible) are superior to stoichiometric reagents. • **Design for Degradation**. Chemical products should be designed so that at the end of their function they do not persist in the environment and instead break down into innocuous degradation products. • **Real-time Analysis for Pollution Prevention**. Analytical methodologies need to be further developed to allow for real-time in-process monitoring and control prior to the formation of hazardous substances. • **Inherently Safer Chemistry for Accident Prevention**. Substance and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires (7 M)
8.	**What is rain water harvesting? What are the purposes survived by it? (7 M)** BTL2 **Answer : Refer : 6.8 - A. Ravikrishnan** **Rain water harvesting :** A technique of capturing and storing of rain water for further utilization (1 M) **Objective:** • To meet increasing demands of water • Raise water table by recharging ground water • Reduce ground water contamination from salt water intrusion • To reduce the surface run-off losses • To reduce storm water and soil erosion • To increase hydrostatic pressure to stop land subsidence

	• To reduce water crises and water conflicts (1 M) **Roof top rainwater harvesting** • Involves collecting water that falls on roof of house • Rainwater from roof top, road surface, playground diverted to surface tank. Explanation (2 M) • Diagram (2 M) **Advantages of rainwater harvesting** • Increases the well water availability § Raise ground water level • Minimizes soil erosion and flood hazards • Upgrading the environmental and social status • Reduction in the use of current for pupping water • Future generation is assured for water (1 M)
9.	**What is wasteland? Mention its types and sources. Explain the objectives and methods of wasteland reclamation. (7 M)** BTL2 **Answer : Refer : 6.28 - A. Ravikrishnan** The land which is not in use is named as wasteland. Types: 1. Uncultivable wasteland 2. Cultivatable wasteland (1 M) Causes of wasteland (1 M) Objectives of wasteland reclamation (1 M) Methods of wasteland reclamation (4 M)
10.	**List the traditional rights of seller and buyer. Describe the objectives of consumerism and factors affecting consumerism. (7 M)** BTL2 **Answer : Refer : 6.31 - A. Ravikrishnan** Traditionally favourable rights of seller (1 M) Traditional buyer rights (1 M) Objectives of consumerism (3 M) Factors affecting comsumerism (2 M)
11.	**What is biomedical waste? Describe types and the various steps involved in management of biomedical waste. (7 M)** BTL2 **Answer : Refer : 6.41 - A. Ravikrishnan** Waste generated from health care activities. (1 M) Types of biomedical waste (3 M) Three steps involved in management of biomedical waste (3 M)
12.	**Define watershed and watershed management? Explain the concept of watershed management in detail. (13 M)** BTL2 **Answer : Refer : 6.11 - A. Ravikrishnan** Watershed – The land area from which water drains under the influence of gravity into a stream, lake, reservoir or other body of surface water, (1 M) Watershed management – The management of rainfall and resultant runoff is called watershed management. (1 M) Factors affecting watershed management (1 M) Objectives of watershed management (2 M) Watershed management techniques (2 M) Components of integrated watershed management (6 M)

13.	**Discuss the causes, effects and control measures of Acid rain. (8 M)** BTL2 Introduction (1 M) Formation of acid rain (2M) Effects of Acid rain (3M) i. Effects on Human beings. ii. Effects on buildings iii. Effects on Ecosystem. Control measures. (2 M)
14.	**Discuss the causes, effects and control measures of ozone layer depletion. (8 M)** Importance of Ozone layer with diagram (1 M) Formation of Ozone (2 M) Mechanism (2 M) Ozone depleting substance (1) Effects (1 M) Control measures (1 M)
15.	**Give Short notes on Climatic change and Green House Effect. (8 M)** BTL 3 Definition (2 M) Causes (1 M) Effects (1 M)
PART–C	
1	**What is an Acid rain? Write about its causes, effects and measures to face the Acid rain. (15 M) (APR/MAY 2008, NOV/DEC 2008, NOV/DEC 13, NOV/DEC 2014)** BTL4 **Answer : Refer : 6.58 – 5.58 - A. Ravikrishnan** • Definition: An earthquake is a sudden vibration caused on the earth's surface due to the sudden release of tremendous amount of energy stored in the rocks under the earth's crust. (2 M) • Causes (4 M) • Effects (4 M) • Preventive measures (5 M)
2	**Give a note on** (a)Climatic changes (b) Global Warming (c) Ozone layer Depletion **(15 M)** BTL2 **Answer : Refer : 6.52 – 6.57 - A. Ravikrishnan**

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

Q. No.	PART-A
1.	**Define immigration and emigration. (Coim A.U. Dec 2009)** BTL1 **Immigration -** Arrival of individuals from neighbouring population. **Emigration -** Dispersal of individuals from the original population to new areas
2.	**Define population and population density. (Coim A.U. Dec 2009, Chen A.U. Apr 2011)** BTL1 **Population**-Group of Individuals belonging to the same species, which live in a given area at a given time. **Population density**-Number of individuals of the population per unit area (or) unit volume
3.	**Define birth rate and death rate.** BTL1 **Birth rate or Natality**-No. of live birth per 1000 people in a population in a given year **Death rate or Mortality**-No. of deaths per 1000 people in a population in a given year
4.	**Define doubling time with reference in population growth. (Chen A.U. Dec 2008, 2013)** BTL1 Time required for a population to double its size at a constant annual rate. $Doubling\ time = Td = \frac{70}{r}$ Where, r - Annual growth rate. If a nation has 2% annual growth; its population will double in the next 35 year.
5.	**What are the reasons behind the increased population growth in the less developed nations compared with developed nations? (Chen AU Dec 2007)** BTL1 • Due to decrease in the death rate and increase in the birth rate • The availability of antibodies, immunization, increased food production, clean water and air decreases the famine-related deaths and infant mortality. • In agricultural based countries, children are required to help parents in the fields.
6.	**Write population equation. (Coim. A.U. Dec 2008)** BTL1 $Pt + 1 = Pt + (B - D) + (I - E)$ Where Pt and Pt+1 = sizes of population in an area at two different point s in time t and t+1; B- Birth rate I-Immigration; D-Death Rate; E-Emigration.
7.	**List the characteristics of population growth.** BTL4 • Exponential growth • Doubling time • Infant mortality rate • Total fertility rates (TFR) • Replacement level

	• Male-Female Ratio • Demographic transition
8.	**Mention the various problems of population growth.** BTL4 • Increasing demands for food and natural resources • Inadequate housings and health services • Loss of agricultural lands • Unemployment and socio-political unrest • Environmental pollution
9.	**What is population explosion? (Chen AU Jun 2007, May 2008, TCY A.U. Dec 2008, Dec 2009, Dec2010, Apr 2015)** BTL1 The enormous increase in population due to low death rate and high birth rate.
10.	**What are the effects of population explosion? (Chen A.U. Dec 2009)** BTL1 • Poverty • Environmental degradation • Over exploitation of natural resources • Renewable resources like forests, grass lands are also under threat • Will increase disease, economic inequity and communal war • Leads to development of slums • Lack of basic amenities like water supply and sanitation, education, health, etc • Unemployment and low living standard of people
11.	**How the age structure of population can be classified?** BTL4 • Pre-productive population (0-14 years) • Reproductive population (15-44 years) • Post reproductive population (Above 45 years)
12.	**State the reasons of population explosion.** BTL1 • Invention of modern medical facilities; Illiteracy • Decrease in death rate and increase in birth rate • Availability of antibiotics, Food, clean water, air, etc. • Decreases the famine-related deaths and infant mortality • In agricultural based countries- Children are required
13.	**What is family welfare programme?** BTL1 Programme implemented by the government of India. An integral part of overall national policy of growth covering human health, maternity, family welfare, child care and women's right, education, nutrition, health, employment, shelter, safe drinking water
14.	**Define population stabilization ratio.** BTL1 Ratio of crude death rate to crude birth rate.
15.	**What are the objectives of family welfare programme? (TNV A.U. Dec 2009)** BTL1 • Slowing down the population explosion by reducing the fertility • Pressure on the environment due to over exploitation of natural resources is reduced
16.	**List the factors influencing family size.** BTL4 • Reduce infant mortality rate to below 30 per 1000 infant • Achieve 100% registration of births, deaths, marriage and pregnancy • Encourage late marriage, late child-bearing, breast feeding

	• Enables to improve women’s health, education and employment • Prevent and control of communicable disease and AIDS/HIV • Promote vigorously the family norms • Making school education up to age 14 free and compulsory
17.	**What is meant by NIMBY syndrome? (Chen A.U. Dec 2008)** BTL1 NIMBY-**N**ot **I**n **M**y **B**ack **Y**ard. Describes the opposing of residents to the nearby location of something they consider undesirable, even clearly a benefit for many
18.	**List the factors influencing human health.** BTL4 • Nutritional Factors • Biological Factors • Chemical Factors • Psychological Factors
19.	**What is meant by human rights?** BTL1 The fundamental rights which are possessed by all human beings irrespective of their caste, nationality, sex and language. These cannot be taken away by any legislature. Every citizen must enjoy certain rights and also has certain duties towards the country.
20.	**List the features of draft declaration of human rights**. BTL4 • Human rights to freedom • Human rights to property • Human rights to freedom of religion • Human rights to culture and education • Human rights to constitutional remedies • Human rights to equality • Human rights against exploitation • Human rights to food and environment • Human rights to good health
21.	**What is education? List its types.** BTL1 **Education-**learning through which knowledge about the particular thing can be acquired **Types of Education** • **Formal Education**-Self related. Will read, write, get jobs and tackle the problems • **Value Education**–Instrument to analyse our behavior and provide proper direction to youth. Teaches distinction between right and wrong, helpful, loving, etc. • **Value-based environmental education**-Provide knowledge on principles of ecology, fundamentals of environment and biodiversity
22.	**Write the importance of value education. (Chen A.U. Dec 2008, 2013)** BTL2 • Improve the integral growth of human being • Create attitudes and improvement towards sustainable lifestyle • Increase awareness about our national history, cultural heritage, constitutional rights, national integration, community development and environment • Create and develop awareness about the values, role and their significance
23.	**What is role playing element of value education?** BTL1 Acting out the true feelings of the actors by taking the role of another person but without the risk of reprisals.

24.	**Mention the types of values imported through value education.** BTL1 • Universal Values or Social Values • Cultural Values • Individual Values • Global Values • Spiritual Values
25.	**Define the term HIV/AIDS.** BTL1 **HIV**-**H**uman **I**mmunodeficiency **V**irus; **AIDS**-**A**cquired **I**mmuno **D**eficiency **S**yndrome; a condition in humans in which the immune system begins to fail, leading to life-threatening opportunistic infections.
26.	**What are the factors which do not influence transmission of HIV?** BTL1 Tears, food, air, cough, handshake, mosquito, flies, insect bites, urine, saliva during kissing, sharing of utensils, cloths, toilet, bathroom etc.
27.	**Mention some effects of HIV/AIDS. (Chen A.U. Dec 2008, 2011, 2014)** BTL1 • Large number of death occurs, which affect environment and natural resources • Loss of labour and level of production decreases • Required more water for maintaining hygiene in AIDS affected locality • People affected by HIV, cannot perform work well, due to lack of energy and frequent fever and sweating
28.	**What are the major precautions to avoid AIDS? (Chen AU May 2008)** BTL1 • Avoid indiscriminate sex and encourage the use of condoms and also avoid the use of sharing razors needles and syringes • Prevention of blood borne HIV transmission • Aids awareness programmes should be encouraged • Counseling services should be provided • Drug treatment
29.	**State the role of information technology in Environment. (Coim A.U. Dec 2009, Chen AU Jan 2006)** BTL4 • Plays a vital role in the field of environmental education. • Means collection, processing, storage and dissemination of information. • Numbers of software have been developed to study about the environment. • The internet facilities, information through satellites, World Wide Web, and geographical information systems provide us up-to-date information on various aspects of environment and weather.
30.	**What is value education? Give its significance. (NOV/DEC 2013)** BTL4 An instrument used to analyse our behavior and provide proper direction to our youths. Teaches them the distinction between right and wrong, to be compassionate, helpful, loving, generous and tolerant. So that a youth can move towards the sustainable future.
31.	**What do you mean by Doubling Time? (NOV/DEC 2013)** BTL1 Period of time required for a quantity to double in size or value. Generally applied to denote the population growth.
32.	**State the role of Information Technology in health protection.** BTL1 • Health organization turning to package solution of IT for streamlining services oriented work in effective manner.

	• Health service technology such as finance and accounting, pathology, patient administration • Helps the doctor to monitor the health of the people effectively • Online help of expert doctors can be used for the patient • The outbreak of epidemic diseases can be conveyed easily • Effective function of a hospital • Drugs and its replacement can be administered efficiently • The data regarding birth and death rate, immunization and sanitation programmes can be maintained accurately with the help of computers
33.	**What is environmental impact assessment?** BTL1 Formal process of predicting the environmental consequences of any development projects. Used to identify the environmental, social and economic impacts of the project prior to decision making.
34.	**What is GIS?** BTL1 Graphical Information System (GIS) acts as a technique of superimposing various thematic maps with the use of digital data on a large number of inter-related aspects. Considered to be an effective tool in environmental management.
35.	**List out the benefits of EIA.** BTL4 • Reduce the cost and time • Performance of the project improved • Waste treatment and cleaning expenses are minimized • Usages of resources are decreased • Biodiversity is maintained • Human health is improved (
36.	**Mention the key element of EIA.** BTL1 • **Scoping** – To identify the key issues of the concern in the planning process at early stage, aid site selection and identify any possible alternatives. • **Screening -**To decide whether an EIA is required or not. • **Identifying and evaluating alternatives-**Knowing alternative sites and techniques and their impacts. • **Mitigation measures dealing with uncertainty-**Action taken to prevent adverse effect of a project. • **Environmental statements-**Final stage of EIA process which reports the findings of the EIA.
37.	**What is child welfare? Mention the schemes towards child welfare.** BTL1 **Child Welfare** • Children occupy 40% of the total population. • Out of 21 Million Children born every year in India, 20 Million are estimated to be working as Child Labour in hazardous industries **Organizations towards Child Welfare** • UN Conventions on Rights of Child or International Laws • Rights of child • …Right to Survival

  - …Right to Participation
  - …Right to Development
  - …Right to Protection
- Ministry of HRD
- Centre for Science and Environment (CSE)
- Environment degradation and child welfare

So it is essential to keep our environment clean to children for better and healthy life Poverty

38. **What is women welfare? List the various organization function towards women welfare.** BTL1

Welfare to improve the status of the women by providing opportunities in education, employment and economic independence (1M)

Organizations Towards Women Welfare

- NNWM (National Network for Women and Mining): Fighting for the "Gender Audit" of India's mining companies
- UNDW (United Nations Decade for Women): Women welfare related issues on international agenda
- CEDAW (Convention on Elimination of all forms of Discrimination against Women)
- NGO's as Mahila Mandals
- Ministry for Women and Child Welfare (1M)

PART – B

1. **(i) Can you recall population characteristics & variations among nations? (7M)** BTL1
(ii) What is population explosion and state the views on population growth. (6M) BTL2

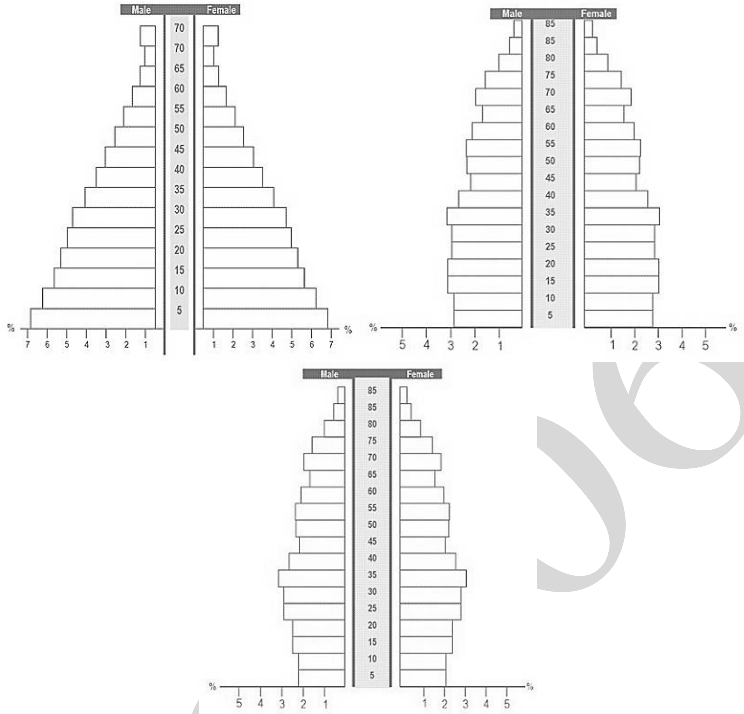
(i) Answer: Page: 7.3 – 7.8-**A. Ravikrishnan**

Characteristics of population growth

- Exponential growth
- Doubling time
- Infant mortality rate
- Total fertility rates
- Replacement level
- Male-Female ratio
- Demographic transition (3M)

Variation of population among nation based on age structure

- Pre-productive population (0-14 years)
- Reproductive population (15-44 years)
- Post Reproductive population (above 45 years)
  - Pyramid shaped variation of population (Increase)
  - Bell shaped variation of population (Stable)
  - Urn shaped variation of population (Decrease) (2M)



- Diagrams (2M)

(ii) Answer: Page: 7.8 – 7.11-**A. Ravikrishnan**

Population explosion–Enormous increase in population due to low death rate and high birth rate is termed as population explosion. (1M)

Causes of population explosion

- Invention of modern medical facilities; Illiteracy
- Decrease in death rate and increase in birth rate
- Availability of antibiotics, Food, clean water, air, etc.
- Decreases the famine-related deaths and infant mortality
- In agricultural based countries- Children are required (3M)

Effect of Population Explosion

Poverty; Environmental degradation; Unsustainable environment; Over exploitation of natural resources; Renewable resources become under threat; Increase disease, economic inequity and communal war; development of slums; lake of basic amenities; Unemployment. (2M)

2.

(i) How would you explain the family welfare programs (8M) BTL2

(ii) Show family planning in Indian context. (5M) BTL2

(ii) Answer: Page: 7.11 – 7.14-A. Ravikrishnan.

Family welfare programme

- An integral part of overall national policy of growth covering human health, maternity, family welfare, child care and women's right, education, nutrition, health, employment, shelter, safe drinking water (1M)

Objectives of family welfare programme

- Slowing down the population explosion by reducing the fertility
- Pressure on the environment is reduced (1M)

Objectives of family planning

- Reduce infant mortality rate to below 30 per 1000 infant
- Achieve 100% registration of births, deaths, marriage and pregnancy
- Encourage late marriage and late child-bearing.
- Encouraging breast feeding
- Enables to improve women's health, education and employment
- Making family planning available to all women who wanted do
- Constrain the spread of AIDS/HIV
- Prevent and control of communicable disease
- Promote vigorously the family norms
- Making school education up to age 14 free and compulsory (3M)

Methods of family planning

- Traditional method
- Modern method
- Temporary method (3M)

(iii) Answer: Page: 7.14-A. Ravikrishnan. (BTL2)

Family planning in India

- It was started in the year 1952
- In 1970's Indian government forced family planning campaign all over the country
- In 1977, national family programme and ministry of health and family welfare redesigned
- In 1978, the government legally raised the minimum age of marriage for men from 18 to 21 and for women 15 to 18
- In 1981, census report showed that there was no drop in population. Since then funding for family planning programmes has been increased further
- The first country that implemented the family welfare programme at government level
- Centrally sponsored programme. For this, the states receive 100% assistance from central government
- The ministry of health and family welfare have started the operational aims and objectives of family welfare
    - To promote the adoption of small family size norm, on the basis of voluntary acceptance
    - To ensure adequate supply of contraceptives to all eligible couples within easy each
    - Extensive use of public health education for family planning (5M)

3. **Discuss the influence of environmental parameters and pollution on human growth. (13M)** BTL2

Answer: Page: 7.14 – 7.17-A. Ravikrishnan

Factors influencing human health-A state of complete physical, mental, social and spiritual well-being and not merely the absence of disease or infirmity. “The Ability To Lead A Socially And Economically Productive Life.”

- Nutritional factors
- Biological factors
- Chemical factors
- Psychological factors (3M)

Holistic concept of health-Recognizes the strength of social, economic, political and environmental influences on health

Determinants of health- Heredity, Health and family welfare services, Environment, Life-style Socio-economic conditions. Disease result from complex interaction between man and the environment.

Disease-“Maladjustment of the human organism to the environment”. (2M)

Environmental degradation due to population explosion

- All that which is external to man is the environment
- The concept of environment is complex
- The external environment or the Macro-environment to be responsible for millions of preventable diseases originating in it (1M)

Environmental hazards

- **Physical:** Air, water, soil, housing, climate, geography, heat, light, noise, debris, radiation, etc. and their health effects
- **Biological**: bacteria, viruses, parasites, microbial agents, insects, rodents, animals and plants, etc. and their health effects
- **Chemical**: Combustion of fossil fuel liberates SO_2, NO_2, CO_2 ; Industrial effluents; Pesticides; Heavy metals; Chloro fluoro carbons and their health effects
- **Psychosocial**: Cultural values, customs, beliefs, habits, attitudes, morals, religion, education, lifestyles, health services, social and political organization and their health effects (7M)

4.

(i) Write short notes on human rights. (5M) BTL4

(ii) Discuss the salient features of draft declaration of Human Rights and environment. (8M) BTL2

(i) Answer: Page: 7.17-7.19 A. Ravikrishnan.

Human rights

- The fundamental rights which are possessed by all human beings irrespective of their caste, nationality, sex and language
- These cannot be taken away by any legislature or an government act
- Seen as belonging to men and women by their very nature
- India is a democratic country
- Aim of India is to ensure happiness to all the citizens with equal rights, opportunities and comforts

- Every citizen must enjoy certain rights and also has certain duties towards the country
- Include civil and political rights, such as the right to life and liberty, freedom of expression, and equality before the law; and social, cultural and economic rights, including the right to participate in culture, the right to food, the right to work, and the right to education.
- All human beings are born free and equal in dignity and rights
- They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood (5 M)

(ii) Answer: Page: 7.17-7.19**-A. Ravikrishnan.** BTL2

Features of draft declaration of human rights

- Human rights to freedom
- Human rights to property
- Human rights to freedom of religion
- Human rights to culture and education
- Human rights to constitutional remedies
- Human rights to equality
- Human rights against exploitation
- Human rights to food and environment
- Human rights to good health (8M)

5. **Summarize the objectives, concepts, types of values and elements of value education? How can the same be achieved? (13M)** BTL3

Answer: Page: 7.20 – 7.24-A. Ravikrishnan

Education-learning through which knowledge about the particular thing can be acquired

Types of Education

- Formal Education-Self related
- Value Education–Instrument to analyse our behavior and provide proper direction to youth
- Value-based environmental education-Provide knowledge on principles of ecology, fundamentals of environment and biodiversity (1M)

Objectives of value education

- To improve the internal growth of human beings.
- To create attitudes and improvement towards sustainable life style.
- To increase awareness on national history, our cultural heritage, constitutional rights, national integration, community development and environment.
- To create and develop awareness about the values and their significance and role.
- To understand about our natural environment in which land and, air and water are interlinked. (2M)

Concepts of value education

- Why and how can we use less resources and energy?
- Why do we need to keep our surrounding clean?

	- Why should we use less fertilizers and pesticides? - Why it is important for us to save water and keep our water sources clean? - Separate our garbage into degradable and non-degradable types before disposal (2M) **Types of values** - **Universal Values or Social Values**: Expresses the human nature reflected as joy, compassion, tolerance, service, truth, etc - **Cultural Values:** To reflect true and the false behaviour of human beings in language, aesthetics, education, law, economics, etc - **Individual Values:** Parents and Teachers shape individual values to a greater extent - **Global Values:** To reduce disturbance of Harmony leading to ecological imbalance - **Spiritual Values:** To become more self-disciplined (3M) **Elements of value education–How the objectives can be achieved** - Telling Modeling - Role playing - Problem solving - Studying biographies of great man (5M)
6.	**Explain the objectives, benefits and key elements of EIA (13M) (TNV AU Dec. 2009)** BTL2 **Answer: Page:7.32 – 7.34-A. Ravikrishnan** **Objectives of EIA** - To identify the main issues and problems of the parties - To identify who is the party - To identify what are the problems of the parties - To identify why are the problems arise (2M) **Benefits of EIA** - Reduce the cost and time - Performance of the project improved - Waste treatment and cleaning expenses are minimized - Usages of resources are decreased - Biodiversity is maintained - Human health is improved (2M) **Key element of EIA** - **Scoping** – To identify the key issues of the concern in the planning process at early stage, aid site selection and identify any possible alternatives. (2M) - **Screening -**To decide whether an EIA is required or not. (2M) - **Identifying and evaluating alternatives-**Knowing alternative sites and techniques and their impacts. (1M) - **Mitigation measures dealing with uncertainty-**Action taken to prevent adverse effect of a project. (2M)

	• **Environmental statements-**Final stage of EIA process which reports the findings of the EIA. (2M)
7.	**Explain in details about women welfare and child welfare. (13M)** BTL2 **Answer: Page: 7.28 – 7.32-A. Ravikrishnan** **Women welfare** Welfare to improve the status of the women by providing opportunities in education, employment and economic independence (1M) **Need for Women Welfare** • As women suffer Gender Discrimination • Due to physical and mental torture given to them • Violation of Human Rights to Women. • Neglecting of Women in Policy making and decision making (2M) **Objectives of Women Welfare** • To provide Education • To impart Vocational Training • To generate awareness about the environment • To improve employment opportunities • To restore Dignity, Status and Equality (2M) **Objectives National Commission for Women by Government of India** • To examine constitutional and human rights for women. • To review existing legislations. • To sensitize the enforcement and administrative machinery to women's causes (1M) **Organizations Towards Women Welfare** • NNWM (National Network for Women and Mining): Fighting for the "Gender Audit" of India's mining companies • UNDW (United Nations Decade for Women): Women welfare related issues on international agenda • CEDAW (Convention on Elimination of all forms of Discrimination against Women) • NGO's as Mahila Mandals • Ministry for Women and Child Welfare (2M) **Child Welfare** • Children occupy 40% of the total population. • Out of 21 Million Children born every year in India, 20 Million are estimated to be working as Child Labour in hazardous industries (1M) **Reason for Child Labour** • Poverty • Want of Money (1M) **Organizations towards Child Welfare**

- **UN Conventions on Rights of Child or International Laws**-Formulated a set of International Standards to promote and protect the wellbeing of Children in our society
- **Rights of child**
    - …Right to Survival
    - …Right to Participation
    - …Right to Development
    - …Right to Protection
- **Ministry of HRD**-Concentrates on child's health, education, nutrition, clean and safe drinking water, sanitation and environment
- **Centre for Science and Environment (CSE)**-Scientific report says that "Children consume more water, food and air than adults and hence more susceptible to environmental contamination
- **Environment degradation and child welfare**-Children are more affected due to environmental pollution. So it is essential to keep our environment clean to children for better and healthy life Poverty (3M)

8. **Write a note on Indian constitution. (13M)** BTL1

Answer: Page: 7.19 – 7.20-A. Ravikrishnan
Indian constitution; Article 14-30 .

- Article 14: Provides Equality before Law
- Article 15: Prohibits Discrimination
- Article 16: Provides Equal Opportunity
- Article 19: Provides Freedom of Speech and Expression
- Article 20: Provides Protection from Conviction
- Article 22: Lays down the Rights of a person in Custody
- Article 23: Prohibits forms of Forced Labour
- Article 24: Prohibits appointment of Child Labour
- Article 25: Provides Freedom to Practice any Religion
- Article 26: Right to establish Charitable Institutions
- Article 27: Prohibits Tax for Promoting Religion
- Article 28: Guarantees Secular Character in Education
- Article 29: Right to conserve their Language for Minorities
- Article 30: Right of Minority to run Educational Institutions
- Article 32: Right to Constitutional Remedies for enforcement of Rights by proceeding in Supreme Court (13M)

PART-C

1. **(i) Narrate the role of information technology in environment protection (TNV AU Dec.2008 Dec. 2009, June 2013, Nov. 2011) (8M)** BTL4
(ii) Describe the case studies on role of IT in environment protection. (7M) BTL5

Answer: Page: 7.34 – 7.37-A. Ravikrishnan

(i) Role of IT in environment

Software for environment education

- **Remote Sensing**-Gather information about an object without contact with it
    - In agriculture
    - In forestry
    - In land cover
    - Water resources Remote sensing (2M)
- **Data base**
    - The ministry of environment and forest
    - National Management Information System (NMIS)
    - Environment Information System (ENVIS) (1M)
- **Geographical Information System (GIS) –**Superimposing various thematic maps
    - Water resources, soil type, forest land
    - Interpretations of polluted zones, degraded lands
    - Check unplanned growth and environmental problems (1M)
- **Satellite data**
    - Forest cover information
    - Information on monsoon, ozone layer depletion, smog etc.
    - Discovery of new reserves of oils, minerals, etc. (1M)
- **World Wide Web**
    - Online learning centers
    - Provides the current and relevant information on principles, queries, and applications of environmental science.
    - Stores all digital files related to teaching (1M)
- **General applications**
    - Easily Accessible around The World
    - Disaster Management-Suitable warning system, disaster preparedness
    - Opened up a large number of scientific and technological resources and skills to reduce disaster risk.
    - Internet
    - Aerial sensor technologies to detect and classify objects on earth.
    - To capture, store, manipulate, analyse, manage and present geographical data.
    - Store books, pictures and other data that reduces paper waste that helps us in saving trees.
    - E-bills has significantly increased, which also contribute in saving trees. (2M)

(ii) Answer: Page: 7.38 – 7.39-A. Ravikrishnan

Case studies on Role of IT in environment

- Study on polluted back waters of Kerala
- Ocean study monitor (OCM) to study phytoplanktons
- GIS for forest management
- National Emission Data System (NEDS)
- Environment Information System (ENVIS) (7M)

2.

(i) **Explain the role of IT in protection of human health. (10 M) (AU June 2013, Dec. Nov. 2009)(10M)** BTL4

(ii) Explain the case study on role of IT in human health protection. (5M) BTL5

(i) Answer: Page: 7.39–7.40-A. Ravikrishnan

Role of IT in human protection

- Health service technology- Finance and accounting, pathology, patient administration.
- Helps the doctor to monitor the health of the people effectively.
- Online help of expert doctors can be used for the patient.
- The outbreak of epidemic diseases can be conveyed easily.
- Effective function of a hospital.
- Drugs and its replacement can be administered efficiently.
- The data maintenance- birth and death rate, immunization and sanitation programmes
- Spreading awareness about diseases and preventive measures to be taken.
- Reduces panic and provides information about prevention and treatment options.
- Airports-Screened passengers for high temperature and other symptoms
- Robots that emulate or simulate living biological organisms.
- Nano-Robots act as delivery systems within the organism
- e-Health for healthcare practice.
- Gaining momentum in academic research as well as in psychology, clinical work, and mental health counselling.
- Statistics about diseases like malaria, fluorosis, AIDS, etc.
- DNA databases about population, medical records, fingerprints, etc
- Saves lives in critical care and emergency situations.
- Bioinformatics for drug discovery and thus contributing to human health.
- Provide a great support in maintaining individual fitness. (10M)

(ii) **Answer: Page: 7.40–7.41-A. Ravikrishnan**

Case study

Health services on New south wales (3 M)

National Institute of Occupational health (2M)

3.

Explain HIV/AIDS, its sources, diagnosis, mode of transmission of HIV infection and control and preventive measures.(15M) BTL2

Answer: Page: 7.24 – 7.28**-A. Ravikrishnan**

HIV-**H**uman **I**mmunodeficiency **V**irus; **AIDS**-**A**cquired **I**mmuno **D**eficiency **S**yndrome; a condition in humans in which the immune system begins to fail, leading to life-threatening opportunistic infections. (2M)

Sources of HIV infection.

- AIDS has spread from Africa.
- HIV has transferred to human from African monkey or Chimpanzees.
- HIV contaminated polio vaccine, prepared from monkey's kidney.
- Spread through hepatitis-B viral vaccine in Los Angels New York.

- Spread through small pox vaccine programme of Africa. (2 M)

Symptoms or diagnosis of HIV/AIDS

Minor symptoms

- Persistent cough for more than one month
- General skin disease
- Viral infection
- Fungus infection in mouth and throat
- Frequent fever, headache, fatigue

Major symptoms

- Fever for more than one month
- Diarrhea for more than one month
- Cough and TB for more than six months
- Fall of hair from the head
- 10% of body weight get reduced within a short period. (4M)

Mode of transformation of HIV.

- Sexual transmission, presence of STD increases likelihood of transmission.
- Exposure to infected blood or blood products.
- Use of contaminated clotting factors by hemophiliacs.
- Sharing contaminated needles.
- Transplantation of infected tissues or organs.
- Certain body fluids from an HIV-infected person-Blood, Semen, Rectal fluids, vaginal fluids, Breast milk.
- Having unprotected sex with someone who has HIV.
- Receiving blood transfusions, blood products, or organ/tissue transplants that are contaminated with HIV.
- Contact between broken skin, wounds, or mucous membranes and HIV-infected blood or blood-contaminated body fluids.
- Women are more vulnerable to HIV. Transmission of HIV to their new born babies happen easily.
- Women around 18-20 years are at risk, since their cervical tissue is more vulnerable to invading HIV.
(5M)

Control and preventive measure

- Education
- Prevention of blood borne HIV transmission
- Primary health care
- Counselling services
- Drug treatment (2M)

CS8251-Programming in c

L T P C
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UNIT I - BASICS OF C PROGRAMMING

Introduction to programming paradigms - Structure of C program - C programming: Data Types –Storage classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associatively - Expressions - Input/output statements, Assignment statements – Decision making statements - Switch statement – Looping statements – Pre-processor directives - Compilation process

UNIT II - ARRAYS AND STRINGS

Introduction to Arrays: Declaration, Initialization – One dimensional array – Example Program: Computing Mean, Median and Mode - Two dimensional arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search

UNIT III -FUNCTIONS AND POINTERS

Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion – Example Program: Computation of Sine series, Scientific calculator using built-in functions, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example Program: Swapping of two numbers and changing the value of a variable using pass by reference.

UNIT IV-STRUCTURES

Structure - Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Self-referential structures – Dynamic memory allocation - Singly linked list -type def.

UNIT V- FILE PROCESSING

Files – Types of file processing: Sequential access, Random access – Sequential access file- Example Program: Finding average of numbers stored in sequential access file - Random access file -Example Program: Transaction processing using random access files – Command line arguments.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Develop simple applications in C using basic constructs
- Design and implement applications using arrays and strings
- Develop and implement applications in C using functions and pointers.
- Develop applications in C using structures.
- Design applications using sequential and random access file processing.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Reema Thareja, ―Programming in C‖, Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, ―The C Programming language‖, Second Edition, Pearson Education, 2006 26

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1. Paul Deitel and Harvey Deitel, ―C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, ―Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011
3. Pradip Dey, Manas Ghosh, ―Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, ―Computer Fundamentals and Programming in C‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

TABLE OF CONTENT

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Subject Name: PROGRAMMING IN C **Subject Handler: Ms.S.Scinthia Clarinda**

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<tr><td colspan="2">Introduction to programming paradigms - Structure of C program - C programming: Data Types – Storage classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process</td></tr>
<tr><th colspan="2">PART * A</th></tr>
<tr><th>Q.No.</th><th>Questions</th></tr>
<tr><td>1.</td><td>Define programming paradigm (Jan 2018) BTL1
A programming paradigm is a fundamental style of programming that defines how the structure and basic elements of a computer program will be built.The style of writing programs and set of capabilities and limitations that a particular programming language has depends on the programming paradigm it supports.</td></tr>
<tr><td>2</td><td>Give two examples for assignment statements. BTL1
Syntax for assignment :
variable = expression / value ;
Example : x=100;y= a+b;</td></tr>
<tr><td>3</td><td>Distinguish between character and string.
<table>
<tr><th>No.</th><th>Character</th><th>String</th></tr>
<tr><td>i.</td><td>It is a single character.</td><td>It is a sequence of characters.</td></tr>
<tr><td>ii.</td><td>It is enclosed by single quotes.</td><td>It is enclosed by double quotes.</td></tr>
<tr><td>iii.</td><td>Example : ‘C’</td><td>Example : “Computer”</td></tr>
</table></td></tr>
<tr><td>4</td><td>What are keywords? Give an example
✓ Keywords are reserved words, they have standard and predefined meaning.
✓ Keywords cannot be used as normal identifiers.
✓ Example: auto, break, char, continue, else, if, switch, struct, union.</td></tr>
</table>

5	**What do you mean by variables in ‘C’? BTL1** A variable is an identifier that is used to represent some specified type of information. Syntax : data_type variable_name; Example : int marks;

6 **Identify the use of ternary or conditional operator.**

- ✓ ?: is known as conditional operator.It evaluates the first expression if the condition is true otherwise the second expression is evaluated.
- ✓ Syntax: condition? exp1 : exp2 ;

7 **What is mean by Operators precedence and associativity?**

- ✓ The precedence is used to determine how an expression involving more than one operator is evaluated.
- ✓ The operator at higher level of precedence is evaluated first. The evaluation is based on PEMDAS rule.
- ✓ The operator of same precedence evaluated from either from left to right or right to left depending on level is known as associativity.

8 **What is a compilation process?**

Compiler converts source code into executable code. It includes

- ✓ Pre-processor
- ✓ Compilation
- ✓ Assembly
- ✓ Linking

9 **How to create enumeration constants?**

Enumerated data type is a user defined data type. Enumerated data type helps in creating a list of identifiers also called as symbolic numeric constants of type int.enum keyword is used to create enumeration constant.

Syntax : enum identifier{value1, value2,…….,value n};

Example : enum holidays{sun, sat};

10 **Differentiate between an expression and a statement in C.**

No.	Expression	Statements
i.	Expression consists of operators and operands.	It is defined as a set of declaration or sequence of actions.
ii.	Example: a=29; b=a+77;	Example: Assignment statement Mark=73;

11 **What is the output of the programs given below?**

```
#include <stdio.h>
main( )
{
int a = 20, b = 10, c = 15, d =
5; int e;
e = (a + b) * c / d;
printf("Value of (a + b) * c / d is : %d\n", e );
}
```

OUTPUT:

```
Value of (a + b) * c / d is : 90
```

12 **Generalize the types of I/O statements available in ‘C’.**

Unformatted Input / Output statements

- ✓ Input : *getc(), getchar(), gets(), getche(), getch()*
- ✓ Output: *putc(), putchar(), puts().*

Unformatted Input / Output statements

- ✓ Input : *scanf(), fscanf()*
- ✓ Output : *printf(), fprintf()*

13 **List the categories of Programming languages.** BTL1

Programming languages are divided into the following categories:

- ✓ Interpreted Programming language
- ✓ Functional Programming language
- ✓ Compiled Programming language
- ✓ Procedural Programming language
- ✓ Scripting Programming language

- ✓ Markup Programming language
- ✓ Logic-Based Programming language
- ✓ Concurrent Programming language
- ✓ Object Oriented Programming Languages

14 **Classify the different types of storage classes .**

There are mainly four types of storage classes. They are

- ✓ Automatic (auto)
- ✓ Static
- ✓ External (extern)
- ✓ Register

.

15 **Discover the meaning of C pre-processor**

1. The preprocessor contains any operations in the processing language, it will be transformed first.
2. The preprocessing language consists of
   - ✓ Inclusion of header file
   - ✓ Macro expansion
   - ✓ Conditional compilation
   - ✓ Line control

16 **Invent the difference between ++a and a++.**

- ✓ ++a is known as pre increment where the value is incremented by one and then the operation is done.
- ✓ a++ is known as post increment where the operation is done first and then the value is incremented by one.

17 **Give the differences between recursion and iteration.** BTL1

Recursion	Iteration
Function calls itself until the base condition is reached.	Repetition of process until the condition fails.
Only base condition (terminating condition) is specified.	It involves four steps: initialization, condition, execution and updation.
It keeps our code short and simple.	Iterative approach makes our code longer.
It is slower than iteration due to overhead of maintaining stack.	Iteration is faster.
It takes more memory than iteration due to overhead of maintaining stack.	Iteration takes less memory.

18 **Differentiate switch( ) and nested-if statement**

No.	**Switch( )**	**Nested if**
i.	The switch( ) can test only constant values.	The if can evaluate relational or logical expressions.
ii.	In switch( ) case nested if can be used.	In nested if statements, switch( ) case can be used

- ✓ Sequence generation is easier with recursion than using some nested iteration.

Disadvantages

- ✓ Sometimes the logic behind recursion is hard to follow through.
- ✓ Recursive calls are expensive (inefficient) as they take up a lot of memory and time. Recursive functions are hard to debug.

19 **Summarize the various types of C operators.**

- ✓ Arithmatic operators
- ✓ Relational operators
- ✓ Logical operators
- ✓ Increment or decrement operators
- ✓ Conditional or Ternary operators
- ✓ Bitwise operators
- ✓ Special operators (sizeof, & and * , . and -->)

20 **What is Pseudocode?** BTL2

Pseudocode is a compact and informal high-level description of a program using the conventions of a programming language, but intended more for humans. Pseudocode does not contain programming level details like declaration of variables, looping syntax.

21 **List out the limitations of Flowchart.** BTL2

- ✓ It is not easy to draw flow chart for some complex logic
- ✓ Alteration and modifications are not easily done.
- ✓ Reproduction or reuse of flowchart are very difficult.
- ✓ Cost is very high.

22 **Write an algorithm to accept two numbers, compute the sum and print the result (Jan 2018)** BTL2

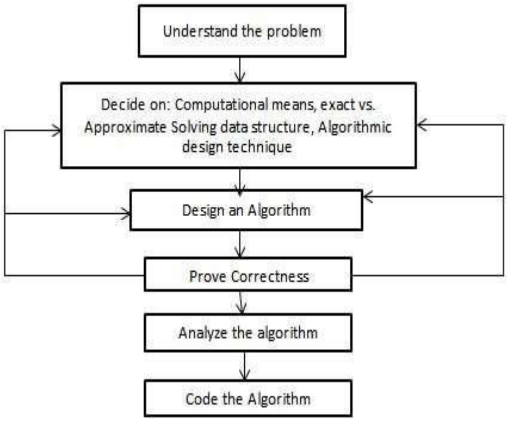
- ✓ Start
- ✓ Read the two numbers a and b
- ✓ Calculate sum=a + b
- ✓ Display the sum
- ✓ Stop

23 **What is a global variable?**

Global variables are declared at the beginning of the program and it can be used inside any part of the program.

```
a=10;
main( )
{
  print("Value of a : %d",a);
}
```

PART * B	
1	**What are the building blocks of an algorithm? Explain in detail. (16M)** BTL3 **Answer: Page :1.19 - 1.24 – Dr. Ramesh Babu** The building blocks of algorithm are (2M) ✓ Statements – the instructions in the code ✓ State - the state of the variable ✓ Control flow – flow of the program ✓ Functions - a block of code that performs a specific task Statements: There are 3 types of statement (5M) There are 3 types of statement ✓ Input/Output Statement

	✓ Assignment Statement ✓ Control Statement State: There are 3 types of state (3M) ✓ Initial state ✓ Current state ✓ Final state Control flow: (2M) ✓ if ✓ if – else ✓ switch Repetition (2M) ✓ while ✓ for Functions: (2M) A function is a block of organized reusable code that is used to perform a single action.
2	**Explain Algorithmic problem solving in detail.(16M)** BTL3 **Answer:Page:1.11 - 1.16 – Dr. Ramesh Babu** Steps – Explain each steps of the problem solving (16M) 
3	**Describe pseudo code with its guidelines.(16M)** BTL3 **Answer: Page:1.25 - 1.27 – Dr. Ramesh Babu** Pseudocode is an informal language used by programmer for human understanding rather than machine understanding. (3M) ✓ Guidelines - Pseudo Code (3M) ✓ Write one statement per line (2M) ✓ Capitalize Initial Keywords (2M)

- ✓ Indent to show hierarchy (2M)
- ✓ End Multiline Structure (2M)
- ✓ Keep statements language independent (2M)

4

What is flowchart? Explain in detail (16M)BTL3

Answer: Page:1.27 - 1.38 – Dr. Ramesh Babu

A flowchart is a pictorial representation of the algorithm defined in a sequence of steps and decisions needed to perform a process. (3M)

Aim - flowchart (4M)

- ✓ Program preparation can be simplified using the flowchart
- ✓ Flowchart are easier to understand at a glance.
- ✓ Flowchart are easy to analyze and compare various methods
- ✓ Flowchart assist in reviewing and debugging of a program
- ✓ Flowchart provide effective programming documentation

Symbols - flowchart (5M)

Structure in Flowchart (4M)

- ✓ Sequence Structure
- ✓ Selection structure
- ✓ Loop structure

5

Write an algorithm and give the flowchart to find the net salary of an employee. (16M) BTL1

Answer: Page:1.59 –1.60 Dr. Ramesh Babu

Algorithm (5M)

```
Step 1: Start
Step 2 : Read the basic salary
Step 3 : IF the basic is greater than or equal to 4000 ELSE Goto Step 4
    Step 3.1 : DA= 0.32 * basic (Dearness Allowance)
    Step 3,2 : HRA = 0.15 * basic (House Rent Allowance)
    Step 3.3 : CCA = 325 (City Compensatory Allowance)
    Step 3.4 : Net Salary basic + DA HRA + CCA
Step 4 : Print the Net Salary
Step 5 : Stop
```

Flowchart (8M)

Explanation (3M)

6

Write the program to Guess an integer between 0 to 100. (16M) BTL1

Answer: Page:1.59- 1.60 – Dr. Ramesh Babu

(13M)

```
import random
randomNumber = random.randrange(0,100)
print("Random number has been generated")
guessed = False
while guessed==False:
 userInput = int(input("Your guess pleas: "))
 if userInput==randomNumber:
 guessed = True
```

```
 print("Well done!")
 elif userInput>100:
 print("Our guess range is between 0 and 100, please try a bit lower")
 elif userInput<0:
 print("Our guess range is between 0 and 100, please try a bit higher")
 elif userInput>randomNumber:
 print("Try one more time, a bit lower")
elif userInput < randomNumber:
print("Try one more time, a bit higher")
print("End of program")
```

Explanation (3M)

7	(13M) **Describe the structure of a C program with an example. BTL1** ✓ Structure is a user-defined datatype in C language which allows us to combine data of different types together. ✓ Structure helps to construct a complex data type which is more meaningful. It is somewhat similar to an Array, but an array holds data of similar type only. But structure on the other hand, can store data of any type, which is practical more useful. ✓ **For example:** If I have to write a program to store Student information, which will have Student's name, age, branch, permanent address, father's name etc, which included string values, integer values etc, how can I use arrays for this problem, I will require something which can hold data of different types together. ✓ In structure, data is stored in form of **records** (3M)
8	**Write an algorithm to find the minimum number in a list. (16M)**BTL4 **Answer: Page:1.75-1.76 – Dr. Ramesh Babu** ✓ Algorithm (5M) ✓ Pseudocode (3M) ✓ Flowchart (5M) ✓ Explanation (3M)

9	**Illustrate the Tower of Hanoi (16M) (Jan -2018)** BTL4 **Answer:Page:1.83-1.85 – Dr. Ramesh Babu** ✓ Algorithm (3M)

```
def TowerOfHanoi(n , from_rod, to_rod, aux_rod): if n == 1:
   print "Move disk 1 from rod",from_rod,"to rod",to_rod
return
```

```
    TowerOfHanoi(n-1, from_rod, aux_rod, to_rod)
    print "Move disk",n,"from rod",from_rod,"to rod",to_rod
    TowerOfHanoi(n-1, aux_rod, to_rod, from_rod)
    n = 4
    TowerOfHanoi(n, \'A\', \'C\', \'B\')
```

✓ Diagram (5M)
✓ Flowchart (5M)
✓ Explanation (3M)

UNIT II - ARRAYS AND STRINGS

Introduction to Arrays: Declaration, Initialization – One dimensional array – Example Program: Computing Mean, Median and Mode - Two dimensional arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search

.

PART * A

Q.No.	Questions
1.	**List out the features of Arrays.** ✓ An array is used to represent a collection of elements of same data type. ✓ The elements in an array can be accessed by using the base address. ✓ The elements are stored in continuous memory locations, The starting memory location is known as the array name and it is known as the base address (index) of the array.
2	**Define a float array of size 5 and assign 5 values to it.**

```
main( )
{
    float a[5] = {26.9, 32.4, 84.2, 20.0, 78.1};
}
```

Q.No.	Questions
3	**Identify the main elements of an array declaration.** ✓ Arrays are declared like variable declaration but the array declaration has size of the array. **Syntax :** data_type array_name[size]; **[OR]** data_type array_name[array_size]={list_of_values}; Example for array declaration : int marks[6];

4	**Point out an example code to express two dimensional array.** ✓ A two dimensional array is created by specifying its row and column size. Examples : int matrix[2][2]; int a[3][2];
5	**How to create a two dimensional array?** ✓ Two dimensional arrays are stored in a row-column matrix, where the left index indicates the row and right matrix indicates the column. ✓ **Syntax :** data_type array_name[row_size][column_size]; Example : int mat[3][3];
6	**What are the different ways of initializing array?** ✓ Values can be assigned to an array by normal declaration otherwise they hold garbage values. ✓ Arrays can be initialized in following two ways : i. At compile time ii. At Run time
7	**What is the use of '\0' and '%s'?** ✓ '\0' is the escape sequence for null character it is automatically added at the end of the string. ✓ '%s' is a format specifier for string. It is used in scanf( ) and printf( ) functions to get the string input or to print string output
8	**What is the role of strrev( )?** The function strrev( ) is used to reverse a string. This function takes only one argument and return only one argument

<table>
<tr><td>9</td><td>What do you meant by an assignment statement? BTL1
An assignment statement creates new variables and gives them values:
Eg 1: Message = 'And now for something completely different'
Eg 2: n = 17</td></tr>
<tr><td>10</td><td>Define string.
✓ String is a sequence / array of characters enclosed with double quotes.
✓ Null character (‘\0’) is used to mark the end of the string
<table><tr><td>C</td><td>O</td><td>M</td><td>P</td><td>U</td><td>T</td><td>E</td><td>R</td><td>\0</td></tr></table>Example : char word= “computer”;</td></tr>
<tr><td>11</td><td>Name any two library functions used for string handling.
✓ strlen() – finds the length of a string. It returns an integer value. It counts the number of characters except null character and returns the count
Syntax : strlen(str)
✓ strcpy() – copies the source string into destination string. So, the source string should be enough to store the destination string.
Syntax : strcpy(source,destination)</td></tr>
<tr><td>12</td><td>Define sorting.
✓ Sorting is a process of arranging the elements either in ascending order or descending order.
✓ Sorting refers to ordering data in an increasing or decreasing fashion according to some linear relationship among the data items.
✓ Sorting can be done on names, numbers and records.</td></tr>
<tr><td>13</td><td>Define Multi-dimensional array.
✓ Multi-dimensioned arrays have two or more index values which specify the element in the array.
✓ Declaration:
int m1[10][10];
static int m2[2][2] = { {0,1}, {2,3} };</td></tr>
</table>

14

101	102	103	104	105	106	107	108	109	110
a[0]	a[1]	a[2]	a[3]	a[4]	a[5]	a[6]	a[7]	a[8]	a[9]

Given an array int a[10]={101,012,103,104,105,106,107,108,109,110}. Show the memory representation and calculate its length.

Memory Representation:Length calculation:

Length of an array=upper_bound - lower_bound +
1 Here, upper_bound = 9 and lower_bound = 0
Thus, length of an array = 9-0+1 = 10

15

What are the types of sorting available in C?

- ✓ Insertion sort.
- ✓ Merge Sort.
- ✓ Quick Sort.
- ✓ Radix Sort.
- ✓ Heap Sort
- ✓ Selection sort
- ✓ Bubble sort

.

16 **What is function call?** BTL1

A function is a named sequence of statements that performs a computation. When we define a function, we specify the name and the sequence of statements. Later, we can –call‖ the function by its name called as function call.

17 **What is the difference between an array and pointer?**

No.	Array	Pointer
i.	Array allocates space automatically.	Pointer is explicitly assigned to point to an allocated space
ii.	It cannot be resized	It can be resized using realloc ()
iii.	It cannot be reassigned	Pointers can be reassigned.
iv.	Size of(array name) gives the number of bytes occupied by the array.	Sizeof(pointer name) returns the number of bytes used to store the pointer variable.

18 **Mention the various String Manipulation Functions in C.**

- ✓ strcpy(s1, s2);Copies string s2 into string s1.
- ✓ strcat(s1, s2); Concatenates string s2 onto the end of string s1.
- ✓ strlen(s1);Returns the length of string s1.
- ✓ strcmp(s1, s2);Returns 0 if s1 and s2 are the same; less than 0 if s1<s2; greater than 0 if s1>s2.
- ✓ strchr(s1, ch);Returns a pointer to the first occurrence of character ch in string s1.
- ✓ strstr(s1, s2); Returns a pointer to the first occurrence of string s2 in string s1.

19 **What is the use of atoi() function?**

- ✓ C allows us to manipulate characters the same way we do with numbers. Whenever a character constant or character variable is used in an expression, it is automatically converted into integer value by the system.
- ✓ For eg, if the machine uses the ASCII representation, then,x = ‘a’; printf(“%d \n”,x);will display the number 97 on the screen.
- ✓ The C library supports a function that converts a string of digits into their integer values.

20

What is scope of variable? BTL1

Variable has scope i.e up to which line it can be used. Its depends where your declared. Variables declared inside the functions are local variable, its scope is only inside the function, not outside the function.

21

Define Searching.

- ✓ Searching is a process of finding the position of a given element in a list.
- ✓ The searching is successful if the element is found. There are two types of searching.
    - Linear Search
    - Binary Search

22

Define Bubble sort.

- ✓ A simple but popular sorting algorithm. Bubble sorting is used frequently as a programming exercise because it is relatively easy to understand.
- ✓ It is not, however, particularly efficient. Other sorting algorithms, such as heap sorts, merge sorts and quick sorts, are used more often in real applications.

23

Write a c program to find a number is even or odd BTL2 num

```
= int(input("Enter a number: "))
if (num % 2) == 0:
   print("{0} is Even".format(num))
else:
   print("{0} is Odd".format(num))
```

24

Write a C program to find a factorial of a number BTL2 num

```
= float(input("Enter a number: "))
if num > 0:
   print("Positive number")
elif num == 0:
   print("Zero")
else:
   print("Negative number")
```

25

Write a Cprogram to find a GREATEST 3 of a number BTL2

```
num1 = 10
num2 = 14
```

```
num3 = 12num1 = float(input("Enter first number: "))
#num2 = float(input("Enter second number: "))
#num3 = float(input("Enter third number: "))

if (num1 >= num2) and (num1 >= num3):
   largest = num1
elif (num2 >= num1) and (num2 >= num3):
   largest = num2
else:
   largest = num3

print("The largest number between",num1,",",num2,"and",num3,"is",largest)
```

	PART * B
1.	**What is the role of an interpreter? Give a detailed note on python interpreter and interactive mode of operation.(16M)** BTL3 **Answer:Page:2.24- 2.26 Dr.V.Ramesh** Interpreter- processes the program (6M) Two Types of modes (10M) Interactive Mode – displays the result immediately >>>2+2 4 Script mode-store and execute the program
2	**List down the rules for naming the variable with example. (16M)** BTL3 **Answer:Page:2.36-Dr.V.Ramesh** Rules for writing the variable (10M) ✓ Variables names must start with a letter or an underscore, such as: _underscore underscore_ ✓ The remainder of your variable name may consist of letters, numbers and underscores. password1 n00b un_der_scores ✓ Names are case sensitive. case_sensitive, CASE_SENSITIVE, and Case_Sensitive are each a different variable. Example Program (6M) >>> a_var=10 >>>print a_var 10

<table>
<tr><td>3</td><td>What is operator? Explain operators in C. (Jan 2018) (16M) BTL2
Answer:Page:2.65 Dr.V.Ramesh
Operator
- Performs an operation on operands
- >>>3+3
(3M)
Types
(10M)
- Arithmetic Operators.
- Comparison (Relational) Operators.
- Assignment Operators.
- Logical Operators.
- Bitwise Operators.
- Membership Operators.
- Identity Operators.
Example Program for each operator
(3M)
>>>2+3
5
>>>2>3
False
>>>a=10
>>>print a
10
>>> 10 in [10,20,30]
True</td></tr>
<tr><td>4</td><td>Outline the operator precedence in C (Jan 2018) (16M) BTL3
Answer: Page: 2.79 Dr.V.Ramesh
Operator Precedence
(3M)
-order of execution
Tabulation with rules
(10M)
<table>
<tr><th>Precedence</th><th>Operators</th></tr>
<tr><td>High</td><td>*/ %</td></tr>
<tr><td>Low</td><td>+-</td></tr>
</table>
1. Parentheses (simplify inside 'em)
2. Exponents
3. Multiplication and Division (from left to right)
4. Addition and Subtraction (from left to right)
Explanation
(3M)</td></tr>
<tr><td>5</td><td>(i) Write a C program to exchange the value of two variable (ii) Write a python program using function to find the sum of first „n‟ even numbers and print the result (Jan 2018) (16 M) BTL2</td></tr>
</table>

Answer:(i) Page: SP.5-Dr.V.Ramesh (ii) Page: SP.10-DR.V.Ramesh

(i) Progra
m: (8M)

```
  x = 5
  y = 10
  # create a temporary variable and swap the values
  temp = x
  x = y
  y = temp
  print('The value of x after swapping:
  {}'.format(x)) print('The value of y after
  swapping: {}'.format(y))
```

(ii) Program:

```
def
evensum(n):
(8M)
  curr = 2
  sum = 0
  i = 1

  # sum of first n even
  numbers while i <= n:
     sum += curr
            # next even
     number curr += 2
     i = i +
  1 return
  sum
# Driver
Code n = 20
 print("sum of first ", n, "even number is: ", evensum(n))
```

6

Write a C program to calculate mean and median for an array of elements. BTL1

```
#include<stdio.h>
int main()
{
int invalue[]={2,4,5,2,6};
int num_value=5;
float tot=0;
float mean=0;
for(int i=0; i<num_value; i++)
{
tot = tot+invalue[i];
}
mean = tot/num_value;
printf("
The mean value is: %.1f",mean);
 //Median calculation
float median = 0;
float mid=0;
if(num_value%2 == 0)
{
int temp=(num_value/2)-1;
 for(int i=0;i<num_value;i++)
{
if(temp==i || (temp+1)==i)
{
mid=mid+invalue[i];
}
}
mid=mid/2;
printf("
Median value is: %.1f",mid);
}
else
{
int temp=(num_value/2);
for(int i=0;i<num_value;i++)
{
if(temp==i)
{
int mid=invalue[i];
printf("
Median value: %d",mid);
}
}
}
```

7

Write a program to circulate the value of n variable?(16M)BTL3

Answer:Page:2.98-DR.V.Ramesh

Program

(12M)

```
# Circulate the values of n variables

no_of_terms = int(input("Enter number of values : ")) list1
= []
for val in range(0,no_of_terms,1): ele =
    int(input("Enter integer : "))
    list1.append(ele)

print("Circulating the elements of list ", list1) for

val in range(0,no_of_terms,1):
    ele = list1.pop(0)
    list1.append(ele)
    print(list1)
```

Output (2M)

Explanation (2M)

8

What is function? How it is defined? Explain the flow of execution(16M) BTL3

Answer: Page:3.28-DR.V.Ramesh

- ✓ -Group of statement (6M)
- ✓ -should be called
- ✓ -executes when called
- ✓ Syntax of Function (6M)
- ✓ def functionname(parameters):
- ✓ ///statements
- ✓ Example (4M)

9

Explain about the String Arrays and its manipulation in detail .BTL1

Few commonly used string handling functions are discussed below:

Function	Work of Function
strlen()	computes string's length
strcpy()	copies a string to another
strcat()	concatenates(joins) two strings
strcmp()	compares two strings
strlwr()	converts string to lowercase
strupr()	converts string to uppercase

Strings handling functions are defined under `"string.h"` header file.

```
#include <string.h>
```

UNIT III FUNCTIONS AND POINTERS

Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion – Example Program: Computation of Sine series, Scientific calculator using built-in functions, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example Program: Swapping of two numbers and changing the value of a variable using pass by reference

PART * A

Q.No	Questions
1	**What is a function?** ✓ Function is a set of instructions ✓ Self-contained block ✓ Performs a specific task Used to avoid redundancy of code.
2	**List operators supported in C**BTL2 Arithmetic Operators. Relational Operators. Assignment Operators. Logical Operators. Membership Operators. Identity Operators. Bitwise Operators.
3	**What is the need for functions?** ✓ To reduce the complexity of large programs ✓ To increase the readability ✓ To achieve reusability ✓ To avoid redundancy of code ✓ To save Memory

4	**What are the uses of pointer?** ✓ Saves Memory Space ✓ Used for dynamic memory allocation ✓ Faster execution. ✓ Used to pass array of values to a function as a single argument.
5	**Define Iteration.** BTL1 Computers are often used to automate repetitive tasks. Repeating identical or similar tasks without making errors is something that computers do well and people do poorly. In a computer program, repetition is also called **iteration**.

6 **Write the syntax for while statement.** BTL2

While loop is used to execute number of statements or body till the condition passed in while is true. Once the condition is false, the control will come out of the loop. Here, body will execute multiple times till the expression passed is true. The Body may be a single statement or multiple statement.

Syntax: while <expression>:

```
                statements
```

7 **Define for loop with syntax** BTL1

The for loop processes each item in a sequence, so it is used with Python‘s sequence data types – strings, lists, and tuples .Each item in turn is (re-)assigned to the loop variable, and the body of the loop is executed. The general form of a for loop is: It has a header terminated by a colon (☺ and a body consisting of a sequence of one or more statements indented the same amount from the header.

For LOOP_VARIABLE **in** SEQUENCE:

8 **Define break statement.** BTL1

Break statement is a jump statement that is used to pass the control to the end of the loop. When break statement is applied the control points to the line following the body of the loop hence applying break statement makes the loop to terminate and controls goes to next line pointing after loop body.

9 **Define continue statement with syntax.** BTL1

Continue Statement is a jump statement that is used to skip the present iteration and forces next iteration of loop to take place. It can be used in while as well as for loop statements.

```
While<condition>:
        Stetement1
        Statement2
        If<condition>:
                Continue
        Statement3
        Statement4
```

10 **Define Typedef.**

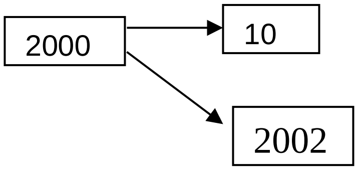
- ✓ The typedef keyword enables the programmer to create a new data type name by using an existing data type.
- ✓ By using typedef, no new data is created, rather an alternate name is given to a known data type.

11 **Define Fruitful function.** BTL1

Fruitful functions are those that return a value. Such as the math functions, yield results; for lack of a better name, I call them **fruitful functions**.

12	**What are the types of variables based on scope?** BTL2 There are two types of variables based on Scope: ✓ Local Variable.

	✓ Global Variable
13	**Explain local variable and global variable** BTL3 Variables declared **inside a function body** is known as Local Variable. These have a local access thus these variables cannot be accessed outside the function body in which they are declared. Variable defined **outside the function** is called Global Variable. Global variable is accessed all over program thus global variable have widest accessibility.
14	**Compare actual parameter & formal argument.** ✓ **Actual argument:** Specified in the function call statement. Used to supply the input values to the function either by copy or reference ✓ **Formal argument:** Specified in the function definition statement. It takes either copy or address of the actual arguments

15	**How is pointer arithmetic done?**
	Pointer Arithmetic:
	Valid operation
	✓ Pointer can be added with a constant
	✓ Pointer can be subtracted with a Constant
	✓ Pointer can be Incremented or
	Decremented Not Valid
	✓ Two pointers can not be added,subtracted,multiplied or divided
	Ex: int a=10
	int
	*p=&a;
	p=p+1;
	
	✓ The pointer holds the address 2000. This value is added with 1.
	✓ The data type size of the constant is added with the
	address. p= 2000+(2*1)=2002
	:

16	**Define Strings?** BTL1 A string is a sequence of characters. You can access the characters one at a time with the bracket operator []. String pythons are immutable (cannot be modified). In Python, Strings are stored as individual characters in a contiguous memory location. The benefit of using String is that it can be accessed from both the directions in forward and backward. Both forward as well as backward indexing are provided using Strings in Python. ✓ Forward indexing starts with 0,1,2,3, ✓ Backward indexing starts with -1,-2,-3,-4 ...
17	**What are the types of operators supported by string?** BTL1 ✓ Basic Operators. ✓ Membership Operators. ✓ Relational Operators.
18	**What is a function prototype?** ✓ Function prototype is a function declaration statement. ✓ **Syntax :** return_type function_name(parameters_list) ✓ **Example:** int factorial(int);

19	**Differentiate call by value and call by reference.** ✓ **Call by value:** The values of the variables are passed by the calling function to the called function. ✓ **Call by reference:** The addresses of the variables are passed by the calling function to the called function.
20	**Differentiate for loop and while loop.** For loops works only with sequence whereas While loop works with numbers
21	**List the header files in 'C' language.** ✓ <stdio.h> contains standard I/O functions ✓ <ctype.h> contains character handling functions ✓ <stdlib.h> contains general utility functions ✓ <string.h> contains string manipulation functions ✓ <math.h> contains mathematical functions ✓ <time.h> contains time manipulation functions
22	**What are the steps in writing a function in a program?** **Function Declaration (Prototype declaration):** ✓ Every user-defined functions has to be declared before the main(). **Function Callings**: ✓ The user-defined functions can be called inside any functions like main(), user defined function, etc. **Function Definition:** ✓ The function definition block is used to define the user-defined functions with statements.

23	**Write the syntax for pointers to structure.**
	Struct S
	{
	char
	datatype1; int
	datatype2;
	float
	datatype3;
	};
	Struct S *sptr //sptr ia pointer to structure S

24	**What is meant by Recursive function?**
	✓ If a function calls itself again and again, then that function is called Recursive function.
	Example:
	void recursion()
	{
	recursion(); /* function calls itself */
	}
	int main()
	{
	recursion();
	}

25	**Name the type of Boolean operators.** 1. True 2. False
	Part * B
1	**(i)What are Conditional execution? Explain in detail. (ii) Define Iteration. Briefly discuss looping statements in detail (Jan 2018) (16M)** BTL1 **Answer: (i)Page:2.95-DR.V.Ramesh (ii) Page:2.102-Dr.V.Ramesh** (i)Condition true - execute (2M) Types of conditional execution with example program for each (6M) ✓ If ✓ If …else ✓ If …elif.. else **(ii)** Repeated execution up to some condition true (2M)

Types of iteration with example program for each (6M)

- ✓ **For**
- ✓ **While**
- ✓ **While … else**
- ✓ **Break Continue**

2

Describe about pointers and their operations that can be performed on it.

C provides two pointer operators, which are (a) Address of Operator & and (b) Indirection Operator *.

A pointer is a variable that contains the address of another variable or you can say that a variable that contains the address of another variable is said to "point to" the other variable. A variable can be any data type including an object, structure or again pointer itself.

The . (dot) operator and the -> (arrow) operator are used to reference individual members of classes, structures, and unions.

The Address of Operator &

The & is a unary operator that returns the memory address of its operand. For example, if var is an integer variable, then &var is its address. This operator has the same precedence and right-to-left associativity as the other unary operators.

You should read the & operator as **"the address of"** which means **&var** will be read as "the address of var".

The Indirection Operator *

The second operator is indirection Operator *, and it is the complement of &. It is a unary operator that returns the value of the variable located at the address specified by its operand.

The following program executes the two operations

```
#include <iostream>

using namespace std;

int main () {
   int  var;
   int  *ptr;
   int  val;

   var = 3000;

   // take the address of var
   ptr = &var;
```

```
   // take the value available at ptr
   val = *ptr;
   cout << "Value of var :" << var << endl;
   cout << "Value of ptr :" << ptr << endl;
   cout << "Value of val :" << val << endl;

   return 0;
}
```

When the above code is compiled and executed, it produces the following result −

```
Value of var :3000
Value of ptr :0xbff64494
Value of val :3000
```

Discuss in detail about the string functions and methods. (16M) BTL 4

Answer:Page:3.65-DR.V.Ramesh

List of string functions with example

3

(16M)

- ✓ strrev()
- ✓ toupper()
- ✓ tolower()
- ✓ isdigit()
- ✓ isalpha()
- ✓ capitalize()
- ✓ find()
- ✓ split()

4

Explain in detail about Pass by Value and Pass by reference.

I will call what you are passing in a to a function the actual_parameters, and where you receive them, the parameters in the function, the formal_parameters. They are also called actual and formal arguments.

When passing parameters, what it is called and what happens can be confusing. It is less essential that you call it the "correct" thing than you know exactly what is happening. It is critical to have a good mental model, a valid memory picture of the process.

Recall that when you call a function, a chunk of memory called an activation_record_is allocated. Critical to the discussion here is that this memory holds the formal parameter values and function local variables.

By definition, pass_by_value means you are making a copy in memory of the actual parameter's value that is passed in, a copy of the contents of the actual parameter. Use pass by value when when you are only "using" the parameter for some computation, not changing it for the client program.

In pass_by_reference (also called pass by address), a copy of the address of the actual parameter is stored. Use pass by reference when you are changing the parameter passed in by the client program.

Consider a swapping function to demonstrate pass by value vs. pass by reference. This function, which swaps ints, cannot be done in Java.

```
main() {
   int i = 10, j = 20;
   swapThemByVal(i, j);
   cout << i << "  " << j << endl;     // displays 10  20
   swapThemByRef(i, j);
   cout << i << "  " << j << endl;     // displays 20  10
   ...
}
```

```
void swapThemByVal(int num1, int num2) {
   int temp = num1;
   num1 = num2;
   num2 = temp;
}

void swapThemByRef(int& num1, int& num2) {
   int temp = num1;
   num1 = num2;
   num2 = temp;
}
```

```
else:
                    return n*recur factorial(n-1)
```

5

Write a C program to print N Fibonacci series (Jan 2018) (8M) BTL6
Answer:Page: 3.50-DR.V.Ramesh Fibonacci
Series using Recursion def fib(int n):

```
  if (n <= 1): return n;
   return fib(n-1) + fib(n-2); n = 9;
  print(fib(n));
```

6

Write a program to find sum of array and exponentiation[16M] BTL6
Answer:Page:3.51-DR.V.Ramesh Sum of
array
(6M)

```
a = [6,7,29,4,6,7,8,9]
acc = 0 for i in a: acc
+= i print acc
```

Exponentiation

(10M)

```
def power(base,exp): if(exp==1):
       return(base) if(exp!=1):
       return(base*power(base,exp-1))
base=int(input(—Enter base: —)) exp=int(input(—Enter
exponential value: —))
print(—Result:‖,power(base,exp))
```

7

Explain linear search with example (Jan 2018) (16M) BTL6
Answer:Page:4.48 DR.V.Ramesh
Diagram representation (8M)
Program
(8M)

8	**Explain binary search with example(16M)** BTL6 **Answer:Page:4.50-DR.V.Ramesh** Diagram representation (8M) Program (8M)

UNIT – IV - STRUCTURES

Structure - Nested structures – Pointer and Structures – Array of structures – **Example Program** using structures and pointers – Self-referential structures – Dynamic memory allocation - Singly linked list-typedef

PART * A

1 **Compare arrays and structures.**

Arrays	**Structures**
An array is a collection of data items of same data type. Arrays can only be declared.	A structure is a collection of data items of different data types. Structures can be declared and defined.
There is no keyword for arrays.	The keyword for structures is struct.
An array cannot have bit fields.	A structure may contain bit fields.
An array name represents the address of the starting element.	A structure name is known as tag. It is a Shorthand notation of the declaration.

2 **Difference between structure and union.**

Structure	**Union**
Every member has its own memory.	All members use the same memory.
The keyword used is struct.	The keyword used is union.
All members occupy separate memory location, hence different interpretations of the same memory location are not possible. Consumes more space compared to union.	Different interpretations for the same memory location are possible. Conservation of memory is possible

3 **Define Structure in C**

- ✓ C Structure is a collection of different data types which are grouped together and each element in a C structure is called member.
- ✓ If you want to access structure members in C, structure variable should be declared. Many structure variables can be declared for same structure and memory will be allocated for each separately.

	✓ It is a best practice to initialize a structure to null while declaring, if we don't assign any values to structure members
4	**What you meant by structure definition?** ✓ A structure type is usually defined near to the start of a file using a typedef statement. ✓ typedef defines and names a new type, allowing its use throughout the program. ✓ Typedefs usually occur just after the #define and #include statements in a file. ✓ Here is an example structure definition. typedef struct { char name[64]; char course[128]; int age; int year; } student; This defines a new type student variables of type student can be declared as follows. student st_rec;
5	**List out the methods that are available with list object in C programming.** BTL1 ✓ index(object) ✓ count(object) ✓ pop()/pop(index) ✓ insert(index,object) ✓ extend(sequence) ✓ remove(object) ✓ reverse() ✓ sort() ✓ copy()
6	**Show the membership operators used in list.** BTL1 Python's membership operators test for membership in a sequence, such as strings, lists or tuples. There are two membership operators.

- ✓ In
- ✓ not in

7 **What is meant by Union in C?**

- ✓ A **union** is a special data type available in C that enables you to store different data types in the same memory location.
- ✓ You can define a union with many members, but only one member can contain a value at any given time.
- ✓ Unions provide an efficient way of using the same memory location for multi-purpose.

8 **How to define a union in C.**

- ✓ To define a union, you must use the **union** statement in very similar was as you did while defining structure.
- ✓ The union statement defines a new data type, with more than one member for your program.
- ✓ The format of the union statement is as follows:

union [union tag]
{
member
definition;
member
definition;
...
member definition;
} [one or more union variables];

9 **Classify the C accessing Elements in a tuples**? BTL1

- ✓ Indexing
- ✓ Negative Indexing
- ✓ Slicing

10 **Point out the methods used in tuples**? BTL1

count(*x*)	Return the number of items that is equal to *x*
index(*x*)	Return index of first item that is equal to *x*

11	**How a tuple is iterated? Explain with an example**? BTL1 Using a for loop we can iterate though each item in a tuple. Eg:

```
for name in
    ('John’,‘Kate'):
    print("Hello",name)

output:
Hello John
Hello Kate
```

12	**What are storage classes?** A storage class defines the scope (visibility) and life time of variables and/or functions within a C Program
13	**Define dictionary with an example?** BTL1

	A dictionary is an unordered set of key and value pair. It is one of the compound data types of python. A dictionary contains a collection of indices, which are called **keys**, and a collection of values. Each key is associated with a single value Eg: data={100:'Ravi' ,101:'Vijay' ,102:'Rahul'} print (data) Output: {100: 'Ravi', 101: 'Vijay', 102: 'Rahul'}
14	**What are the properties of dictionary keys?** BTL1 ✓ More than one entry per key not allowed ✓ Keys must be immutable
15	**Can you use the addition assignment operator, +=, with two lists. What is the result**? BTL1 'pythonic' way to do list concatenation

16

Perform the bubble sort on the elements 23,78,45,8,32,56 BTL1

```
def bubbleSort(alist):
    for passnum in range(len(alist)-1,0,-1):
        for i in range(passnum):
            if alist[i]>alist[i+1]:
                temp = alist[i]
                alist[i] = alist[i+1]
                alist[i+1] = temp

alist = [54,26,93,17,77,31,44,55,20]
bubbleSort(alist)
print(alist)
output:
[14, 21, 27, 41, 43, 45, 46, 57, 70]
```

17	**What is empty? list how its created?** BTL1 **The which has no element is called empty list.** **L1=[]**
18	**What is list mutability?** BTL1 List items can be changed using its index values it is called list mutability
19	**What is list cloning?** BTL1 List cloning is a process of copying data of one list to another list. There are two types of cloning Deep copy and shallow copy
20	**What is list aliasing?** In list aliasing, items of one list will be copied to other list. Change in one list will affect the other
21	**Describe list comprehension.** h_letters = [letter for letter in 'human'] print(h_letters)
22	**Print list items in reverse** h_letters =‖Welcome‖ print(h_letters.reverse())

23	**What is the use of copy method in dictionary?** Creates a copy of dictionary in another name

```
original = {1:'one', 2:'two'}
new = original.copy()
print('Orignal: ', original)
print('New: ', new)
```

24

How to delete or remove elements from a dictionary?

```
squares = {1:1, 2:4, 3:9, 4:16, 5:25}

# Output: 16

 print(squares.pop(4))
```

25

Difference in Using copy() method, and = Operator to Copy Dictionaries

Using =,Here, when the new dictionary is cleared, the original dictionary is also cleared
Using copy(), Here, when the new dictionary is cleared, the original dictionary remains unchanged

PART * B

1

Arrays of Structure

- 'C" language permits to declare an array of structure variable.
- C does not limit a programmer to storing simple data types inside an array.
- User defined structures too can be elements of an array.
- Example:

  ```
  struct date birthdays[10];
  ```

  - This defines an array called birthdays that has 10 elements.
  - Each element inside the array will be of type struct *date*.
  - Referencing an element in the array is quite simple.

    ```
    birthdays[1].month = 09;
    birthdays[1].day = 20;
    birthdays[1].year = 1965;
    ```

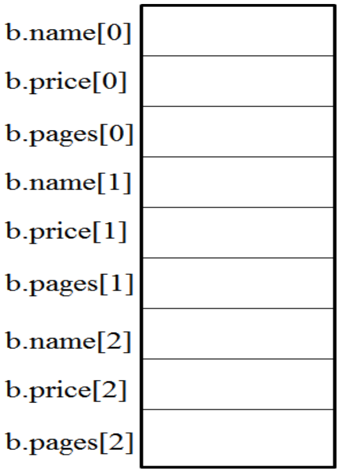
- Initialisation of structure arrays is similar to initialization of multidimensional arrays.
- For Example:

  ```
  static struct birthdays[10] = {{9,30,1965},{9,26,1971}};
  ```

  - will initialise the first two elements of the *birthdays* array.

✓ **Example:**

```
struct book
{
        char name[10];
        int price;
        int pages;
};
```



2

Program 1:

/* Program to store 3 book records in one structure / using array of structure */

```
#include<stdio.h>
#include<conio.h>
struct book
{
        char name[10];
        int price;
        int pages;
};
struct book b[3];
void main()
{
        int i;
        clrscr();
        for(i=1;i<=3;i++)
        {
                printf("Enter book name,price and pages:\n");
                scanf("%s%d%d",&b[i].name,&b[i].price,&b[i].pages);
        }
        printf(" The Records of book are as follows:\n");

        for(i=1;i<=3;i++)
                printf"\n%s\t%d\t%d",b[i],name,b[i].price,b[i].pages);
        getch();
}
```

Output:

```
        Enter book name, price and pages:
```

```
English  165  200

Enter book name, price and pages:
Maths    300  450

Enter book name, price and pages:
Physics  250  370

The Records of book are as follows:
        English         165     200
        Maths           300     450
        Physics         250     370
```

(2M)

3

Programs using Structures

Program 1:

/* Program to print student details using structure / Write a C program to create a mark sheet for students using structure. */ (JAN 2014)

```
#include<stdio.h>
#include<conio.h>


struct student
{
        char name[10],grade;
        int rollno, m1,m2,m3,m4,m5,total;
        float average;
} s[10];

void main()
{
        int i,n;
        clrscr();
        printf("\n Enter the Number of student :\n",);
        scanf("%d",&n);

        for(i=0;i<n;i++)
        {
                printf("\n Enter the student name :",);
```

```
                scanf("%s",s[i].name);

                printf("\n Enter the Roll no:");
                scanf("%d",&s[i].rollno);

                printf("\n Enter the five subject marks :");
                scanf("%d%d%d%d%d",&s[i].m1,&s[i].m2,&s[i].m3,&s[i].m4,&s[i].m5);

                s[i].total=s[i].m1+s[i].m2+s[i].m3+s[i].m4+s[i].m5;
                s[i].average=(s[i].total)/5;

                if (s[i].average>=90)
                        s[i].grade='S';
                else if (s[i].average>=75 && s[i].average<90)
                        s[i].grade='A';
                else if(s[i].average>=50 && s[i].average<75)
                        s[i].grade = 'B';
                else s[i].grade= 'F';

                printf("\n Total : %d",s[i].total);
                printf("\n Average : %.f", s[i].average);
                printf("\n Grade : %c", s[i].grade);
        }
        getch();
}
```

OUTPUT:

```
  Enter the Number of student: 2

  Enter the student name : Anu
  Enter the Roll no : 101
  Enter the five subject marks : 75 75 75 75 75
  Total : 375
  Average : 75
  Grade : A

  Enter the student name : Sri
  Enter the Roll no : 102
  Enter the five subject marks : 97 91 88 94 96
  Total : 466
  Average : 93.2
  Grade : S
```


Creating the List ,Accessing values in the Lists ,Updating the Lists, Deleting the list Elements (16 M) (BTL2)

Answer:Page:4.10-4.13-DR.V.Ramesh

- ✓ Creating theList (3M)

<list_variable>= [<value 1>, <value 2>,…….<value n>]

- ✓ Accessing values in theLists (5M)
- ✓ Updating theLists (4M)
- ✓ Deleting the listElements (4M)

del <list_name>[starting index: ending index]

4

Pointer and Structures

C structure can be accessed in 2 ways in a C program. They are,

1. Using normal structure variable
2. Using pointer variable

Dot (.) operator is used to access the data using normal structure variable and arrow (->) is used to access the data using pointer variable. You have learnt how to access structure data using normal variable in C – Structure topic. So, we are showing here how to access structure data using pointer variable in below C program.

Consider the structure:

```
    struct student
   {
            char  name[20];
            int age;
            int rollno;
   }  ;
  struct  student s={“Kumar”,21,1001};
  struct student *ptr=&student;
```

We can access members of the structure by any of the following

1. Using structure variable   s.age ,s.rollno ,s.name
2. Using pointer variable   ptr->age,ptr->rollno,ptr->name

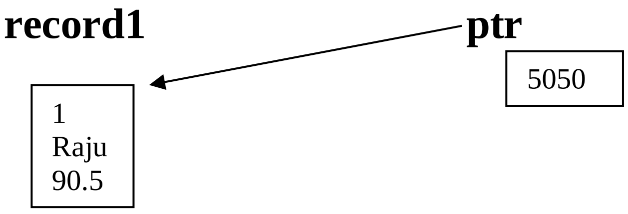
Pointer variable can be assigned address in two ways:

1. Referencing pointer to another structure variable (storing address of a structure variable in a pointer)
2. Using dynamic memory allocation (allocating memory for a structure dynamically and store the address in a pointer variable)

Example program for C structure using pointer (8M)BTL1

In this program, “record1” is normal structure variable and “ptr” is pointer structure variable. As we know, Dot(.) operator is used to access the data using normal structure variable and arrow(->) is used to access data using pointer variable.

```
#include <stdio.h>
#include <string.h>

struct student
{
    int id;
    char name[30];
    float percentage;
};


int main()
{
    int i;
    struct student record1 = {1, "Raju", 90.5};
    struct student *ptr;

    ptr = &record1;

        printf("Records of STUDENT1: \n");
        printf("  Id is: %d \n", ptr->id);
        printf("  Name is: %s \n", ptr->name);
        printf("  Percentage is: %f \n\n", ptr->percentage);

    return 0;
}
```



(Assume address of record1 is 5050)

Output:

Records of STUDENT1:
Id is: 1
Name is: Raju
Percentage is: 90.500000

5

Illustrate List Comprehension with suitable examples(16M) (BTL2)

Answer:Page:4.22-DR.V.Ramesh

Definition (5M)

Python includes a more advanced and powerful operation known as a list comprehension expression.

List comprehensions are coded in square brackets and are composed of an expression and a looping construct that share a variable name

The output of list comprehension is List

Example (8M)

Explanation (3M)

6

Dynamic Memory Allocation

The process of allocating memory during program execution is called dynamic memory allocation. (4M)

(2M)

(2M)

(2M)

(2M)

(2M)

(2M)

C language offers 4 dynamic memory allocation functions. They are,

1. malloc( )
2. calloc( )
3. realloc( )
4. free( )
5.

These library functions are defined under `<stdlib.h>`

Function	Use of Function
malloc()	Allocates requested size of bytes and returns a pointer first byte of allocated s
calloc()	Allocates space for an array elements, initializes to zero and then returns a poi memory
free()	deallocate the previously allocated space
realloc()	Change the size of previously allocated space

malloc( )

The name malloc stands for "memory allocation".

The function `malloc()` reserves a block of memory of specified size and return a pointer of type `void` which can be casted into pointer of any form.(returns the starting address of reserved memory)

Syntax of malloc( )

ptr = (cast-type*) malloc(byte-size)

Here, *ptr* is pointer of cast-type. The `malloc()` function returns a pointer to an area of memory with size of byte size. If the space is insufficient, allocation fails and returns NULL pointer.

ptr = (int*) malloc(100 * sizeof(int));

This statement will allocate either 200 or 400 according to size of int 2 or 4 bytes respectively and the pointer points to the address of first byte of memory

---

8

calloc( )

The name calloc stands for "contiguous allocation".

The only difference between malloc() and calloc() is that, malloc() allocates single block of memory whereas calloc() allocates multiple blocks of memory each of same size and sets all bytes to zero.

(4M)
(4M)
(4M)
(1M)
(3M)

Syntax of calloc( )

ptr = (cast-type*)calloc(n, element-size);

This statement will allocate contiguous space in memory for an array of *n* elements. For example:

ptr = (float*) calloc(25, sizeof(float));

This statement allocates contiguous space in memory for an array of 25 elements each of size of float, i

.e, 4 bytes.

free( )

Dynamically allocated memory created with either calloc() or malloc() doesn't get freed on its own. You must explicitly use free() to release the space.

syntax of free( )

free(ptr);

This statement frees the space allocated in the memory pointed by `ptr`.

9

Create a python program to perform selection sort on the elements (16M) (BTL2)

Answer:Page:4.38-DR.V.Ramesh

```
def selectionSort(x):                                              (10M)
  for i in range(len(x)-1,0,-1):
pMax=0
      for j in range(1,i+1):
          if x[j]>x[pMax]:
pMax = j
tmp = x[i]
      x[i] = x[pMax]
      x[pMax] = tmp
x = [98,26,52,21,67,39,48,99,11]
selectionSort(x)
print(x)
```

Output (3M)

Explanation (3M)

10

Create a python program to perform insertion sort (16M)(BTL2)

Answer:Page:4.36-DR.V.Ramesh

```
Def insertionSort(x):                                              (10M)
  for index in range(1,len(x)):
currentvalue = x[index]
    position = index
    while position>0 and x[position-1]>currentvalue:
        x[position]=x[position-1]
        position = position-1
    x[position]=currentvalue
x = [98,26,52,21,67,39,48,99,11]
insertionSort(x)
print(x)
```

Output (3M)

Program explanation (3M)

11 **Create a C program to perform Merge Sort (16M)** (BTL2)

Answer:Page:4.44-DR.V.Ramesh

(10M)

```
 def mergeSort(x):
    print("Splitting ",x)
    if len(x)>1
        mid = len(x)//2
lefthalf = x[:mid]
righthalf = x[mid:]
mergeSort(lefthalf)
mergeSort(righthalf)
        i=0
        j=0
        k=0
        while i <len(lefthalf) and j <len(righthalf):
            if lefthalf[i] <righthalf[j]:
                x[k]=lefthalf[i]
                i=i+1
            else:
                x[k]=righthalf[j]
                j=j+1
            k=k+1
        while i <len(lefthalf):
            x[k]=lefthalf[i]
            i=i+1
            k=k+1
        while j <len(righthalf):
            x[k]=righthalf[j]
            j=j+1
            k=k+1
    print("Merging ",alist)
```

Output (3M)

Program explanation (3M)

UNIT-V FILE PROCESSING

Files – Types of file processing: Sequential access, Random access – Sequential access file - Example Program: Finding average of numbers stored in sequential access file - Random access file - Example Program: Transaction processing using random access files – Command line arguments

Q.No	**PART * A**
1	**Why files are needed?** ✓ When a program is terminated, the entire data is lost. Storing in a file will preserve your data even if the program terminates.
2	**What are the types of Files ?** When dealing with files, there are two types of files you should know about: 1. Text files. 2. Binary files.
3	**Enlist the File Operations.** In C, you can perform four major operations on the file, either text or binary: 1. Creating a new file 2. Opening an existing file 3. Closing a file 4. Reading from and writing information to a file
4	**Define module.** BTL1 ✓ A module is a file containing Python definitions and statements. ✓ The file name is the module name with the suffix .py appended. ✓ Within a module, the module‘s name (as a string) is available as the value of the global variable_name_. ✓ Modules are used to categorize code in python into smaller part. ✓ A module is a Python object with arbitrarily named attributes that you can bind and reference. Simply, a module is a file consisting of Python code. A module can define functions, classes and variables. A module can also include runnable code.
5	**What are the advantages for using module?** BTL2 ✓ Reusability ✓ Categorization
6	**How to open a file?** ✓ Opening a file is performed using the library function in the **"stdio.h"** ✓ header file: fopen(). ✓ The syntax for opening a file in standard is: ptr = fopen("fileopen","mode")

	.
7	**How to close a file?** ✓ The file (both text and binary) should be closed after reading/writing. Closing a file is performed using library function fclose(). fclose(fptr); //fptr is the file pointer associated with file to be closed.
8	**Reading and writing to a text file** ✓ For reading and writing to a text file, we use the functions fprintf() and fscanf(). ✓ They are just the file versions of printf() and scanf(). The only difference is that, fprint and fscanf expects a pointer to the structure FILE. .
9	**What are two main ways a file can be organized?** ✓ **Sequential Access** — The data are placed in the file in a sequence like beads on a string. Data are processed in sequence, one after another. To reach a particular item of data, all the data that proceeds it first must be read. ✓ **Random Access** — The data are placed into the file by going directly to the location in the file assigned to each data item. Data are processed in any order. A particular item of data can be reached by going directly to it, without looking at any other data.
10	**What are the advantages of files?** BTL2 ✓ When the data is stored in a file, it is stored permanently. ✓ The files in the data can be utilized as and when required. ✓ It is possible to update the data. ✓ Files are highly useful to store huge amount of data.
11	**Write the syntax for write () method and read () method?** BTL1 fileObject.write(string) fileObject.read([count])
12	**Define syntax errors.** BTL1 Syntax errors, also known as parsing errors, are perhaps the most common kind of complaint you get while you are still learning Python. >>> while True print ('Hello Python') Syntax Error: invalid syntax >>>

13 **What is file?**

- ✓ A file is a semi-permanent, named collection of data. A File is usually stored on magnetic media, such as a hard disk or magnetic tape.
- ✓ Semi-permanent means that data saved in files stays safe until it is deleted or modified.
- ✓ Named means that a particular collection of data on a disk has a name, like mydata.dat and access to the collection is done .

14 **Define package.** BTL1

A package is a directory that contains modules. Having a directory of modules allows us to have modules contained within other modules. This allows us to use qualified module names, clarifying the organization of our software

15 **What is Errors?** BTL3

In Python, there are two kinds of errors: syntax errors and exceptions. This post will describe what those errors are. Upcoming posts will show how we can handle those errors

16 **What is syntax error?** BTL3

Let's start with syntax errors, (also known as parsing errors).

The parser repeats the offending line and displays an 'arrow' pointing at the earliest point in the line where the error was detected

```
>>> while True print 'Hello world' File
  "", line 1, in ?
```

```
   while True print 'Hello world'
```

17 **What is exception?** BTL3

Even if a statement or expression is syntactically correct, it may cause an error when an attempt is made to execute it. Errors detected during execution are called exceptions

Example of an exception error.

```
>>> 10 * (1/0)
```

18 **Define Namespaces.** BTL3

Variables are names or identifiers that map to objects. A namespace is a dictionary of variable names/keys and their corresponding objects values. Each function has its own local namespace.

19 **Mention the attributes related to file object.** BTL3

- ✓ File.closed
- ✓ file.mode
- ✓ file.name
- ✓ file.softspace

21	**What is Try and Except?** BTL3 If an error is encountered, a try block code execution is stopped and transferred down to the except block. In addition to using an except block after the try block, you can also use the finally block. The code in the finally block will be executed regardless of whether an exception occurs.

	PART * B
1	**Write a Python program to demonstrate the file I/O operations(16M)** BTL4 **Answer:Page:5.12-DR.V.Ramesh** ✓ Introduction – storage of bits (4M) ☐ Program (6M) ✓ Explanation - open() function – close () funation- working of file need to be explained (6M)
2	**Discuss with suitable examples (i) Close a File. (ii) writing file (Jan 2018) (16M)** BTL4 **Answer:Page:5.5-DR.V.Ramesh** (i) Close a File. ☐ Syntax - close() (4M) ☐ Program (4M) (ii)Writing to a File. Syntax - write () (4M) ✓ Program (4M)
3	**i)Write a program to catch a Divide by zero exception. Add a finally block too. ii)Write a function to print the hash of any given file . (16M)** BTL5 **Answer:Page:5.41-DR.V.Ramesh** **Program** (8M)

```
import random try:
  ri = random.randint(0, 2) if ri
  == 0:
    infinity = 1/0
```

```
  elif ri == 1:
    raise ValueError("Message")
    #raise ValueError, "Message" # Deprecated elif
  ri == 2:
    raise ValueError # Without message
except ZeroDivisionError:
  pass
except ValueError as valerr:
#except ValueError, valerr: # Deprecated? print
  valerr
  raise # Raises the exception just caught except: #
Any other exception
  pass
finally: # Optional pass
  # Clean up
class CustomValueError(ValueError): pass # Custom exception try:
  raise CustomValueError
  raise TypeError
except (ValueError, TypeError): # Value error catches custom, a derived class, as well pass
```

ii)Program to print the hash of any given file in python (8M)

4	**(i)Describe in detail about Exception with Arguments (ii)Describe in detail about user – defined Exceptions (Jan 2018) (16M)** BTL1 **Answer:Page:5.43-6-DR.V.Ramesh, Page:5.34-DR.V.Ramesh** **(i) Exception with Arguments** Syntax (4M) Example (4M) **(ii) Describe in detail about user – defined Exceptions.** About Exception (4M); Example (4M)
5	**(i)Explain with example of closing a file (Jan 2018) (ii) Discover syntax for reading from a file. (6M)** BTL3 **Answer:Page:5.12-DR.V.Ramesh** ✓ Syntax (4M) ✓ Example (4M) **(ii)Discover syntax for reading from a file.** ✓ file.read(). (1M) ✓ file.read(5) (2M) ✓ file.readline() (1M)

- ✓ file.readline(3) (2M)
- ✓ file.readlines() (2M)

6 **What is command line arguments? Explain with example.** BTL2

Command Line Arguments

Command line arguments are values passed in during execution of a program. These values are passed after the file name.

Sys.argv is the package used for accessing command line arguments. Sys.argv[0]

will be file name.

Cmdline.py

```
import sys

print sys.argv[0] print

sys.argv[1] print

sys.argv[2] print

sys.argv[3] print

len(sys.argv)
```

Output

```
>>>python Cmdline.py good morning hello hi
             0            1    2      3   4

cmdline.py

good morning

hello
```

BE8255 BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

OBJECTIVES:

- To understand the fundamentals of electronic circuit constructions.
- To learn the fundamental laws, theorems of electrical circuits and also to analyze them
- To study the basic principles of electrical machines and their performance
- To study the different energy sources, protective devices and their field applications
- To understand the principles and operation of measuring instruments and transducers

UNIT I ELECTRICAL CIRCUITS ANALYSIS 9

Ohms Law, Kirchhoff‟s Law-Instantaneous power- series and parallel circuit analysis with resistive, capacitive and inductive network - nodal analysis, mesh analysis- network theorems - Thevenin's theorem, Norton theorem, maximum power transfer theorem and superposition theorem, three phase supply-Instantaneous, Reactive and apparent power-star delta conversion.

UNIT II ELECTRICAL MACHINES 9

DC and AC ROTATING MACHINES: Types, Construction, principle, Emf and torque equation, application Speed Control- Basics of Stepper Motor – Brushless DC motors- Transformers-Introduction- types and construction, working principle of Ideal transformer-Emf equation- All day efficiency calculation.

UNIT III UTILIZATION OF ELECTRICAL POWER 9

Renewable energy sources-wind and solar panels. Illumination by lamps- Sodium Vapour, Mercury vapour, Fluorescent tube. Domestic refrigerator and air conditioner-Electric circuit, construction and working principle. Batteries-NiCd, Pb Acid and Li ion–Charge and Discharge Characteristics. Protection-need for earthing, fuses and circuit breakers. Energy Tariff calculation for domestic loads.

UNIT IV ELECTRONIC CIRCUITS 9

PN Junction-VI Characteristics of Diode, Zener diode, Transistors configurations - amplifiers. Op amps- Amplifiers, oscillator, rectifiers, differentiator, integrator, ADC, DAC. Multi vibrator using 555 Timer IC . Voltage regulator IC using LM 723,LM 317.

UNIT V ELECTRICAL MEASUREMENT 9

Characteristic of measurement-errors in measurement, torque in indicating instruments- moving coil and moving iron meters, Energy meter and watt meter. Transducers- classification-thermo electric, RTD, Strain gauge, LVDT, LDR and piezoelectric. Oscilloscope-CRO.

TOTAL: 45

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

- Discuss the essentials of electric circuits and analysis.
- Discuss the basic operation of electric machines and transformers
- Introduction of renewable sources and common domestic loads.
- Introduction to measurement and metering for electric circuits.

TEXT BOOKS:

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, 2016,Third Edition.
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.

REFERENCES:

1. S.B. Lal Seksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016
2. B.L Theraja, Fundamentals of Electrical Engineering and Electronics. Chand & Co, 2008.
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson, 2015
4. John Bird, ―Electrical and Electronic Principles and Technology‖, Fourth Edition, Elsevier, 2010.
5. Mittle,Mittal, Basic Electrical Engineering‖, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. C.L.Wadhwa, ―Generation, Distribution and Utilisation of Electrical Energy‖, New Age international pvt.ltd.,2003.

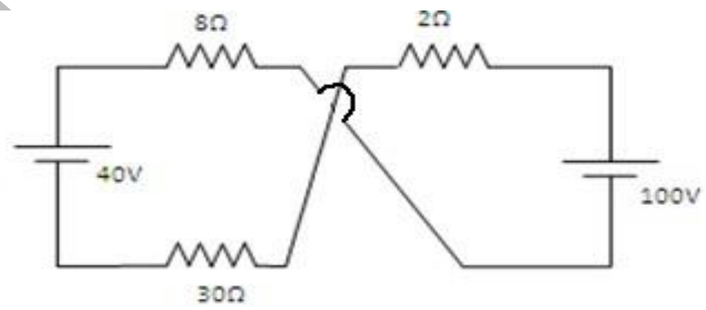
Subject Code:BE8255 **Year/Semester: II /02**
Subject Name: BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENTENGINEERING
Subject Handler: Mr.A.Antony charles

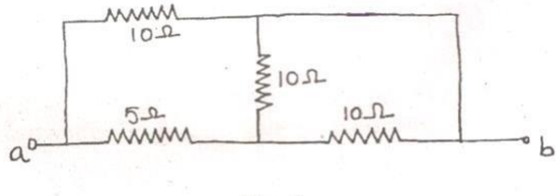
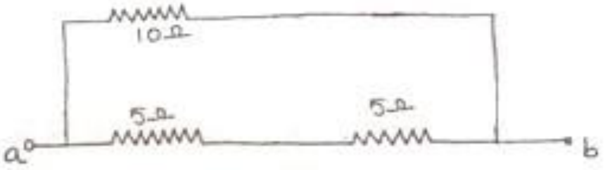
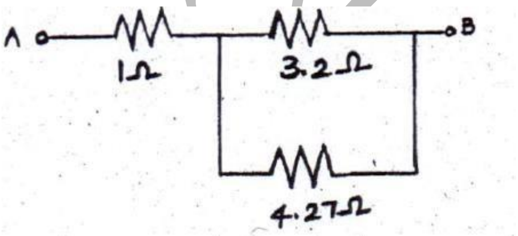
UNIT I ELECTRICAL CIRCUITS ANALYSIS

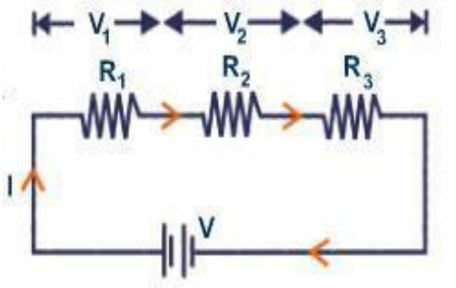
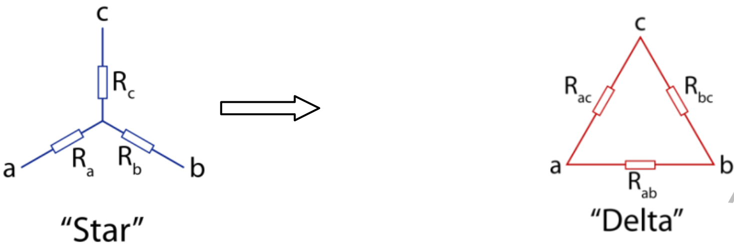
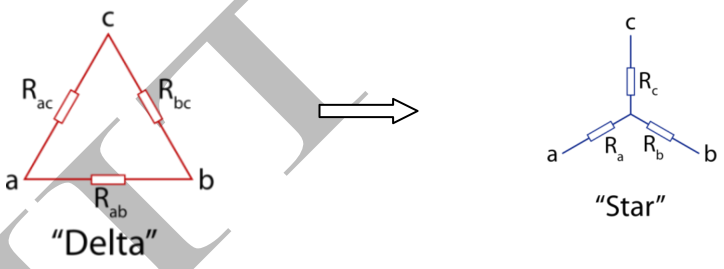
Ohms Law, Kirchhoff 's Law-Instantaneous power- series and parallel circuit analysis with resistive, capacitive and inductive network - nodal analysis, mesh analysis- network theorems - Thevenins theorem, Norton theorem, maximum power transfer theorem and superposition theorem, three phase supply-Instantaneous, Reactive and apparent power-star delta conversion.

Part*A

Q.No	Question
1.	**State Ohm's law.** BTL1 Ohm's law states that the current flowing in a conductor is directly proportional to the potential between two ends of a conductor. i.e., I α V, V = IR.
2.	**State the Limitation of Ohm's law. (APR/MAY 2019)**BTL1 ➢ Ohm's law doesn't apply to all non-metallic conductors. ➢ Doesn't apply to nonlinear devices like Zener diode, Voltage regulator, tubes etc., ➢ It is not applicable for the metallic conductors which changes with temperature.
3.	**Define i) charge ii) electric current iii) power iv) network& v) circuit. . (APR/MAY 2018)**BTL1 **Charge:** Charge is an electrical property of the atomic particles of which matter consists, measured in coulombs(C). **Electric current:** is the time rate of change of charge, measured in amperes (A). i =dq/dt A direct current (DC) is a current that remains constant with time. An alternating current (AC) is a current that varies sinusoidally with time. **Power:** is the time rate of expending or absorbing energy, measured in watts (w).p = $\frac{dw}{dt}$ p- Power in watts(w); E- energy in joules (J);t - time in seconds (S);(or) p = v i ,v - Voltage in volts(V);i - current in amperes(A). **Network:** The inter connection of two or more simple circuit elements forms an electrical network. **Circuit:** If the network contains at least one closed path, it is an electric circuit.
4.	**State Kirchoff's Current law and Kirchoff's Voltage law.** BTL1 **KCL** (Kirchoff's Current Law) states that the algebraic sum of currents entering a node is zero (or).

	The sum of the currents entering a node is equal to the sum of the currents leaving the node. **KVL** (Kirchoff's Voltage Law) states that the algebraic sum of all voltages around a closed path is zero. (Or) Sum of voltage drop = Sum of voltage rise.
5.	**What do you meant by series and parallel circuit?** BTL1 When circuit elements like resistors are connected in series, such that the same current passes through all of them, then they are said to be in series.When circuit elements are connected across one another such that the same voltage is applied to each, then the are said to be in parallel.
6.	**Define: Node (OR) Junction. (APR/MAY 2019)**BTL1 A Node is a point in the network where two or more circuit elements are connected.
7.	**Write down the expression of equivalent resistance for 'n' - number of resistors in parallel connection. (APR/MAY 2018)**BTL1 For 'n' resistors connected in parallel, the equivalent resistance is given by, $\frac{1}{Req} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ... + \frac{1}{R_n}$
8.	**Write down the expression of equivalent resistance for 'n' – number of resistors in series connection.** BTL1 For 'n' resistors connected in series, the equivalent resistance is given by, $Req=R_1+R_2+R_3+ ....+R_n$
9.	**Apply KVL and find the current in the circuit from 40V.** BTL2  By applying KVL,40-8I+100-2I-30I=0, Ans: I=5A
10.	**Distinguish between a Loop & Mesh of a circuit. (APR/MAY 2018)**BTL3 The closed path of a network is called a Loop.An elementary form of a loop which cannot be further divided is called a mesh. In other words Mesh is closed path does not contain an other loop within it.
11.	**Calculate the equivalent resistance between the terminals "a" and "b" in Fig.1.** BTL2

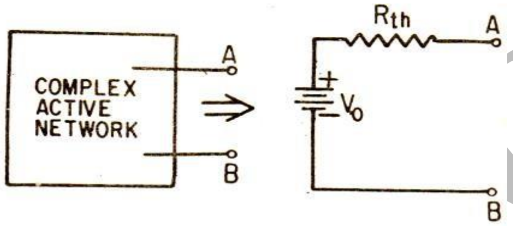
	 Fig. 1  Resistance between terminals 'a' and 'b' =$(10 \text{ X } 10)/(10+10)$ = 5Ω
12.	**The resistance of two wires is 25Ω when connected in series and 6Ω when connected in parallel. Calculate the resistance of each wire.** BTL2 $R_1+R_2=25\Omega$, $R_2=25-R_1$ -------------------(1) $R_1R_2/(R_1+R_2) = 6\Omega$, ------------- (2) Substitute eqn(1) in eqn (2), $R_1^2-25R_I+150=0$ $R_1=10\Omega$, $R_2=15\Omega$ (or)$R_1=15\Omega$, $R_2=10\Omega$
13.	**Find the equivalent resistance of the circuit shown in fig. (APR/MAY 2019)** BTL3  Equivalent resistance = $1+\frac{2\times27}{2+27}$ Ω= 2.86 Ω
14.	**State division of current rule for a two-branch parallel network.** BTL1 R_1 and R_2 are connected in parallel, Let I be the total current, I_1 be the current through R_1, I_2 be the current through R_2. Then $I_1 = I * R_2/(R_1+R_2)$; $I_2 = I * R_1/(R_1+R_2)$
15.	**State division of voltage rule for a circuit with three resistors in series.** BTL1 R_1, $R_2$and R_3 are connected in series, Let V be the total voltage, V_1 be the voltage across R_1, V_2 be the voltage across R_2, V_3 be the voltage across R Then, $V_1=V*R_1/(R_1+R_2+R_3)$,$V_2=V*R_2/(R_1+R_2+R_3)$ and $V_3=V*R_3/(R_1+R_2+R_3)$

	
16.	**Write down the formulae for converting Star to Delta. (APR/MAY 2018)**BTL2  $R_{ab}=(R_aR_b+R_bR_c+R_cR_a) / R_c$; $R_{bc}=(R_aR_b+R_bR_c+R_cR_a) / R_a$; $R_{ca}=(R_aR_b+R_bR_c+RcR_a) / R_b$.
17.	**Write down the formulae for converting Delta to Star.** BTL2 $R_a = (R_{ac}R_{ab})/(R_{ab}+ R_{bc}+ R_{ca})$; $R_b = (R_{ab}R_{bc})/(R_{ab}+ R_{bc}+ R_{ca})$; $R_c = (R_{ac}R_{bc})/(R_{ab}+ R_{bc}+ R_{ca})$ 
18.	**State Superposition theorem.** BTL1 The superposition theorem states that in any linear bilateral network containing two or more sources, the response in any element is equal to algebraic sum of the responses caused by individual sources acting alone, while the other sources are non-operative; that is, while considering the effect of individual sources, other ideal voltage sources and ideal current sources in the network are replaced by short circuit and open circuit across their terminals.

19. **State Thevenin's theorem.** BTL1

Thevenin's theorem states that any circuit having a number of voltage sources, resistances and open output terminals can be replaced by a simple equivalent circuit consisting of a single voltage source (V_{th}) in series with a resistance (impedance) R_{th} (Z_{th}.).

Where V_{th} is equal to the open circuit voltage across the two terminals, R_{th} is equal to the equivalent resistance measured between the terminals with all energy sources are replaced by their internal resistance.



20. **What is the limitation of superposition theorem?** BTL1

Super position theorem can be applied for finding the current through or voltage across a particular element in a linear bilateral circuit containing more than two sources. But this theorem cannot be used for the calculation of the power.

21. **State reciprocity theorem.** BTL1

According to this theorem, in a linear, bilateral network if we apply some input to a circuit which consists of resistors, inductors, capacitors and transformers, the ratio of response in any element to the input is constant even when the position of input and output are interchanged. This is called the Reciprocity Theorem.

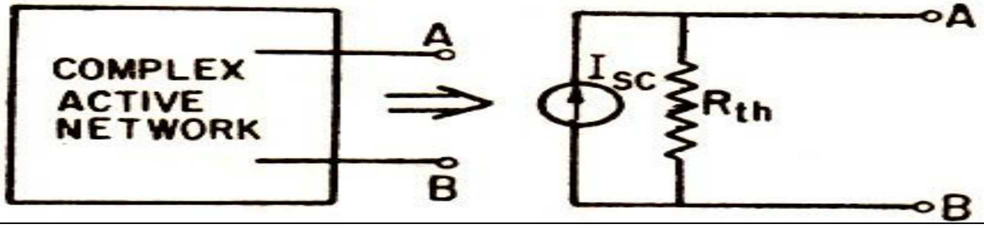
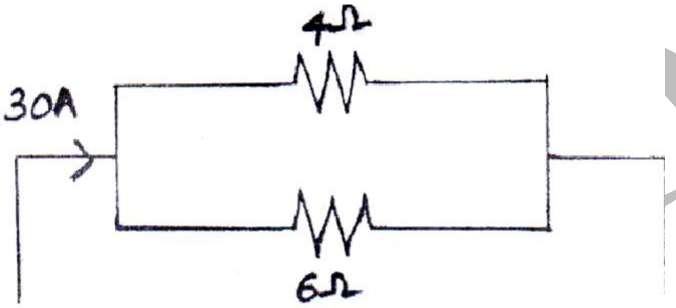
22. **State Maximum power transfer theorem. (or) What is the condition for maximum power transfer in DC and AC circuits.** BTL1

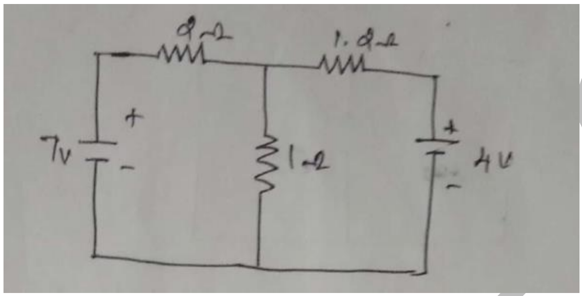
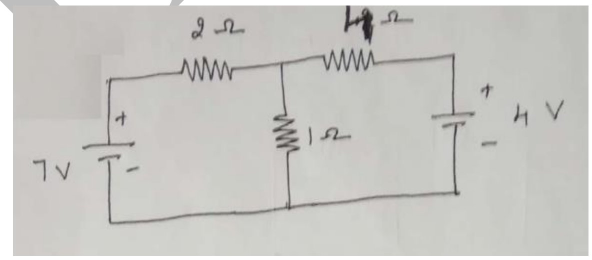
The maximum power transfer theorem states that, to obtain maximum external power from a source with a **finite** internal resistance, the resistance of the load must equal the resistance of the source as viewed from its **output terminals**. According to maximum power transfer theorem, maximum power transfer occurs when $R_L = R_{TH}$, that is, when the load resistance is equal to the thevenin resistance.

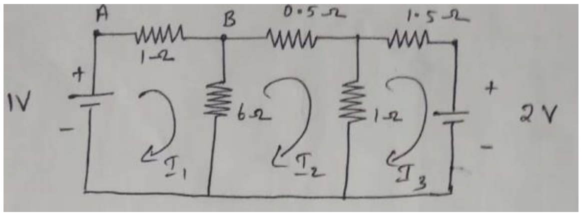
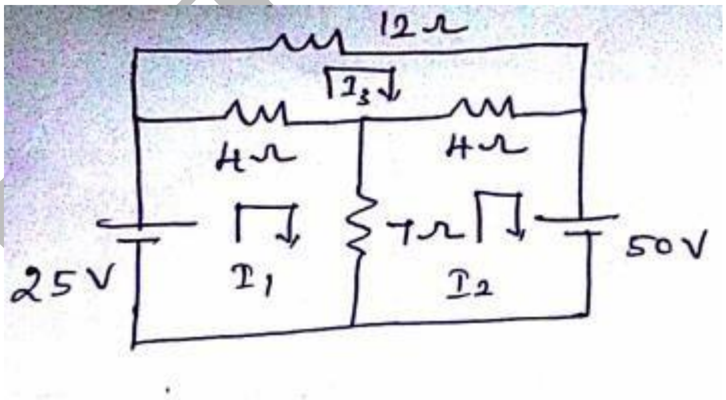
23. **State Norton's theorem.** BTL1

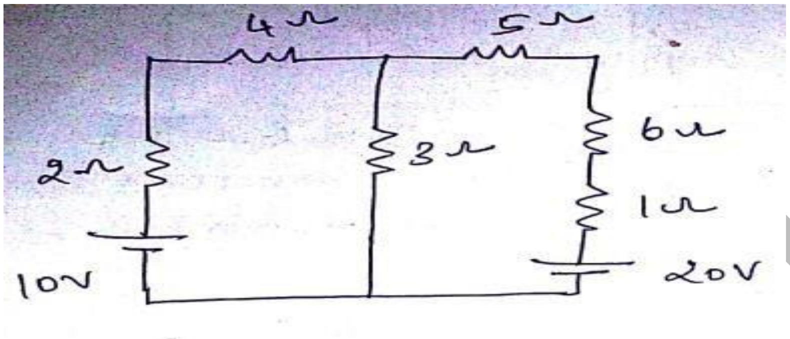
Norton's theorem states that any circuit with voltage sources, resistances (impedances) and open output terminals can be replaced by a single current source I_{sc} in parallel with single resistance R_{th}(impedance Z_{th}.).Where I_{sc} is equal to the current passing through the short circuit output terminals

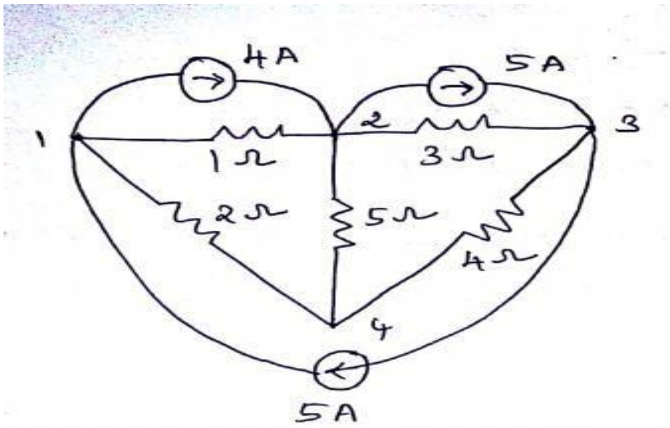
R_{th} is equal to the resistance seen into the output terminals with all energy sources are replaced by their internal resistance.

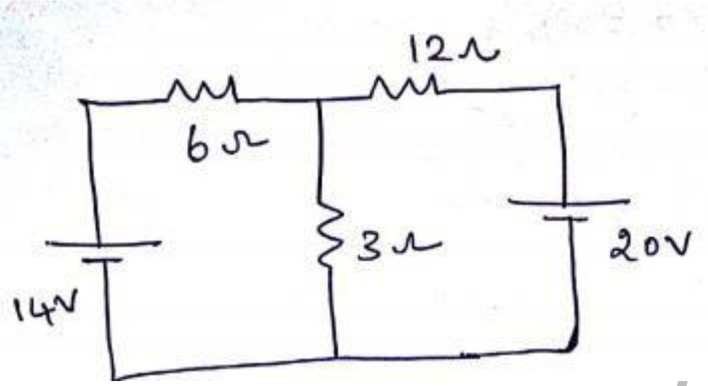
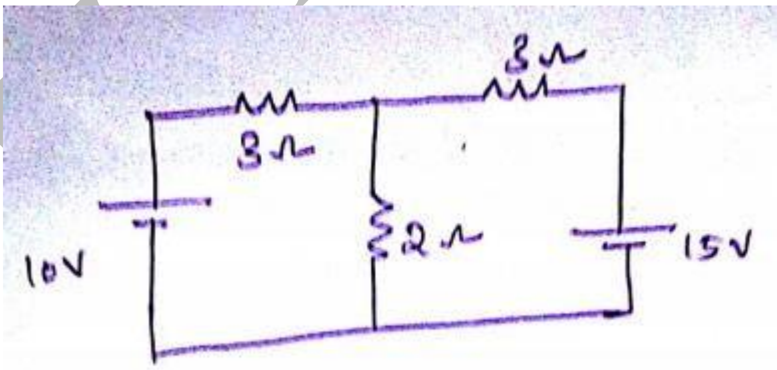
	
24.	**Two resistors of 4 Ω and 6 Ω are connected in parallel. If the total current is 30A. Find the current through each resistor shown in below fig.** BTL3  Current through 4Ω, $I_4 = I_T * \frac{R_6}{R_4 + R_6} = 30 \times \frac{6}{6+4} = 18$ A Current through 6Ω, $I_6 = I_T * \frac{R_4}{R_4 + R_6} = 30 \times \frac{4}{6+4} = 12$ A
25.	**What is meant by Current?** BTL1 The flow of free electron in a conductor is called current. Unit is ampere (A). I = Q/t
26.	**What is meant by charge? (APR/MAY 2019)**BTL1 Charge is an electrical property of the atomic particles which matter consists. The charge of an electron is so small. Charge in motion represents current. The unit of charge is coulomb.
27.	**Define line currents and phase currents.** BTL1 The currents flowing in the lines are called as line currents. The currents flowing through phase are called phase currents.
28.	**Give the phase value & Line value of a star connected system.** BTL1 Line voltage: VL= 3Vph Phase voltage: Vph = VL/3

29.	**What is meant by Real power?** BTL1 Real power means the useful power transfer from source to load. Unit is watts.
30.	**What is meant by apparent power?** BTL1 Apparent power is the product of voltage and current and it is not true power. Unit is VA
31.	**What is reactive power?** BTL1 If we consider the circuit as purely inductive the output power is reactive power. Its unit is VAR
	PART B
Q.No	**Question**
1.	**Using Thevenin's theorem find the current flowing through the resistance 1Ω. (13M) (APR/MAY 2019)**BTL2  **Answer: Page 7.4 - Dr. C. Ramesh Babu Durai** ➢ Vth= 5.12 V ➢ R_{th} = 0.75 Ω ➢ $I_L=V_{th}/R_{th}+ R_L$ ➢ I_L = 2.98 A
2.	**Using Thevenin's theorem find the current flowing through the resistance 1Ω. (13M)** BTL2 

	Answer: Page 7.4 - Dr. C. Ramesh Babu Durai ➢ Vth= 6 V ➢ Rth = 1.33 Ω ➢ I_L=Vth/Rth+R_L ➢ I_L = 2.575 A
3.	**Obtain Norton's equivalent current at the terminal A & B. (13M)** BTL3  **Answer: Page 7.4 - Dr. C. Ramesh Babu Durai** ➢ Δ=16.5 ➢ Δ1=29.75 ➢ Isc = I1 = 1.77 A ➢ Rth = 6.27 Ω ➢ IL=Isc * Rth / Rth + RL ➢ IL=1.5 A
4.	**Calculate current through 7 Ω resistor by using mesh analysis. (APR/MAY 2019) (13M)** BTL2  **Answer: Page 7.4 - Dr. C. Ramesh Babu Durai** ➢ Δ=3048

	➢ I1 = 1.3A ➢ I2 = 2.06A ➢ Current through 7-ohm resistor = -0.76A
5.	**Calculate power consumed by 6 ohm resistor by using super position theorem. (13M) (APR/MAY 2018)** BTL2  **Answer: Page 7.4 - Dr. C. Ramesh Babu Durai** ➢ Total current by first source = 1.2A ➢ I1 = 0.96A ➢ Total current by second source = 1.43A ➢ I2= 0.95A ➢ Load current = 2.15A ➢ Power Consumed= 13.86 watts
Part*C	
Q.No	**Question**

1.	**Calculate voltage across 3-ohm resistor by using nodal analysis. (13M).** BTL2 

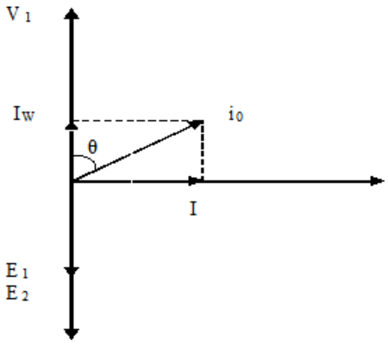
	Answer: Page 7.4 - Dr. C. Ramesh Babu Durai ➢ Δ=0.59 ➢ V2 = -0.49V ➢ V3 = -0.165V ➢ **Voltage across 3 -ohm resistor = 0.211V**
2.	**Calculate current through 3 Ω resistor by using Kirchoff's Laws. (13M)** BTL2  **Answer: Page 7.4 - Dr. C. Ramesh Babu Durai** ➢ 9I1-3I2=14 ➢ 3I1-15I2=20 ➢ I1=9A ➢ I2=1.1A ➢ Current through 3-ohm resistor = 0.8A
3.	**Calculate current through 3 Ω resistor by using Kirchoff's Laws. (13M) (APR/MAY 2019)**BTL2  **Answer: Page 7.4 - Dr. C. Ramesh Babu Durai**

	- 5I1-2I2=10 - 2I1-5I2=15 - I1=0.96A - I2=-2.6A - Current through 2-ohm resistor = 3.56A

Subject Code:BE8255 Year/Semester: II /02
Subject Name: BASIC ELECTRICAL, ELECTRONICS, AND MEASUREMENT ENGINEERING
Subject Handler: Mr.A.Antony Charles

UNIT II ELECTRICAL MACHINES	
DC and AC ROTATING MACHINES: Types, Construction, principle, Emf and torque equation, application Speed Control- Basics of Stepper Motor – Brushless DC motors- Transformers-Introduction- types and construction, working principle of Ideal transformer-Emf equation- All day efficiency calculation.	
Part*A	
Q.No	**Question**
1.	**A 200 V DC Motor has an R_a =0.06Ω and R_{se} =0.04Ω.If the motor input is 20KW find the back emf of the motor and power developed in the armature.** BTL5 I=$\frac{20*1000}{200}$ =100 A ; V= + + Back emf=190 V; Power developed= E_b*I_a=19KW
2.	**How are DC Machines classified ? (APR/MAY 2019)** BTL2 D.C Generators Separately excited machine. Self excited machine. Shunt generator Series generator Compound generator D.C Motors • Shunt • Series • Compound
3.	**Define Back emf of DC motor and expression for speed ? (APR/MAY 2018)** BTL1 The emf induced in the armature of motor usually opposes the applied voltage. This induced emf is called as back emf or counter emf. (Lenz's law) - It acts as a governor (ie., self regulating).

	N= $\frac{E_b}{\Phi}$ = $k\frac{V-I_a R_a}{\emptyset}$ V=Voltage ; = Armature Current ; = Armature Resistance
4.	**n 8 pole wave connected armature has 600 conductors and is driven at 625 rev/min. If the flux er pole is 20 mWb, Determine the generated emf.** BTL5 $E_g = \frac{\Phi Z N}{60}\left(\frac{P}{A}\right)$ Here A=2 Eg = (0.02*600*625*8)/120Eg = 500V
5.	**DC motor operates from a 240V supply. The armature resistance is 0.2Ω. Determine the back emf when the armature current is 50A. (APR/MAY 2019)**BTL5 V= Eb+ IaRa E_b = 240- (50*0.2) E_b = 230 V
6.	**What is the significance of back emf?** BTL1 If the back emf is zero, a high armature current flow which damages the windings. So in order to limit the armature current back emf is necessary for the machine.
7.	**Write down the application of D.C series motor.** BTL2 Electric Trains, Cranes, hoists, elevators and conveyors, Fans and air compressors hair driers, Vacuum cleaners, Sewing machines, Traction drives, Trolley.
8.	**Mention the difference between core and shell type transformer.** BTL2 In core type the winding surround the core considerably and in shell type the core surround the windings i.e windings is placed in central limb of the core.
9.	**Define Transformation Ratio and classify the Transformer based on Transformation ratio.** BTL2 Transformation ratio is defined as the ratio of number of turns in the secondary winding to number of turns in primary winding. K=$\frac{N_2}{N_1}$=$\frac{E_2}{E_1}$

<table>
<tr><td></td><td>Types :Step up transformer & Step down transformer</td></tr>
<tr><td>10.</td><td>Draw the phasor diagram of a transformer in no load.BTL6

</td></tr>
<tr><td>11.</td><td>Define Slip of an induction motor. BTL1
The difference between the synchronous speed (rotating magnetic field) and the rotor speed is known as slip. It is expressed as
%Slip(s)=$\frac{N_{S-N}}{N_S}$*100
Where, Ns – speed of the rotating magnetic field&N – Motor speed.</td></tr>
<tr><td>12.</td><td>Compare Slip ring and Squirrel cage Type Rotor. (APR/MAY 2019)BTL2
Squirrel cage: Resistance Permanently Welded, less losses ,high efficiency
Slipring: Resistance can be added, high losses, low efficiency</td></tr>
<tr><td>13.</td><td>Write the Comparison of Core and Shell type transformers BTL2
<table>
<tr><td>CORE TYPE</td><td>SHELL TYPE</td></tr>
<tr><td>The winding encircles the core</td><td>The core encircles most part of the winding</td></tr>
<tr><td>It has single magnetic circuits</td><td>It has double magnetic circuits</td></tr>
<tr><td>The cylindrical type of coil are used</td><td>Multilayer dick type or sandwich coil are used</td></tr>
<tr><td>The construction preferred</td><td>The construction preferred</td></tr>
</table></td></tr>
</table>

for low voltage transformer	for High voltage transformer
In single phase type ,the core has two limbs	In single phase type ,the core has three limbs

14.	**Why the SC test on transformer is performed on HV side?**BTL4 The Short Circuit test is normally conducted on HV side of the transformer and LV side is short circuited, because on the high voltage side the current rating is low .So we can use normally available meter range.
15.	**Give the emf equation of a transformer and define each term.** BTL2 Emf induced in primary coil $E_1=4.44f\Phi_mN_1$ volt Emf induced in secondary Coil $E_2=4.44f\Phi_mN_2$. f ----------freq of AC input Φ------ maximum value of flux in the core N_1,N_2 --- Number of primary & secondary turns
16.	**Does transformer draw any current when secondary is opened? Why?** BTL2 Yes, it (primary) will draw the current from the main supply in order to magnetize the core and to supply for iron and copper losses on no load .There will not be any current in the secondary since secondary is open.
17.	**State the condition for achieving maximum torque and state the expression for maximum running torque.** BTL1 $S_m = \frac{R_2}{X_2}$ $T_m=\frac{KE_2^2}{2X_2}$N-m
18.	**Why an induction motor never runs at synchronous speed? (APR/MAY 2019)** BTL3 If it runs at synchronous speed then there would be no relative speed between the two, hence no rotor emf, so no rotor current, then no rotor torque to maintain rotation.
19.	**Why an induction motor is called a rotating transformer?** BTL2 The rotor receives same electrical power in exactly the same way as the secondary of a two winding transformer receiving power from primary. That is why induction motor is called a rotating transformer.

20.	**Write two extra features of slip ring induction motor** BTL1 Rotor has 3 phase winding ,Extra resistance can be added into the rotor circuit for speed control and also improving PF with the help of slip rings.
21	**What happen when a DC supply is applied to a transformer?** BTL1 Due to saturation of magnetic core a large current flows through the windings, without induced any emf. This large current burns the windings of the transformer.
22.	**Why transformers are rated in kVA?** BTL4 Copper loss of a transformer depends on current & iron loss on voltage. Hence total losses depend on Volt-Ampere and not on PF. That is why the rating of transformers is in kVA and not in kW.
23.	**Distinguish power transformers & distribution transformers. (APR/MAY 2019)** BTL2 Power transformers have very high rating in the order of MVA. They are used in generating and receiving stations. Sophisticated controls are required. Voltage ranges will be very high. Distribution transformers are used in receiving side. Voltage levels will be medium. Power ranging will be small in order of kVA. Complicated controls are not needed.
24.	**State all day efficiency of a transformer** BTL1 It is computed on the basis of energy consumed during a certain period, usually a day of 24 hrs. all day efficiency = output in kWh/input in kWh tor 24 hrs.
25.	**Why the armature core in dc machines is constructed with laminated steel sheets instead of solid steel sheets?** BTL2 Lamination highly reduces the eddy current loss and steel sheets provide low reluctance path to magnetic field.
26.	**Why commutator is employed in d.c. machines? (APR/MAY 2018)**BTL2 Conduct electricity between rotating armature and fixed brushes, convert alternating emf into unidirectional emf (mechanical rectifier).
27.	**How does DC motor differ from DC generator in construction?** BTL1 Generators are normally placed in closed room and accessed by skilled operators only. Therefore, on ventilation point of view they may be constructed with large opening in the frame. Motors have to be installed right in the place of use which may have dust, dampness, inflammable gases, chemical.etc.to protect the motors against these elements, the motor frames are made either

partially closed or totally closed or flame proof.

28.

What is the necessity of starter in D.Cmotors?BTL1

When a dc motor is directly switched on ,atthe time of starting ,the motor back emf is zero .Due to this, the armature current is very high. Due to the very high current,the motor gets damaged. To reduce the starting current of the motor a starter is used.

29.

What is meant by residual emf in DC generator? (APR/MAY 2018) BTL1

It is induced emf in the self-excited dc generator due to the residual magnetism.

30.

What is back emf in d.c. motor? BTL1

- As the motor armature rotates, the system of conductor come across alternate north and south pole magnetic fields causing an emf induced in the conductors.
- The direction of the emf induced in the conductor is in opposite to current. As this emf always opposes the flow of current in motor operation it is called as back emf.

31.

Name any four applications of DC series motor. BTL2

- Electric traction
- Mixies
- Hoists
- Drilling machines

Define Step angle. BTL1

Step angle is the angle through which the stepper motor shaft rotates for each command pulse It is denoted by β

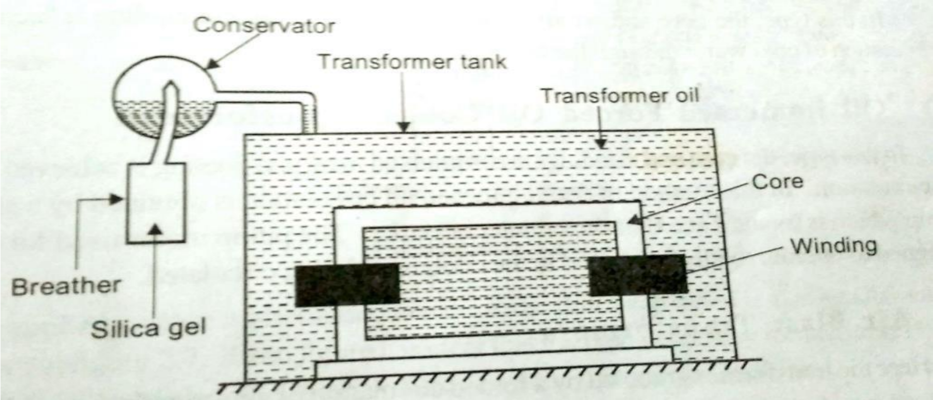
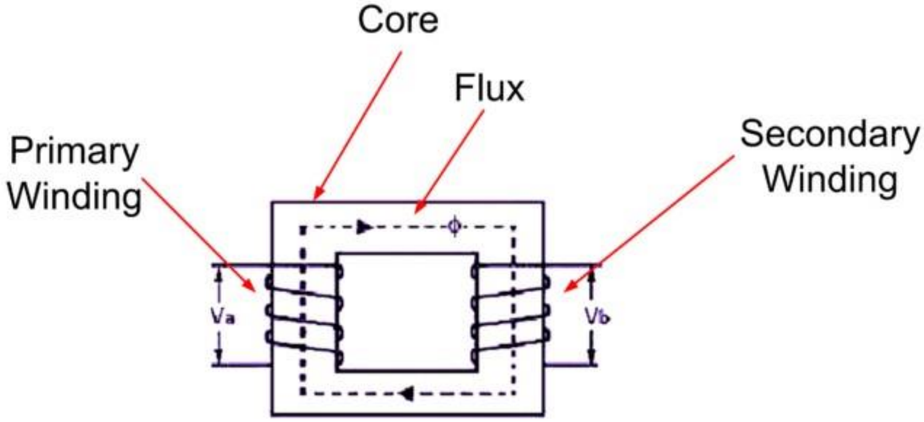
Step angle=360^0/(Number of phases*Number of rotor teeth)

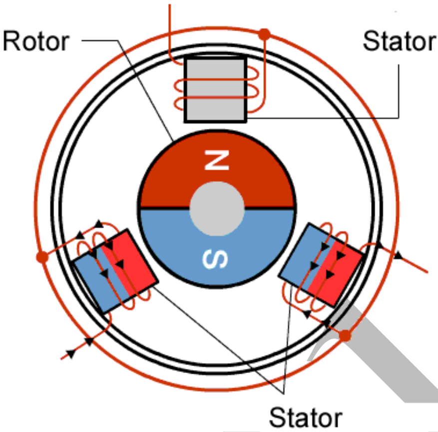
Differentiate the Half step and Full step operation of a stepper motor. (APR/MAY 2019)BTL2

Half step	**Full step**
Exciting three phases at a time.	One phase is energized at any time.
Alternate one phase on and two phase on ,modes of operation.	Rotor and stator teeth are not aligned, the magnetic reluctance is large.
Resolution gets doubled.	Direction of rotation depends sequence in phase winding are energized.
Half stepping produces smoother shaft rotation.	Independent of direction of current.

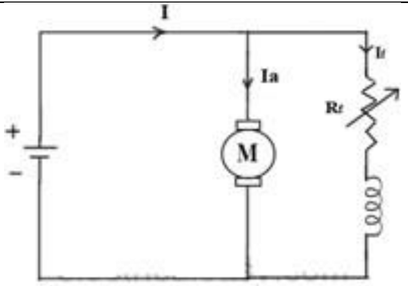
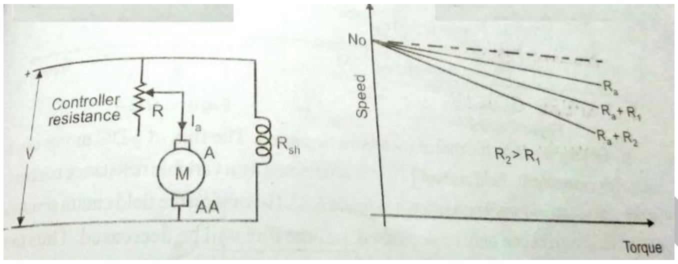
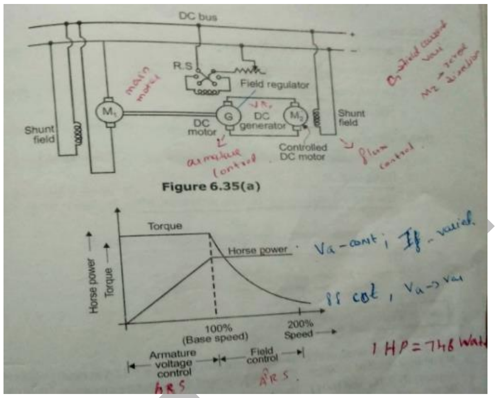
Define holding torque in stepper motors. BTL1

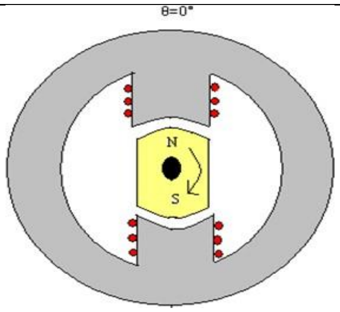
It is defined as the maximum static torque that can be applied to the shaft of an excited motor without causing continuous rotation.

Part*B	
Q.No	**Question**
1.	**Describe the Construction and working principle of a transformer.**BTL2 **(13M)** **Answer: Page :4.3 – Dr.C.Ramesh babu Durai** ➢ Draw the diagram(4 M)  ➢ Explain the parts(5 M) ✓ Magnetic core ✓ Primary and Secondary Winding ✓ Insulation of winding ✓ Expansion tank and Conservator ✓ Lead and tappings for coils – support, terminal and terminal insulator ✓ Tank , Oil , cooling arrangements , temperature gauge , oil gauge ✓ Buchhols relay ✓ Silica gel breather ➢ Explain the working Principle(4 M)  ✓ Electromagnetic induction Principle

	Faradays law
2.	**Explain the working of BLDC motor.** BTL2**(APR/MAY 2018) (13M)** **Answer: Page :5.10 – Dr.C.Ramesh babu Durai**  - Brushless DC motors do not use brushes. - With brushed motors, the brushes deliver current through the commutator into the coils on the rotor. - A brushless motor pass current to the rotor coils? It doesn't—because the coils are not located on the rotor. - the coils do not move, there is no need for brushes and a commutator. - rotation is achieved by controlling the magnetic fields generated by the coils on the rotor - To change the rotation speed, you change the voltage for the coils. - A BLDC motor, it is the permanent magnet that rotates; rotation is achieved by changing the direction of the magnetic fields - A BLDC motor with three coils on the stator will have six electrical wires - Wiring in the BLDC motor case is more complicated than simply connecting the power cell's positive and negative terminals - One big advantage is efficiency, as these motors can control continuously at maximum rotational force (torque) - The second big advantage - related to the first - is controllability - Precision control in turn reduces energy consumption and heat generation
3.	**Derive the EMF equation of a DC generator and explain about the significance of back emf .(13M)** BTL3 **Answer: Page :3.11 – Dr.C.Ramesh babu Durai** ➢ Derive the DC generator EMF equation (10 M) ✓ Ø = flux/pole in Wb (weber)

	✓ Z = total no. of armature conductors ✓ P = No. of generator poles ✓ A = No. of parallel paths in armature ✓ N = rotational speed of armature in revolutions per min. (rpm) ✓ E = emf induced in any parallel path in armature By Faradays law, $e=PN\phi/60$ $= PN\phi/60 * Z/A$ (3 M) For wave A = 2 wound $e=PN\phi Z/120$ for lap A=P wound $\mathbf{e= N\phi Z/60}$ ——
4.	**Describe the following methods of speed control of DC Shunt Motor (i) Flux Control Method (ii) Armature Rheostat Control Method (iii)Ward Leonard Method. (13M)** BTL2 **Answer: Page :3.41 – Dr.C.Ramesh babu Durai** ➢ Draw the circuit (6 M) ➢ Explain the speed control (7 M) **Flux control method:** ✓ Speed Control Of Dc Shunt Motor - Va is the voltage applied across the armature, N is the rotor speed and φ is the flux per pole and is proportional to the field current I_f. ✓ Armature current Ia is decided by the mechanical load present on the shaft. ✓ Varying Va and I_f we can vary n. **Varying Armature Resistance** ✓ Fixed supply voltage and the motor connected as shunt we can vary Va by controlling an external resistance connected in series with the armature. ✓ If of course can be varied by controlling external field resistance Rf connected with the field circuit ✓ The inherent armature resistance Ra being small, speed n versus armature current (Ia) characteristic will be a straight line with a small negative slope as shown in figure. **Flux Control Method**

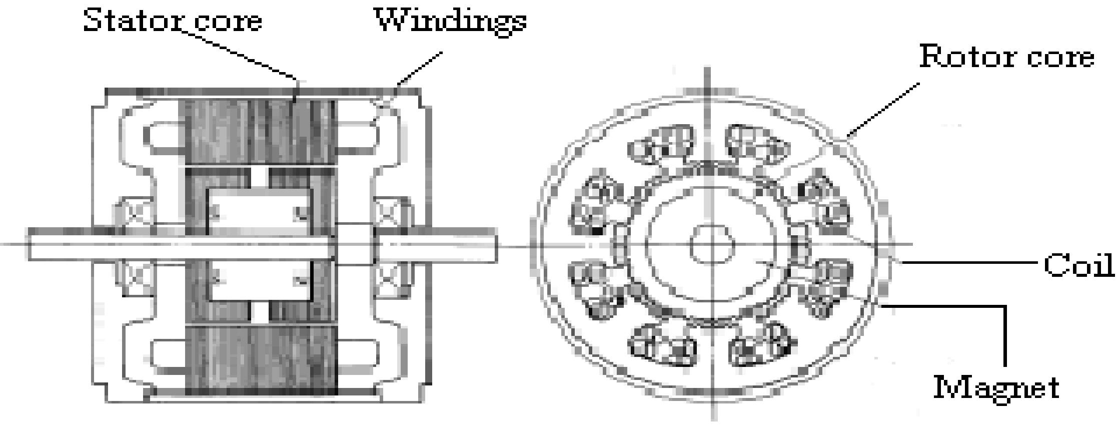
	 **Armature Rheostat Control Method**  **Ward Leonard Method** 
5.	**Discuss the construction and working principle of Hybrid stepper motor with neat diagrams. (13 M) (APR/MAY 2019)** BTL4 **Answer: Page :5.9 – Dr.C.Ramesh babu Durai** **Diagram & construction : (2 M)**



variable reluctance and permanent magnet motors: (2 M)

1. It is salient pole type rotor
2. Permanent magnet rotor
3. It has the features of both VR stepper motor PMSM.
4. A four phase hybrid stepper motor shown.
5. Two coils at a pole are wound in the bifilar scheme
6. Produce different magnetic polarities on excitation.

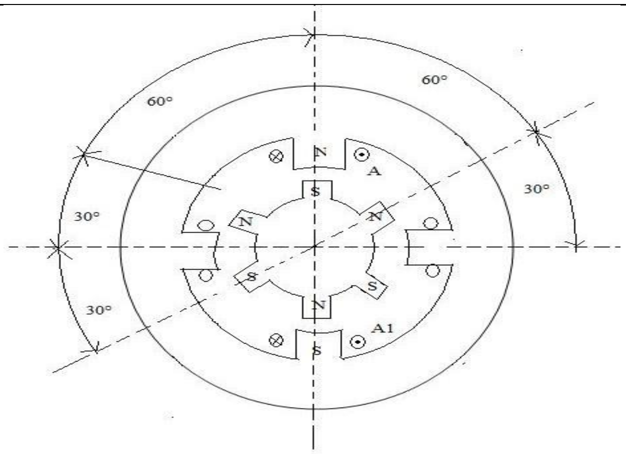
Cross section of hybrid stepper motor: (3 M)



Hybrid stepper motor with 8 stator poles : (4 M)

1. A cylindrical magnet lies in the rotor core.
2. Magnetized lengthwise to produce a unipolar field.
3. Each pole of the magnet covered with uniformly toothed soft steel.

Principle of operation : (2 M)

	 1. Phase winding A is energized with current i_a, N pole at A_1 and S pole at A_2 are created on the stator. 2. Pole at A_1attracts S pole of far end and pole at A_2 attracts N pole of front end. 3. This equilibrium position of rotor structure results in maximizing the flux linkages 4. phase winding 'A'. Here rotation $\theta=0^\circ$ 5. For the rotor clockwise through a step, de-energize phase winding A excite phase winding B so that N pole at B_2 are created on stator.
6.	**Explain stepper motor type merits, demerits and comparison. (15 M)** BTL5 **Answer: Page :5.9– Dr.C.Ramesh babu Durai** **Advantages and disadvantages of variable reluctance motor : (5 M)** 1. High torque to inertia ratio 2. Low rotor inertia 3. High rates of acceleration 4. High speed slewing capability 5. No detent torque available when windings are de energized 6. Low efficiency at low voltage **Advantages and disadvantages of permanent magnet stepper motor : (5 M)** 1. Provides detent torque winding de energized 2. Higher holding torque capability 3. Less tendency to resonate. 4. High stepping rate capability. 5. Slower acceleration and response. 6. Performance affected by change in magnet strength. **Advantages and disadvantages of hybrid stepper motor : (5 M)** 1. Small step length. 2. Detent torque with windings de energized. 3. Higher holding torque capability. 4. More expensive than variable reluctance stepper motor.

5.Performance affected by change in magnet strength.

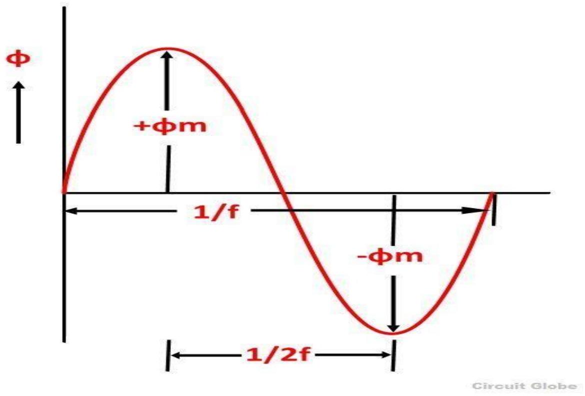
7. **Derive the EMF equation of a Static AC machine or Transformer.** BTL3**(APR/MAY 2018)**

(13M) Answer: Page :4.6 – Dr.C.Ramesh babu Durai

- When a sinusoidal voltage - applied to the primary winding of a transformer
- Alternating flux ϕ_m sets up in the iron core of the transformer.
- This sinusoidal flux links with both primary and secondary winding.
- The function of flux is a sine function.
- The rate of change of flux with respect to time is derived mathematically.

The derivation of **EMF Equation** of the transformer is shown below. Let

- ϕ_m be the maximum value of flux in Weber
- f be the supply frequency in Hz
- N_1 is the number of turns in the primary winding
- N_2 is the number of turns in the secondary winding
- Φ is the flux per turn in Weber



As shown in the above figure that the flux changes from + ϕ_m to – ϕ_m in half a cycle of 1/2f seconds.

By Faraday's Law

Let E_1 is the emf induced in the primary winding

$$E_1 = -\frac{d\psi}{dt}$$

Where $\Psi = N_1\varphi$

$$E_1 = -N_1 \frac{d\varphi}{dt}$$

$$E_1 max = N_1 w \varphi_m$$

But w = 2πf

$$E_1 max = 2\pi f N_1 \varphi_m$$

EMF Equation of a Transformer

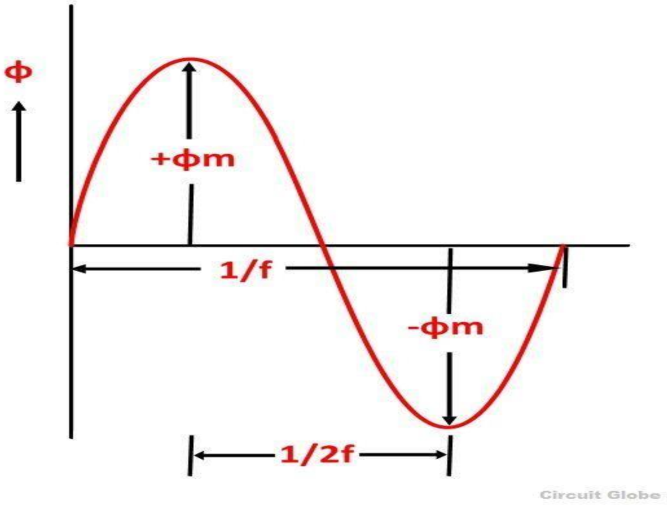
EMF Equation of a Transformer

- When a sinusoidal voltage is applied to the primary winding of a transformer, alternating flux ϕ_m sets up in the iron core of the transformer.
- This sinusoidal flux links with both primary and secondary winding.
- The function of flux is a sine function.
- The rate of change of flux with respect to time is derived mathematically.

The derivation of **EMF Equation** of the transformer is shown below. Let

- φ_m be the maximum value of flux in Weber
- f be the supply frequency in Hz
- N_1 is the number of turns in the primary winding
- N_2 is the number of turns in the secondary winding

Φ is the flux per turn in Weber



As shown in the above figure that the flux changes from + ϕ_m to – ϕ_m in half a cycle of 1/2f seconds.

By Faraday's Law

Let E_1 is the emf induced in the primary winding

$$E_1 = -\frac{d\psi}{dt} \ldots\ldots\ldots (1)$$

Where $\Psi = N_1\phi$

$$\text{Therefore, } E_1 = -N_1 \frac{d\varphi}{dt} \;\ldots\ldots\ldots(2)$$

Since ϕ is due to AC supply $\phi = \phi_m$ Sinwt

$$E_1 = -N_1 \frac{d}{dt} (\varphi_m \text{ Sinwt})$$

$$E_1 = -N_1 \, w\varphi_m \text{ Coswt}$$

$$E_1 = N_1 w\varphi_m \text{ Sin}(wt - \pi/2) \ldots\ldots\ldots.(3)$$

So the induced emf lags flux by 90 degrees.

Maximum valve of emf

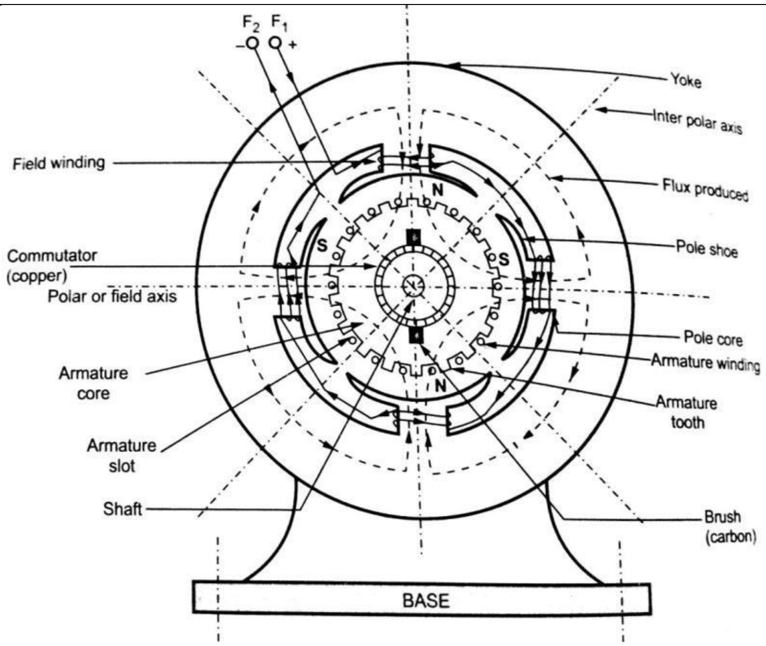
$$E_1 \text{max} = N_1 w\varphi_m \ldots\ldots\ldots.(4)$$

But $w = 2\pi f$

$$E_1 \text{max} = 2\pi f N_1 \varphi_m \ldots\ldots\ldots.(5)$$

$$\frac{\text{R.M.S value}}{\text{Average value}} = \text{Form factor} = 1.11$$

	Root mean square RMS value is $E_1 = \frac{E_{1max}}{\sqrt{2}}$. Putting the value of E_1max in equation $E_1 = \sqrt{2}\pi f N_1 \varphi_m$ $E_1 = 4.44 f N_1 \varphi_m$ $E_2 = \sqrt{2}\pi f N_2 \varphi_m$ $\frac{E_2}{E_1} = \frac{4.44 f N_2 \varphi_m}{4.44 f N_1 \varphi_m}$ $\frac{E_2}{E_1} = \frac{N_2}{N_1} = K$ ($\varphi m = B_m \times A_i$) where A_i is the iron area and B_m is the maximum value of flux density. $E_1 = 4.44 N_1 f B_m A_i$ Volts $E_2 = 4.44 N_2 f B_m A_i$ Volts
Part*C	
Q.No	**Question**
1.	**Describe the construction and principle of operation of DC generator. (13M) (APR/MAY 2018)** BTL2 **Answer: Page :3.3 – Dr.C.Ramesh babu Durai** ➢ Draw the diagram (7 M) ➢ Explain the parts in detail (6M)

	 ➢ The major parts can be identified as ✓ Frame/Yoke -Protecting cover ✓ Poles of Technology Madras ✓ Armature – laminated sheets of silicon steel ✓ Main pole and inter pole ✓ Winding – small section copper ✓ Commutator – DC to AC ✓ Brush gear – supply to external circuit ✓ Commutating poles ✓ Compensating winding- reduce the sparking
2.	**A 8pole DC shunt generator with 778 wave connected armature conductors and running at 500 rpm supplies a load of 12.5Ω resistance at a terminal voltage of 250 V. The armature resistance is 0.24 Ω and field resistance is 250 Ω respectively. Calculate the armature current and induced emf and flux per pole. (13M) (APR/MAY 2018)**BTL4 **Answer: Page :3.49 – Dr.C.Ramesh babu Durai** ➢ Write the formula ➢ Substitution with answer Load current $I_L = V/R_L$ = 20 A (2 M) Shunt field current $I_{sh} = V/R_{sh}$ =1 A(2 M)

	Armature current Ia= $I_L + I_{sh}$(2 M) =21 A (1 M) Induced EMF Eg = V+ IaRa (2M) =255.04 A(1M) Flux per pole (ϕ) = P ϕZN/60A (2M) =19.66 mwb(1M)
3.	**Find all day efficiency of a transformer having maximum efficiency of 98% at 15 Kva at unity power factor and loaded as follows:** **12 hours – 2 KW at 0.5 p.f lag** **6 hours – 12 KW at 0.8 p.f lag** **6 hours – at no load** BTL4 **(13M)** **Answer: Page :4.9 – Dr.C.Ramesh babu Durai** ➢ Write the formula (7M) ➢ Answer (6M) Input power = output power / efficiency (2 M) = 5.306 kW (1 M) Total losses = Input power – output power (2 M) = 0.306 kW (1 M) Full load copper loss = Iron loss = Total loss / 2 (1 M) = 0.153 kW (2 M) η all-day = Output power in Kwh/Input power in kWh *100 (2 M) =95.31% (2 M)

Subject Code:BE8255 **Year/Semester: II /02**

Subject Name: BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING

Subject Handler: Mr.A.Antony Charles

UNIT III UTILIZATION OF ELECTRICAL POWER

Renewable energy sources-wind and solar panels. Illumination by lamps- Sodium Vapour, Mercury vapour, Fluorescent tube. Domestic refrigerator and air conditioner-Electric circuit, construction and working principle. Batteries-NiCd, Pb Acid and Li ion–Charge and Discharge Characteristics. Protection- need for earthing, fuses and circuit breakers. Energy Tariff calculation for domestic loads.

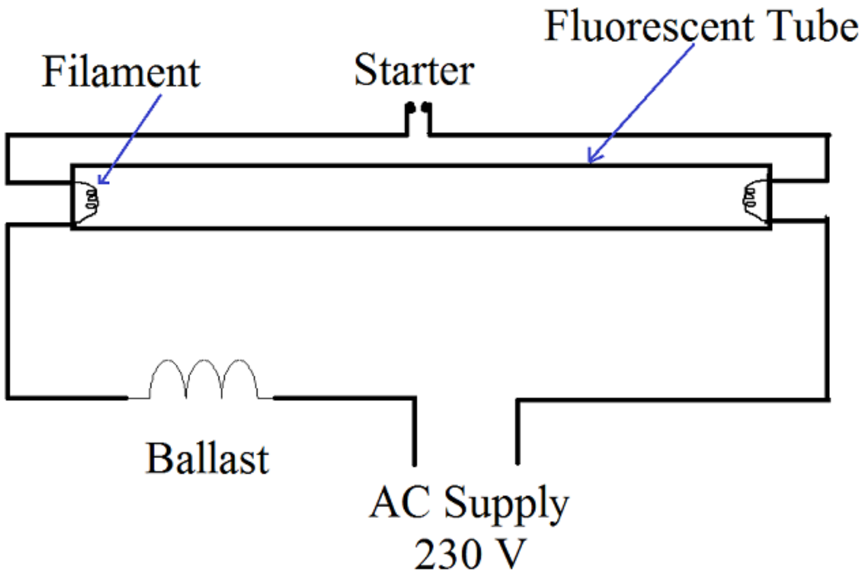
Part*A

Q.No	**Question**
1.	**Define Light. (APR/MAY 2018)**BTL2 Light may be defined as that radiant energy in form of waves which produces a sensation of vision upon human eye
2.	**Define Luminous Flux.** BTL2 Luminous flux is defined as the energy in the form of light waves radiated per second from a luminous body. Eg for a luminous body is an incandescent lamp.
3.	**Define Illumination or Illuminance or Degree of Illumination.** BTL2 When the light falls on the surface it is illuminated. The illuminance is defined as the luminous flux received per unit area. Let the incident luminous flux on a small area dA be dF then Illuminance= dF/dA= lumens/area
4.	**Define Lumen**. BTL2 Lumen is the unit of flux and is defined as the luminous flux per unit angle from a source 1 candle power. Lumens= candle power x solid angle= candle power x ω
5.	**Define Candle Power**. **(APR/MAY 2018)**BTL2 Candle power is the number of lumens per unit solid angle. Candle power= lumens/ω.

6.	**Define Luminous Intensity.** BTL2 The luminous intensity is the measure of luminous flux in lumens emitted per unit solid angle by a point source and is denoted by I, $I = \Phi/\omega$
7.	**What are the two laws of illumination?** BTL1 • Inverse square law. • Lambert’s cosine law.
8.	**State inverse square law.** BTL1 This law states that illumination of a surface is inversely proportional to the square of the distance of the surface from the source of light, under the condition that source is the point source.
9.	**State Lambert’s law.** BTL1 This law states that illumination of a surface at any point is dependent upon the cube of cosine of the angle between the line of flux and the normal at that point.
10.	**Define Brightness or Luminance. (APR/MAY 2018)** BTL2 It is defined as the flux emitted per unit area or the luminous intensity per unit projected area of the source in a direction perpendicular to the surface. The unit of brightness is candles per sq.m.
11.	**Why tungsten is used as filament material ?** BTL2 Pure tungsten has properties including the highest melting point (3695 K), lowest vapour pressure, and greatest tensile strength out of all the metals.
12.	**List the types of lamps.** BTL2 Sodium vapour lamps, fluorescent lamp, neon lamp, mercury vapour lamp
13.	**How does operation of a fluorescent tube differ when it is used on ac and dc supply**? BTL4 Fluorescent lamps can run directly from a direct current (DC) supply of sufficient voltage to strike an arc. The ballast must be resistive, and would consume about as much power as the lamp. When operated from DC, the starting switch is often arranged to reverse the polarity of the supply to the lamp each time it is started; otherwise, the mercury accumulates at one end of the tube. Fluorescent lamps are (almost) never operated directly from DC for those reasons. Instead, an inverter converts the DC into AC and provides the current-limiting function for electronic ballasts

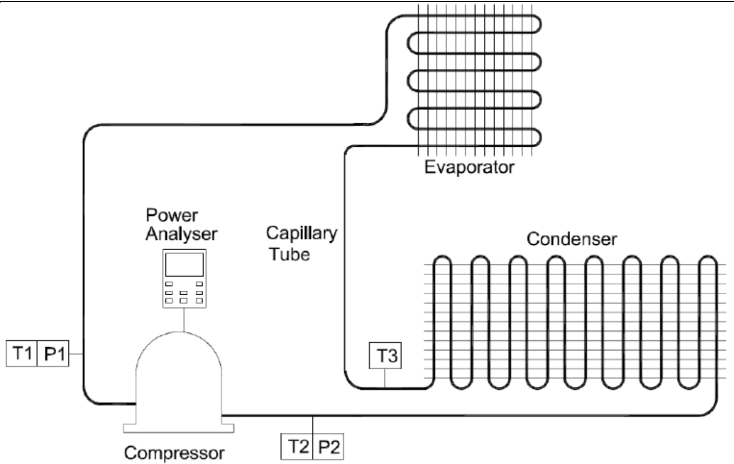
14.	**Define Wind.** BTL2 Wind results from air motion. Air in motion arises from a pressure gradient. The circulation of air in the atmosphere is caused by the non- uniform heating of the earth's surface by the sun.
15.	**What are the different causes of local winds?** BTL2 • Differential heating of land and water • Air heating in hills and mountain sides.
16.	**What are the major components of WCS? (APR/MAY 2018)** BTL1 • Aero turbine • Gearing • Coupling • Generator and • Controller
17.	**What are the broad classification of WECS?** BTL1 There are two broad classifications of WECS, they are • Horizontal axis machines and • Vertical axis machines
18.	**List the advantages of WECS.** BTL2 The advantages of wind energy are, • It is a renewable source of energy, • Non-polluting, • Avoid fuel provision and transport, • Small scale up to few KW system is less costly
19.	**How are the following defects caused in lead acid batteries Sulphation ?** BTL1 A badly desulphated battery has got injured plat grids and separators because of swelling of the plate as the sulphate occupies more space than the active materials. A badly sulphated battery may be restored to a usable condition, nut, its original life expectancy can never be restored as it has

	already lost part of its life due to sulphation
20.	**What is need for earthing, fuse and circuit breakers?** **Earthing** is used to protect you from an electric shock. It does this by providing a path (a protective conductor) for a fault current to flow to **earth**. It also causes the protective device (either a circuit-breaker or fuse) to switch off the electric current to the circuit that has the fault. The **fuse** breaks the circuit if a fault in an appliance causes too much current flow. This protects the wiring and the appliance if something goes wrong. The **fuse** contains a piece of wire that melts easily. If the current going through the **fuse** is too great, the wire heats up until it melts and breaks the circuit. A **circuit breaker** is an automatically operated electrical switch designed to protect an electrical **circuit** from damage caused by excess current, typically resulting from an overload or short **circuit**. Its basic function is to interrupt current flow after a fault is detected
21	**What is a battery? Mention its applications.** BTL1 A battery is an electrochemical cell (or enclosed and protected material) that can be charged electrically to provide a static potential for power or released electrical charge when needed. A battery generally consists of an anode, a cathode, and an electrolyte. Eg:- Lead acid battery, ion, Nickel Cadmium battery. Applications: Mobile phones, Toys, calculators and Automobiles
Part*B	
Q.No	**Question**
1.	**Explain Fluorescent lamb. (13M) (APR/MAY 2018)** BTL1 **Answer: Page :6.9 – Dr.C.Ramesh babu Durai**



- Electric current passes through a column of mercury vapor.
- The UV is emitted in all directions, until it hits the the phosphor coating on the inner wall.
- The coating re-emits lower energy long wavelength visible light
- When the tungsten (W) filament is heated, its special coating will boil off electrons, not light.
- If the coating is too thin, it will fail early because of the sudden heating at turn-on can cause expansion, cracking or flaking. (Image from the Wikipedia Open Commons.)
- Care must be taken to keep the tungsten from evaporating onto the tube inner wall; it can lead to a thick opaque layer, blocking light.
- This flows between the filaments and is needed to bounce against the Hg atoms, causing UV emission.
- A key point not often mentioned is the startup process needed to generate the be am and Hg vapor at an acceptable range of temperatures.

2. **Explain Domestic refrigerator.** BTL1
Answer: Page :6.11 – Dr.C.Ramesh babu Durai



- The domestic refrigerator is one found in almost all the homes for storing food, vegetables, fruits, beverages, and much more.
- This article describes the important parts of the domestic refrigerator and also their working.
- The parts of domestic refrigerator can be categorized into two categories: internal and external. Let see these in details along with their images.

Refrigerant:

- The refrigerant flows through all the internal parts of the refrigerator. It is the refrigerant that carries out the cooling effect in the evaporator.
- It absorbs the heat from the substance to be cooled in the evaporator (chiller or freezer) and throws it to the atmosphere via condenser.
- The refrigerant keeps on recirculating through all the internal parts of the refrigerator in cycle.

Compressor:

- The compressor is located at the back of the refrigerator and in the bottom area.
- The compressor sucks the refrigerant from the evaporator and discharges it at high pressure and temperature.
- The compressor is driven by the electric motor and it is the major power consuming devise of the refrigerator.

Condenser:

- The condenser is the thin coil of copper tubing located at the back of the refrigerator.
- The refrigerant from the compressor enters the condenser where it is cooled by the atmospheric air thus losing heat absorbed by it in the evaporator and the compressor.
- To increase the heat transfer rate of the condenser, it is finned externally.

Expansive valve or the capillary:

- The refrigerant leaving the condenser enters the expansion devise, which is the capillary tube in case of the domestic refrigerators.
- The capillary is the thin copper tubing made up of number of turns of the copper coil. When the refrigerant is passed through the capillary its pressure and temperature drops down suddenly.

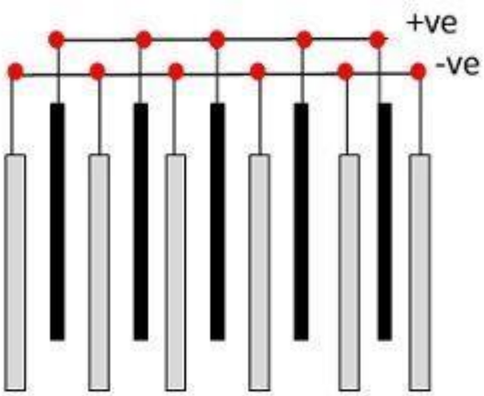
Evaporator or chiller or freezer:

	• The refrigerant at very low pressure and temperature enters the evaporator or the freezer. • The evaporator is the heat exchanger made up of several turns of copper or aluminum tubing. • In domestic refrigerators the plate types of evaporator is used as shown in the figure above. • The refrigerant absorbs the heat from the substance to be cooled in the evaporator, gets evaporated and it then sucked by the compressor. This cycle keeps on repeating. **Temperature control devise or thermostat**: • To control the temperature inside the refrigerator there is thermostat, whose sensor is connected to the evaporator. • The thermostat setting can be done by the round knob inside the refrigerator compartment. • When the set temperature is reached inside the refrigerator the thermostat stops the electric supply to the compressor and compressor stops • when the temperature falls below certain level it restarts the supply to the compressor. **Defrost system**: • The defrost system of the refrigerator helps removing the excess ice from the surface of the evaporator. • The defrost system can be operated manually by the thermostat button or there is automatic system comprising of the electric heater and the timer.
3.	**Explain about Ni Cd batteries.** BTL1 **Answer: Page :6.22 – Dr.C.Ramesh babu Durai** **Nickel–Cadmium battery** (**NiCd battery** or **NiCad battery**): • The **nickel–cadmium battery** (**NiCd battery** or **NiCad battery**) is a type of rechargeable battery using nickel oxide hydroxide and metallic cadmium as electrodes. • The abbreviation NiCd is derived from the chemical symbols of nickel (Ni) and cadmium (Cd): the abbreviation NiCad is a registered trademark of SAFT Corporation, although this brand name is commonly used to describe all Ni–Cd batteries. • NiCd batteries are made in a wide range of sizes and capacities, from portable sealed types interchangeable with carbon-zinc dry cells, to large ventilated cells used for standby power and motive power. • Compared with other types of rechargeable cells they offer good cycle life and performance at low temperatures with a fair capacity but their significant advantage is the ability to deliver practically their full rated capacity at high discharge rates (discharging in one hour or less). .

4.	**Explain about Lithium batteries.** BTL1 **Answer: Page :6.25 – Dr.C.Ramesh babu Durai** LITHIUM ION BATTERY • basically the same for the two types of batteries, so charging methods for lithium polymer batteries can be used for lithium-ion batteries. • Charging lithium iron phosphate 3.2 volt cells is identical, but the constant voltage phase is limited to 3.65 volts. • The lithium ion battery is easy to charge. Charging safely is a more difficult. • The basic algorithm is to charge at constant current (0.2 C to 0.7 C depending on manufacturer) until the battery reaches 4.2 Vpc (volts per cell), • hold the voltage at 4.2 volts until • The charge current has dropped to 10% of the initial charge rate. The termination condition is the drop in charge current to 10%. • The top charging voltage and the termination current varies slightly with the manufacturer
5.	**Explain about Lead Acid batteries.** BTL1 **Answer: Page :6.19 – Dr.C.Ramesh babu Durai** **Construction of Lead Acid Battery** The various parts of the lead acid LED ACID BATTERY • The battery which uses sponge lead and lead peroxide for the conversion of the chemical energy into electrical power, such type of battery is called a lead acid battery. • The lead acid battery is most commonly used in the power stations and substations because it has higher cell voltage and lower cost. • The container and the plates are the main part of the lead acid battery. • The container stores chemical energy which is converted into electrical energy by the help of the plates. **Definition:** • The battery which uses sponge lead and lead peroxide for the conversion of the chemical energy into electrical power, such type of battery is called a lead acid battery. • The lead acid battery is most commonly used in the power stations and substations because it has higher cell voltage and lower cost.. • The container and the plates are the main part of the lead acid battery. • The container stores chemical energy which is converted into electrical energy by the help of the plates.

Container :

- The container of the lead acid battery is made of glass, lead lined wood, ebonite, the hard rubber of bituminous compound, ceramic materials or moulded plastics - seated at the top to avoid the discharge of electrolyte.
- At the bottom of the container, there are four ribs, on two of them rest the positive plate and the others support the negative plates.
- The prism serves as the support for the plates and at the same time protect them from a short-circuit.
- The material of which the battery containers are made should be resistant to sulfuric acid, should not deform or porous, - contain impurities which damage the electrolyte.



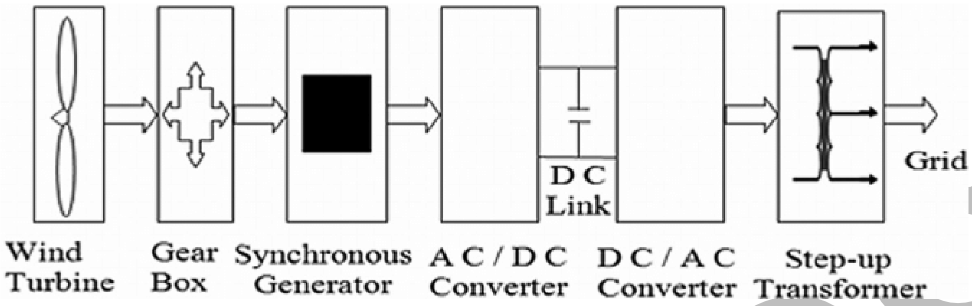
Arrangements of Plates in a Lead-acid-Battery

Circuit GLobe

- The grids are made up of an alloy of lead and antimony.
- These are usually made with the transverse rib that crosses the places at a right angle or diagonally.
- The grid for the positive and negative plates are of the same design,
- the grids for the negative plates are made lighter because they are not as essential for the uniform conduction of the current.

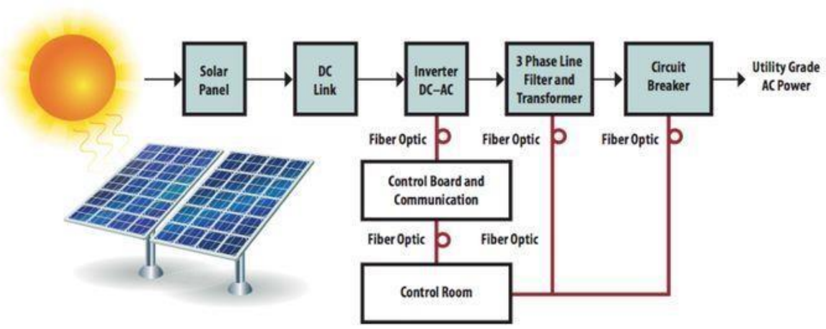
Part*C

Q.No	**Question**
1.	**Explain the wind energy**. BTL1 **Answer: Page :6.2 – Dr.C.Ramesh babu Durai**



- Like old fashioned windmills, today's wind machines use blades to collect the wind's kinetic energy.
- Windmills work because they slow down the speed of the wind.
- The wind flows over the airfoil shaped blades causing lift, like the effect on airplane wings, causing them to turn.
- The blades are connected to a drive shaft that turns an electric generator to produce electricity.
- With the new wind machines, there is still the problem of what to do when the wind isn't blowing.
- At those times, other types of power plants must be used to make electricity.
- Wind power plants, or wind farms as they are sometimes called, are clusters of wind machines used to produce electricity.
- A wind farm usually has dozens of wind machines scattered over a large area. The world's largest wind farm,
- the Horse Hollow Wind Energy Center in Texas, has 421 wind turbines that generate enough electricity to power 220,000 homes per year. Unlike power plants, many wind plants are not owned by public utility companies.
- Instead they are owned and operated by business people who sell the electricity produced on the wind farm to electric utilities.
- These private companies are known as Independent Power Producers.
- Operating a wind power plant is not as simple as just building a windmill in a windy place.
- Wind plant owners must carefully plan where to locate their machines. One important thing to consider is how fast and how much the wind blows

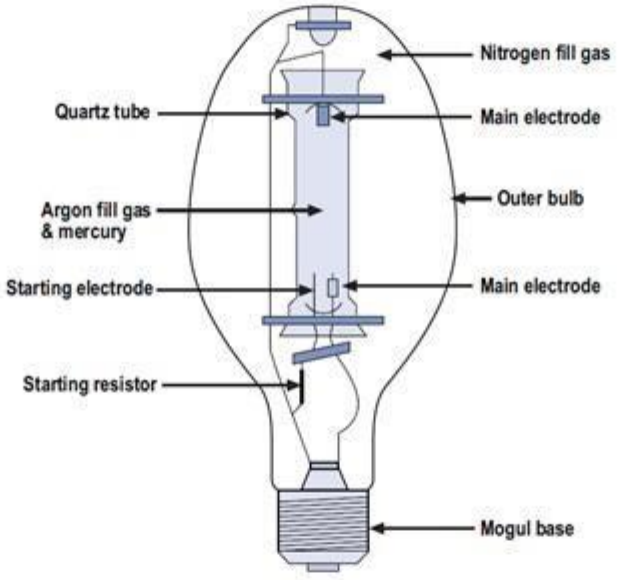
2. **Explain solar power plant.** BTL1
Answer: Page :6.3– Dr.C.Ramesh babu Durai



- Solar energy is the energy that is available from the sun in abundance. Solar power is the conversion of sunlight into electricity.
- As electricity plays a key role in our day to day life we need it in abundance, as sunlight is clean, and is available for free solar power is created from it.
- A solar power plant is basically a system that supplies electricity to wide areas.
- The solar power tower system has many sun tracking mirrors installed that helps in tracking sunlight into a central receiver.
- In the solar thermal power system, the radiation of the sun heats the thermal oil that flows inside the receivers to a temperature of 400 degree Celsius so that the downstream heat exchanger can generate steam.
- The stream is then pressurized into the turbine that drives the generator. Thus the heat collected by the receiver is used as electricity for performing various activities and purposes.
- Electricity can be generated in two ways with the help of solar energy or sun's energy.
- It can be generated Firstly, with the help of photo voltaic electricity and secondly with solar thermal electricity.
- Photovoltaic electricity is a method that uses photovoltaic cells to capture direct sunlight. The photovoltaic cells are nothing but solar cells.
- The solar thermal electricity on the other hand makes use of a solar collector which has mirror for reflecting sunlight into the receiver that heats up the liquid and the heated liquid produces steam which is used to produce electricity.

3. **Explain sodium vapour lamp.** BTL1

Answer: Page :6.7 – Dr.C.Ramesh babu Durai



- Principally the sodium vapour lamp consists of the bulb containing a small amount of metallic sodium, neon gas, and two sets of electrodes connected in a pin type base.
- The presence of neon gas serves to start the discharge envelope is usually bent into U shape.
- The sodium vapour lamp is only suitable for a alternating current, the, therefore, required chock control.
- This requirement is met by operating the lamp for a stray field – up -tapped-autotransformer with an open circuit secondary voltage of 470 to 480 Volts.
- The corrected power factor very low, about 0.3 and a capacitor must be used to improve the power factor.
- A sodium-vapor lamp is a gas-discharge lamp that uses sodium in an excited state to produce light at a characteristic wavelength near 589 nm.
- They are some of the most efficient lamps in the world.
- They have an efficiency of up to 190 lumens per watt compared to an incandescent street lamp which has between 15 and 19 lumens per watt.
- Low-pressure sodium lamps: They are highly efficient electrical light sources, but their yellow light restricts applications to outdoor lighting such as street lamps.
- Low-pressure sodium lamps only give monochromatic yellow light and so inhibit color vision at night
- High-pressure sodium lamps produce a broader spectrum of light than the low-pressure lamps, but they still have poorer color rendering than other types of lamps.
- The tube is made of borosilicate glass to withstand pressure and temperature and contains some sodium metal, neon and argon.

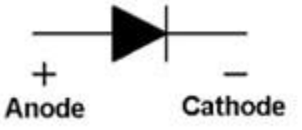
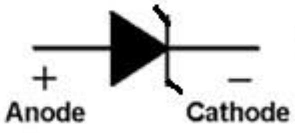
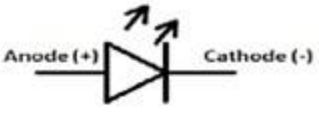
When the lamp is switched on, the sodium vaporises and an arc is established.

Subject Code:BE8355 **Year/Semester: II /02**
Subject Name: BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENTENGINEERING
Subject Handler: Mr.A.Antony Charles

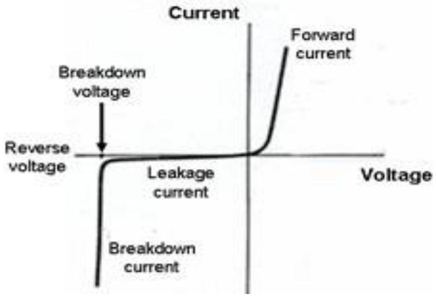
UNIT IV ELECTRONIC CIRCUITS

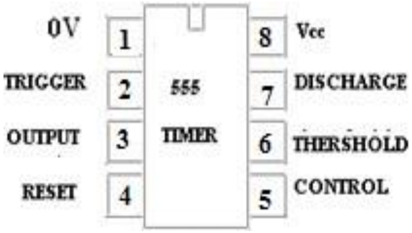
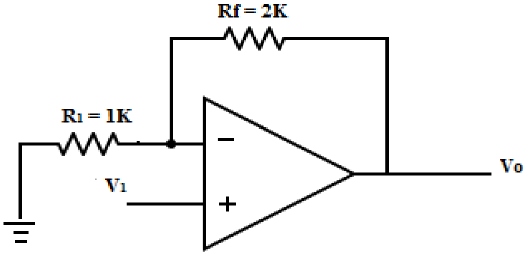
PN Junction-VI Characteristics of Diode, zener diode, Transistors configurations - amplifiers. Op amps-Amplifiers, oscillator, rectifiers, differentiator, integrator, ADC, DAC. Multi vibrator using 555 Timer IC . Voltage regulator IC using LM 723, LM 317.

Part*A

Q.No	Question
1.	**What is diffusion current? (APR/MAY 2019)**BTL1 In a semiconductor it is possible to have a non-uniform distribution of carriers. A concentration gradient exists if the number of either holes or electrons is greater in one region as compared to the rest of the region. The holes and electrons then tend to move from a region of higher concentration to lower concentration region. This process is known as diffusion and the electric current produced due this process is known as diffusion current
2.	**What are a PN junction diode and its application?** BTL1 A PN junction diode is a two terminal device consisting of a PN junction formed either of Germanium or Silicon crystal. A PN junction is formed by diffusing P type material to one half side and N type material to other half side. • Used as rectifier in DC power supplies. • Used as signal diodes in communication circuits. • Used in clipper and clamper circuits
3.	**Draw the symbol of the following devices.** BTL1 **(a) PN Diode** **(b) Zener Diode** **(c) LED**   
4.	**Explain the terms knee voltage and breakdown voltage.** BTL2 Knee voltage: The forward voltage at which the current through the PN junction starts increasing rapidly is known as knee voltage. It is also called as cut-in voltage or threshold voltage. Breakdown voltage: It is the reverse voltage of a PN junction diode at which the junction breaks down with sudden rise in the reverse current.

5.	**Define and explain Peak Inverse Voltage (PIV). (APR/MAY 2019)**BTL1 Peak inverse voltage is the maximum reverse voltage that can be applied to the PN junction without damage to the junction. If the reverse voltage across the junction exceeds to its peak inverse voltage, the junction may be destroyed due to excessive heat.
6.	**Define the term diffusion capacitance or storage capacitance.** BTL1 a. The diffusion capacitance effect is found when the diode is forward biased and it is defined as the rate of change of injected charge with voltage and given by $C_d = \frac{\tau I}{\eta V_T}$ I = diode current, V_T = volt equivalent temperature. V_T = T /11,600 Constant (η) = 1 for Ge diodes, 2 for silicon diodes; τ = mean life time.
7.	**Define the term transition capacitance.** BTL1 When P-N junction is reverse biased the depletion region act as an insulator or as a dielectric medium and the P-type an N-type region have low resistance and act as the plates. Thus this P-N junction can be considered as a parallel plate capacitor. This junction capacitance is called as space charge capacitance or transition capacitance and is denoted as CT. $C_D = \frac{dQ}{dV}$, Where dQ is the increase in charge and dV is the change or increase in voltage. The depletion region increases with the increase in reverse bias potential the resulting transition capacitance decreases. The formula for transition capacitance is given as $C_T = A\varepsilon/W$, where A is the cross sectional area of the region, and W is the width.
8.	**Define Static resistance and Dynamic resistance. (APR/MAY 2019)** BTL1 The resistance offered by the diode to DC operating conditions is called “Static resistance” and the resistance offered by the diode to AC operating conditions is called “Dynamic resistance”.
9.	**What is meant by biasing a transistor?** BTL1 Transistor biasing is the process of maintaining proper flow of zero signal collector current and collector-emitter voltage during the passage of signal. Biasing keeps emitter-base junction forward biased and collector-base junction reverse biased during the passage of signal.
10.	**What is Zener breakdown?** BTL1 When a PN junction is heavily doped the depletion region is very narrow. So under reverse bias condition, the electric field across the depletion layer is very intense. Electric field is voltage per distance and due to narrow depletion region and high reverse voltage, it is intense. Such an intense field is enough to pull the electrons out of the valence bands of the stable atoms. So this is not due to the collision of carriers with atoms. Such a creation of free electrons is called Zener effect which is different that the avalanche effect. These minority carriers constitute very large current and mechanism is called Zener Breakdown.
11.	**When should a transistor be biased? Name two common biasing circuits.** BTL3 For proper operation of transistor, input junction should be forward biased and the output junction

	should be reverse biased. Common base and common emitter configuration are the two common biasing circuits.
12.	**Draw the characteristics of zener diode.** BTL1 
13.	**What is an op-amp? List its functions and application.** BTL2 The op-amp is a multi-terminal device, which internally is quite complex. It is a direct coupled high gain amplifier consisting of one or more differential amplifiers, followed by a level translator and an output stage. **Function:** Op-amp amplifies the difference between two input signals and can perform some of the applications of op-amp in open loop mode are as follows: b. Comparator, Zero crossing detectors, Window detector, Time marker generator. **Some of the applications of op-amp in closed loop mode are as follows:** c. Amplifiers, Basic arithmetic operations – summer, subtractor, multiplier, integrator, differentiator, Rectifiers, Waveform generators, Filters.
14.	**What is the function of 555 timer and list its features and application?** BTL1 • The 555 timer is a highly stable device for generating accurate time delay or oscillation. • The 555 timer can be used with supply voltage in the range of +5 V to +18 V and can drive load upto 200mA. • It is compatible with both TTL and CMOS logic circuits. • Because of the wide range of supply voltage, it is versatile and easy to use in various applications • Some of the applications of 555 timer • Monostable mode: Missing pulse detector, linear ramp generator, Frequency divider and Pulse width modulator. • Astablemode: FSK generator, Pulse position modulator and Schmitt trigger
15.	**Draw the pin diagram of IC 555 timer.** BTL1

	
16.	**What is the value of open loop gain and output impedance of an ideal op-amp?** BTL1 Open loop voltage gain, $A_{OL} = \infty$; Output impedance, $R_O = 0$
17.	**Define input offset current and input offset voltage.** BTL1 Input Offset Current: **The algebraic difference between the currents into the (-) input and (+) input is referred to as input offset current .It is 200nA maximum for 741C.** **Input Offset Voltage:** It is the voltage that must be applied between the input terminals of an op-amp to nullify the output. Since this voltage could be positive or negative.
18.	**Draw a non-inverting amplifier with voltage gain of 3.** BTL1  $\frac{V_0}{V_i} = 1 + \frac{R_f}{R_i} \longrightarrow 3 = 1 + \frac{R_f}{R_i}$ Let R_i=1kΩ; R_f= 2kΩ
19.	**Define the term settling time and conversion time related to DAC's.** BTL1 **Settling time:** The most important dynamic parameter is the settling time. It represents the time it takes for the output to settle within a specified band + or – (1/2) LSB of its final value following a code change at the input (usually a full scale change). **Conversion time:** The time in which the expected analog output changes the result for changes in digital input values.
20.	**How many resistors are required in a 12-bit weighted resistor DAC?** BTL2 Generally a n-bit weighted resistor DAC requires n resistors. Therefore a 12-bit weighted resistor DAC requires 12 resistors.
21.	**How many comparators are required to design a 10 bit flash ADC?** BTL2

	In general the number of comparators required are $2^n - 1$ where n is the number of bits. Therefore for 10 bit flash ADC,$2^{10} - 1 = 1023$ Comparators are required.
22.	**What is the function of a voltage regulator?** BTL1 The function of a voltage regulator is to provide a stable dc voltage for powering other electronic circuits independent of the load current, temperature and ac line voltage variations. A voltage regulator should be capable of providing substantial output current.
23.	**List and explain the performance parameters of regulators**. BTL1 **Line/Input Regulation:** It is defined as the percentage change in the output voltage for a change in the input voltage. It is usually expressed in mill volts or as a percentage of the output voltage. **Load Regulation:** It is defined as the change in output voltage for a change in load current and is also expressed in mill volts or as a percentage of output voltage. **Ripple Rejection:** The IC regulator not only keeps the output voltage constant but also reduces the amount of ripple voltage. It is usually expressed in dB.
24.	**State the Bharkausen's criterion for oscillation.** BTL1 The two important and necessary conditions are (i) The feedback must be positive. (ii) Feedback factor must be unity i.e. $A\beta = 1$
25.	**Define transistor action.** BTL1 A transistor consists of 2 coupled PN junctions. The base is a common region to both junctions and makes a coupling between them. Since the base regions are smaller, a significant interaction between junctions will be available. This is called transistor actions.
26.	**What is P-type Semiconductor?** BTL1 • If a III group element, like indium (In), boron (B), aluminium (AI) etc., having three valence electrons, is added to a semiconductor say Si, the three electrons form covalent bond. • There is a deficiency of one electron to complete the 4th covalent bond and is called a hole. • The impurities added semiconductor is called p-type semiconductor. • The impurities are called acceptors as they accept electrons from the semiconductor • Holes are the majority carriers and the electrons produced by the breaking of bonds are the minority carriers.
27.	**What is N-type Semiconductor?** BTL1 • When an impurity, from V group elements like arsenic (As), antimony having 5 valence electrons is added to Ge (or Si), the impurity atom donates one electron to Ge (or Si). • The 4 electrons of the impurity atom is engaged in covalent bonding with Si atom. • The fifth electron is free. This increases the conductivity. • The impurities are called donors.

	• The impurity added semiconductor is called n-type semiconductor, because their increased conductivity is due to the presence of the negatively charged electrons, which are called the majority carriers. • The energy band of the electrons donated by the impurity atoms is just below the conduction band. • These holes in n-type are called minority carriers.
28.	**What is Extrinsic Semiconductor?** BTL1 The electrical conductivity of a pure semiconductor is very small. • To increase the conductivity, impurities are added. • The impurity added semiconductor is called extrinsic semiconductor. • The process of adding impurity is called doping. • The added impurity is called dopant. • Usually one or two atoms of impurity is added per 10^6 atoms of a semiconductor. • There are two types (i) p-type and (ii) n-type semiconductors
29.	**What is Intrinsic Semiconductor?** BTL1 • An intrinsic semiconductor also called an undoped semiconductor or i-type semiconductor. • It is a pure semiconductor without any significant dopant species present. • In intrinsic semiconductors the number of excited electrons and the number of holes are equal: n = p. • Both electrons and holes contribute to current flow in an intrinsic semiconductor.
30.	**What is conductor?** BTL1 A material through which h electric current can pass. In general, metals are good **conductors**. Copper or aluminum is normally used to conduct electricity in commercial and household systems. Only free electrons near the Fermi surface (energy F ε ≈ ε) can conduct. • To conduct electrons must acquire energy to jump from the valence to the conduction band.
31.	**What are insulators? Give examples?** BTL1 A material or an object that does not easily allow heat, electricity, light, or sound to pass through it. Air, cloth and rubber are good electrical insulators; feathers and wool make good thermal **insulators**.
32.	**What are Semiconductors? Give examples?** BTL1 • A semiconductor is a solid material that has electrical conductivity between those of a

conductor and an insulator.

- A material with electrical conductivity due to electron flow intermediate in magnitude between that of a conductor and an insulator.
- Silicon is the most widely used semiconductor material.
- The number of electrons in the valence orbit is the key to conductivity.
- Conductors have one valence electron, semiconductors have four valence electrons, and insulators have eight valence electrons.

PART B

Q.No	Question

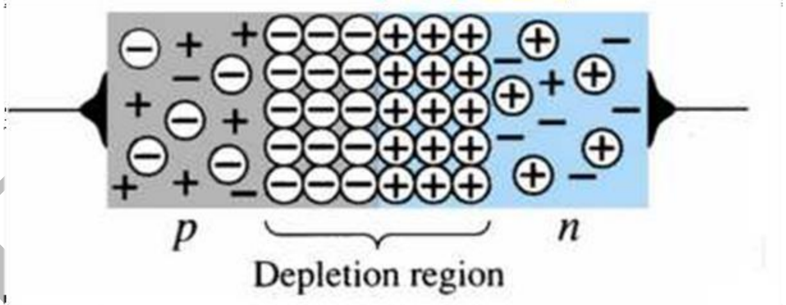
1. **With a neat diagram, explain the working of a PN junction diode in forward bias and reverse bias and explain its VI characteristics. (13M) (APR/MAY 2019)**BTL2

Answer: Page 7.4 - Dr. C. Ramesh Babu Durai

Diagram: 2M

Construction: 3M

Forward bias and reverse bias: 8M



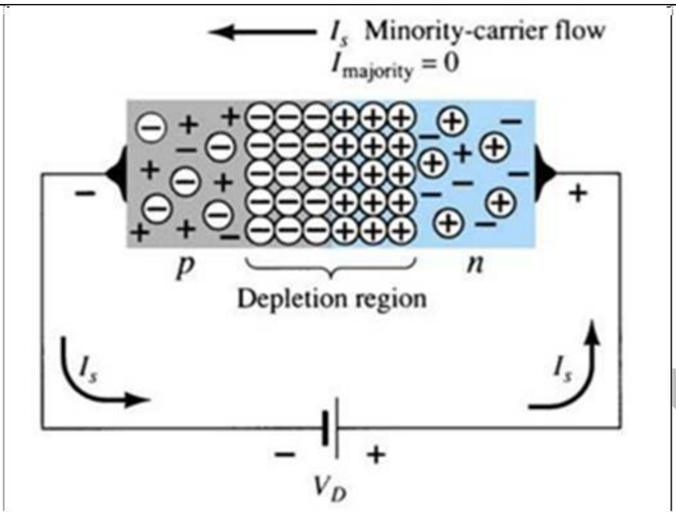
At the *p*-*n* junction, the excess conduction-band electrons on the *n*-type side are attracted to the valence-band holes on the *p*-type side.

The electrons in the *n*-type material migrate across the junction to the *p*-type material (electron flow).

The electron migration results in a negative charge on the p-type side of the junction and a positive charge on the n-type side of the junction.

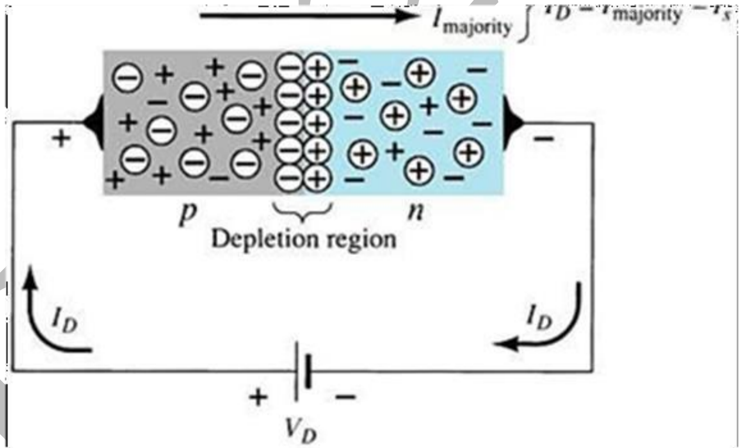
The result is the formation of a depletion region around the junction.

Reverse Bias:



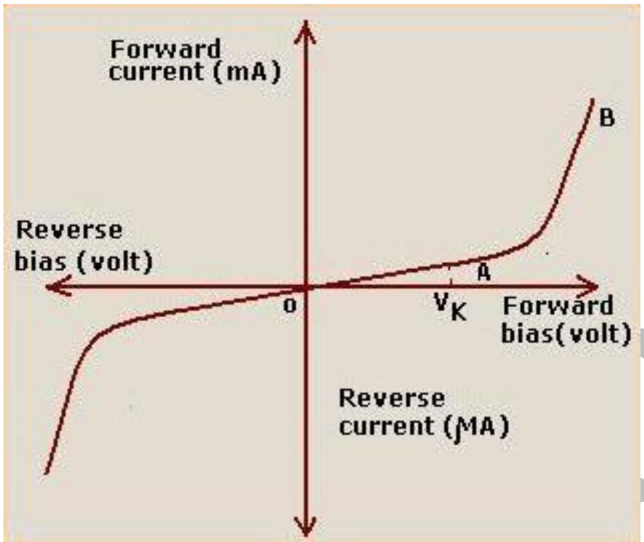
External voltage is applied across the *p*-*n* junction in the opposite polarity of the *p*- and *n*-type materials.

Forward Bias:



External voltage is applied across the *p*-*n* junction in the same polarity as the *p*- and *n*-type materials.

VI characteristics:

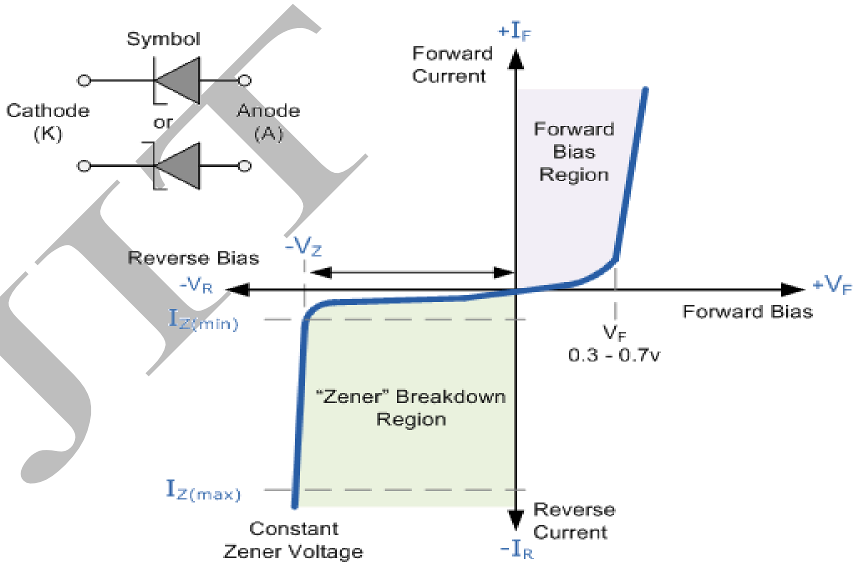


2. **Explain the VI characteristics of Zener diode.(13M)** BTL2

Answer: Page 7.10 - Dr. C. Ramesh Babu Durai

Zener diode:

1. Defiition and Symbol (2M)
2. Forward Bias (2M)
3. Reverse Bias (2M)
4. VI characteristics (3M)
5. Zener diode as voltage regulator (2M)

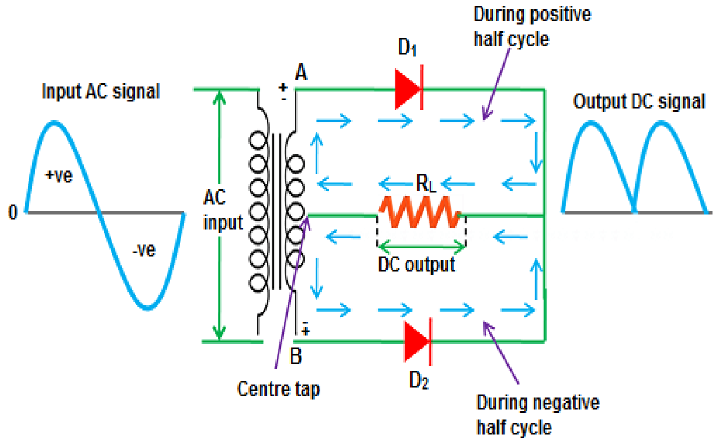


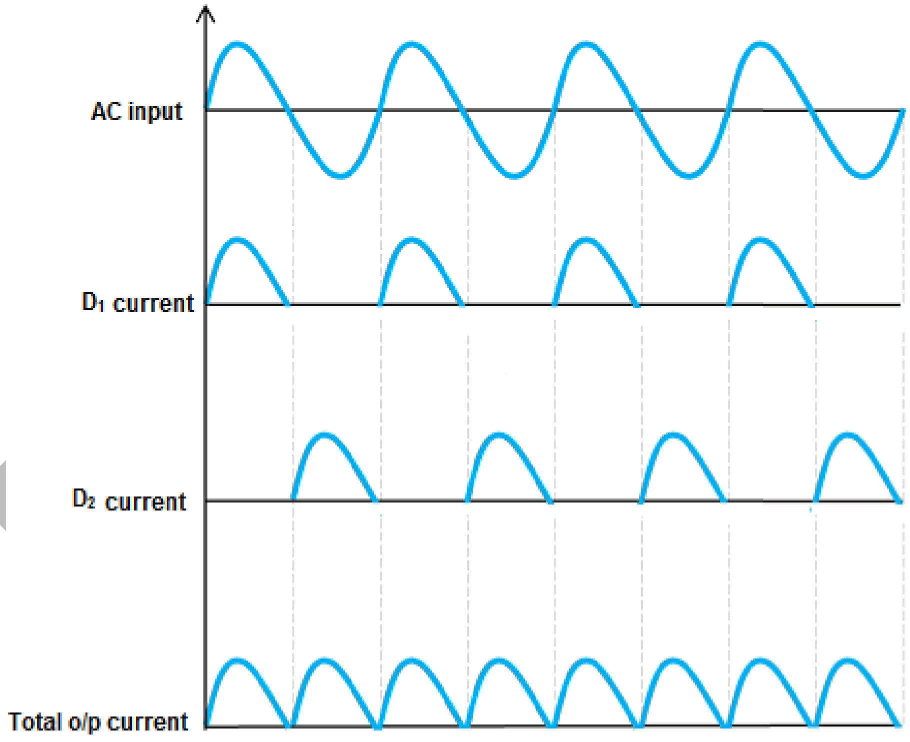
3. **Draw the circuit diagram and explain the working of full wave rectifier and derive the expression of average output voltage and rectification efficiency. (13M)** BTL3

Answer: Page 7.22 - Dr. C. Ramesh Babu Durai

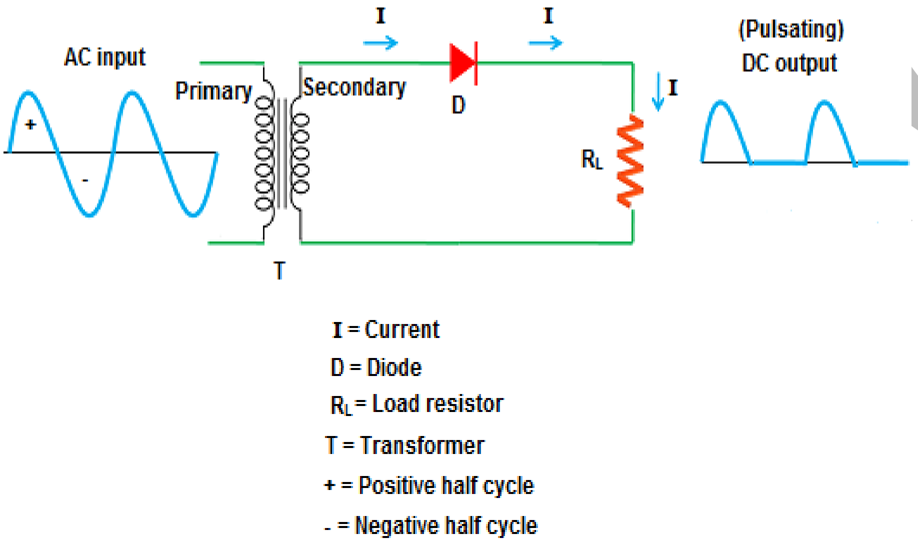
Construction and working: 5M

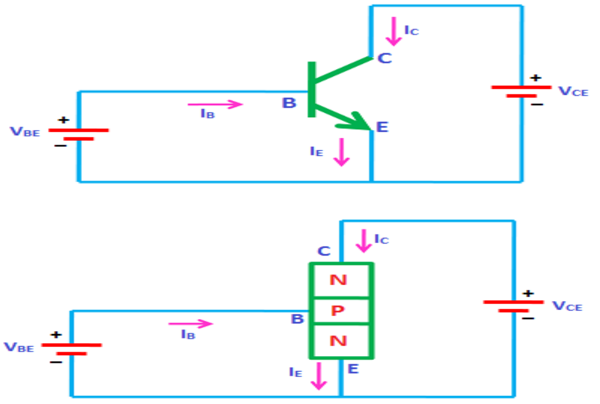
Derivation: 8M (Each 4)





Ripple factor $\gamma = 0.48$

	The rectifier efficiency of a full wave rectifier is 81.2%. $V_{DC} = 2V_{max}/\pi$
4.	**What is half wave rectifier? Explain the working with neat sketch. (13M) (APR/MAY 2019)**BTL2 **Answer: Page 7.15 - Dr. C. Ramesh Babu Durai** Construction and working: 5M Derivation: 8M (Each 4)  Half wave rectifier Ripple factor: **γ = 1.21** The rectifier efficiency of a half wave rectifier is 40.6%
5.	**Draw and explain the input and output characteristics of a BJT in CE configuration (13M)** BTL2 **Answer: Page 8.9 - Dr. C. Ramesh Babu Durai** CE configuration diagram and explanation: 5M Input and output characteristics: 8M (Diagram- each 2, explanation- each 2)

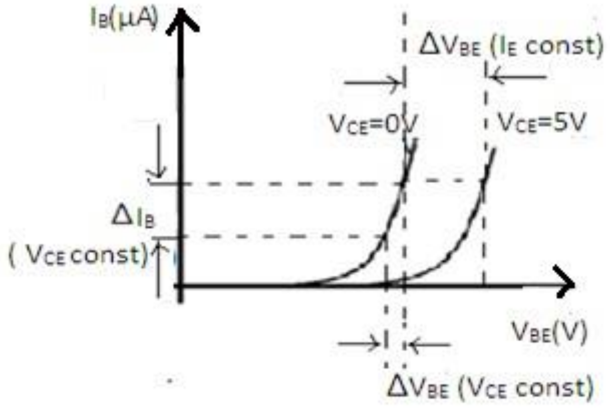


Common emitter configuration

Input characteristics:

The output voltage **V_{CE}** is maintained constant and the input voltage **V_{BE}** is set at several convenient levels. For each level of input voltage, the input current **I_B** is recorded.

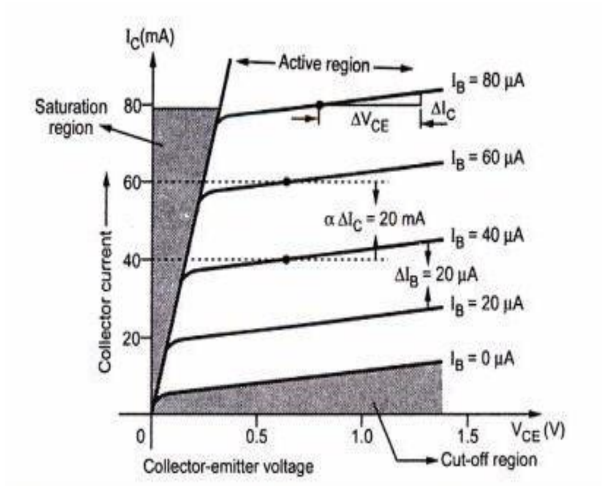
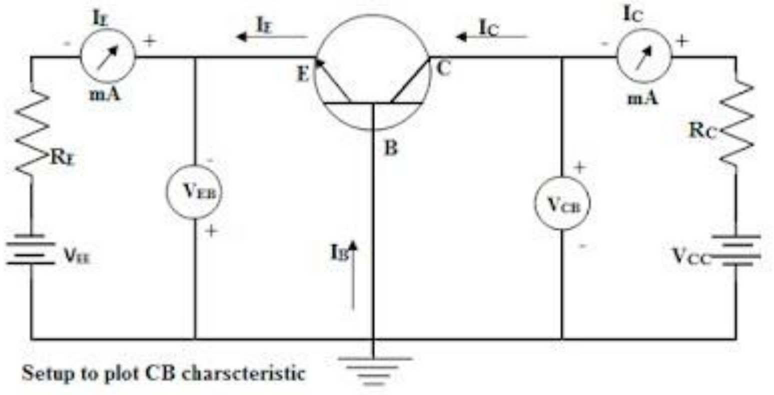
I_B is then plotted versus **V_{BE}** to give the common-base input characteristics.

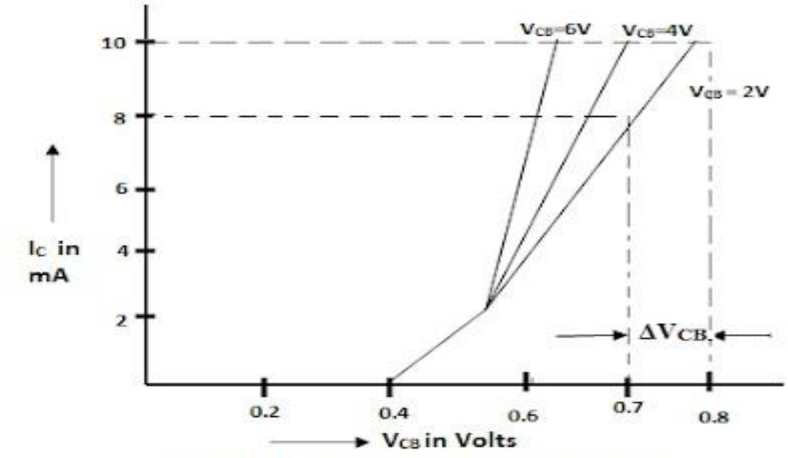


Output characteristics:

The Base current **I_B** is held constant at each of several fixed levels. For each fixed value of **I_B ,** the output voltage **V_{CE}** is adjusted in convenient steps and the corresponding levels of collector current **I_C** are recorded

For each fixed value of **I_B, I_C** level is Recorded at each **V_{CE}** step.For each **I_B** level, **I_C** is plotted versus **V_{CE}** to give a family of characteristics.

	 Fig 3.3: Output characteristics of the transistor in CE configuration
6.	**Explain the input and output characteristics in CB configuration and explain the early effect. (13M)** BTL2 **Answer: Page 8.6 - Dr. C. Ramesh Babu Durai** CB configuration diagram and explanation, early effect: 5M Input and output characteristics: 8M (Diagram- each 2, explanation- each 2)  Setup to plot CB charscteristic **Input characteristics:** The output(CB) voltage is maintained constant and the input voltage (EB) is set at several convenient levels.For each level of input voltage, the input current **I$_E$** is recorded. **I$_E$** is then plotted versus **V$_{EB}$** to give the common-base input characteristics.

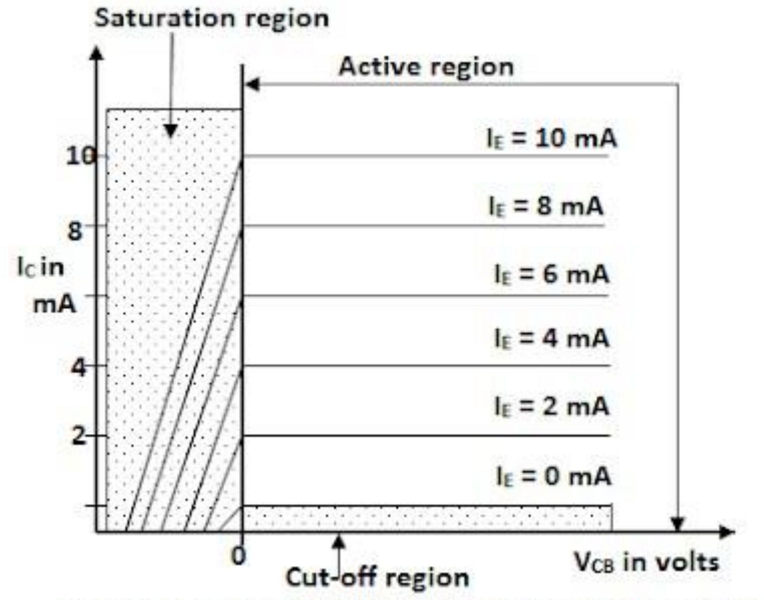


Input Characteristic of CB configuration

Output characteristics:

The emitter current **I_E** is held constant at each of several fixed levels. For each fixed value of **I_E** , the output voltage **V_{CB}** is adjusted in convenient steps and the corresponding levels of collector current **I_C** are recorded

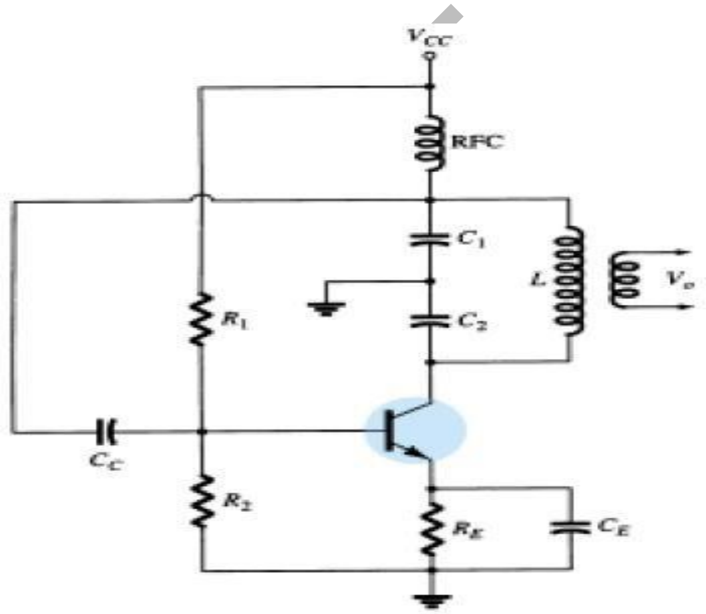
For each fixed value of **I_E**, **I_C** is almost equal to **I_E** and appears to remain constant when **V_{CB}** is increased



Output characteristic of common base configuration

Early effect:

The variation in the effective width of the base in a bipolar junction transistor (BJT) due to a variation in the applied base-to-collector voltage. A greater reverse bias across the collector–base

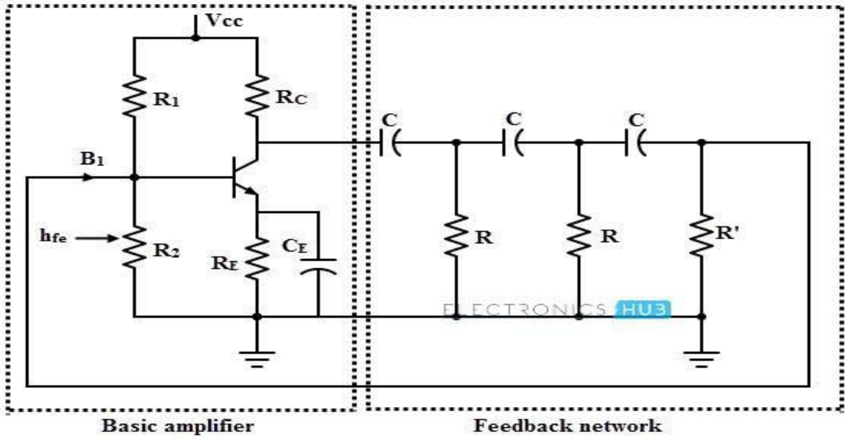
	junction, for example, increases the collector–base depletion width, thereby decreasing the width of the charge carrier portion of the base.
Part*C	
Q.No	**Question**
1.	**Explain the operation of Colpitts oscillator with neat circuit diagram. Also derive the expressions for the frequency of oscillation and the condition for maintenance of oscillation. (15M) (APR/MAY 2019)**BTL3 **Answer: Page 8.29 - Dr. C. Ramesh Babu Durai** General equation for the oscillator: 4M Diagram: 3M Derivation: 8M $\boxed{f_o = \frac{1}{2\pi\sqrt{LC_{eq}}}}$ $C_{eq} = \frac{C_1C_2}{C_1 + C_2}$ 
2.	**Explain the operation of RC phase shift oscillator with neat circuit diagram. Also derive the expressions for the frequency of oscillation and the condition for maintenance of oscillation.**

(15M) BTL3

Answer: Page 8.29 - Dr. C. Ramesh Babu Durai

Diagram and explanation: 5M

Derivation: 10M



Oscillator with a feedback network consisting of three RC high-pass networks connected in serie that produce 180° phase shift.

$$\boxed{f = \frac{1}{2\pi RC\sqrt{6}}}$$

$$\beta = \frac{1}{29}$$

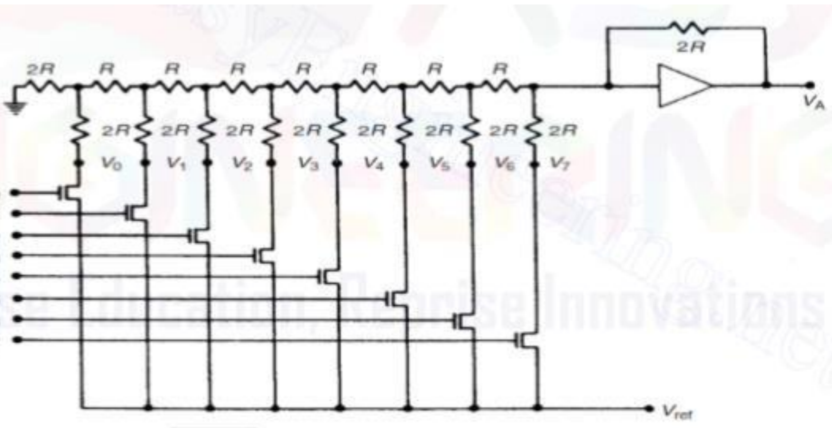
$$A > 29$$

3. a) i) **Explain the binary weighted resistor technique of D/A conversion. (8M) (APR/MAY 2019)**BTL3

Answer: Page 8.37 - Dr. C. Ramesh Babu Durai

- Binary weighted resistor DAC block diagram & Explanation

Digital-to-analogue conversion is much simpler to achieve than analogue-to-digital conversion and the cost of building the necessary hardware circuit is considerably less. It is required wherever a digitally processed signal has to be presented to an analogue control actuator or an analogue signal display device. A common form of digital-to analogue converter is illustrated in Figure 5.24. This is shown with 8 bits for simplicity of explanation, although in practice 10 and 12 bit D/A converters are used more frequently. This form of D/A converter consists of a resistor-ladder network on the input to an operational amplifier.



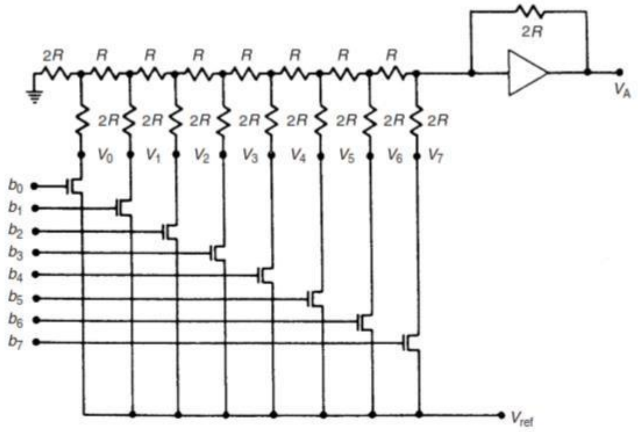
$$V_7 = V_6 = V_4 = V_2 = V_{\text{ref}}; \quad V_5 = V_3 = V_1 = V_0 = 0$$

The analogue output from the converter is then given by:

$$V_A = V_{\text{ref}} + \frac{V_{\text{ref}}}{2} + \frac{V_{\text{ref}}}{8} + \frac{V_{\text{ref}}}{32}$$

a) ii) Discuss R-2R& inverter R-2R ladder type D/A converter. (7M) (APR/MAY 2019) BTL3
Answer: Page 8.39 - Dr. C. Ramesh Babu Durai

- R-2R ladder type converter circuit diagram (3M)



- Explanation(4M)
- Digital-to-analogue conversion is much simpler to achieve than analogue-to-digital conversion and the cost of building the necessary hardware circuit is considerably less. It is required wherever a digitally processed signal has to be presented to an analogue control actuator or an analogue signal display device.
- This is shown with 8 bits for simplicity of explanation, although in practice 10 and 12 bit D/A converters are used more frequently. This form of D/A converter consists of a resistor-ladder network on the input to an operational amplifier.

$$V_A = V_7 + \frac{V_6}{2} + \frac{V_5}{4} + \frac{V_4}{8} + \frac{V_3}{16} + \frac{V_2}{32} + \frac{V_1}{64} + \frac{V_0}{128}$$

V0 to V7 are set at either the reference voltage level Vref or at zero volts according to whether an associated switch is open or closed. Each switch is controlled by the logic level of one of the bits 0 – 7 of the 8 bit binary signal being converted. A particular switch is open if the relevant binary bit has a value of 0 and closed if the value is 1.

4. **Explain the successive approximation type ADC. (15M)** BTL3

Answer: Page 8.45 - Dr. C. Ramesh Babu Durai

- Block diagram (6M)
- Working operation (6M)
    1. When start command is given, SAR sets MSB, d1=1 with all other bits to zero sp that the trail code is 1000 0000. The output Vd from DAC is now compared with analog input Va. If Va>Vd, then 1000 0000 is less than correct digital representation.
    2. This procedure is, repeated for all subsequent bits (i.e., from MSB to LSB), one at a time until all bits positions have been tested.
- Advantages: (3M)
    1. High resolution
    2. It is very versatile
    3. High speed

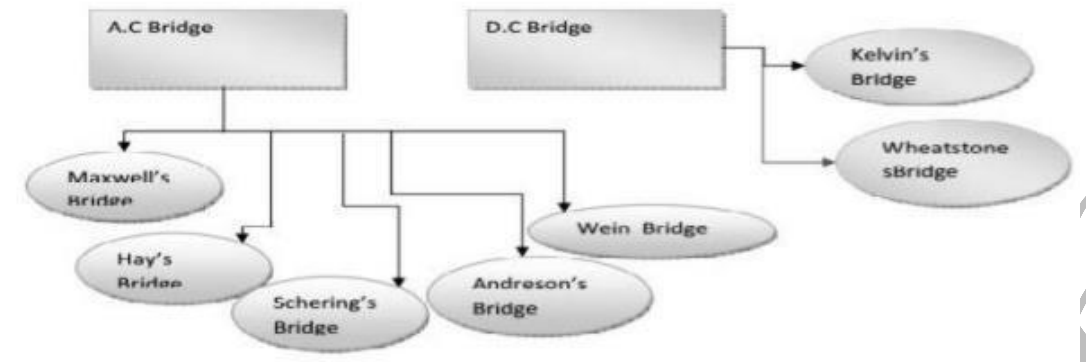
5. **Explain the various types of ADC with suitable sketches. (15M)** BTL3
Answer: Page 8.41 - Dr. C. Ramesh Babu Durai

1. Direct type
2. Indirect type

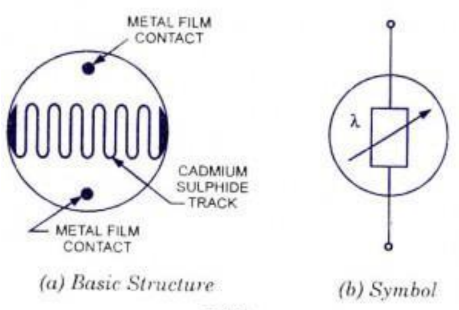
- Direct types are classified as (3M)
    1. Flash (comparator) type converter
    2. Staircase type converter
    3. Tracking or servo converter
    4. Successive approximation type converter
- **Indirect type are classified as (2M)**
    1. Charge balancing analog to digital converter
    2. Dual slope analog to digital converter
- **Explanation of each type (10M)**

Subject Code:BE8255 **Year/Semester: II /02**
Subject Name: BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENTENGINEERING
Subject Handler: Mr.A.Antony charles

UNIT V ELECTRICAL MEASUREMENT	
Characteristic of measurement-errors in measurement, torque in indicating instruments- moving coil and moving iron meters, Energy meter and watt meter. Transducers- classification-thermo electric, RTD, Strain gauge, LVDT, LDR and piezoelectric. Oscilloscope-CRO.	
Part*A	
Q.No	**Question**
1.	**What is meant by Q-factor? (APR/MAY 2019)**BTL1 Q-factor is known as the quality factor. It is used to measure the quality factor of the coils such as inductors, Capacitors etc
2.	**What is meant by Q-meter?** BTL1 Q-meter is generally used to measure the Q-factor of the coil.
3.	**What are the various types of storage oscilloscopes?** BTL1 The various types of storage oscilloscopes are • Analog storage oscilloscope • Mesh storage oscilloscope • Bistable phosphor storage oscilloscope • Digital storage oscilloscope
4.	**What is the DSO? (APR/MAY 2019)**BTL1 DSO is known as digital storage oscilloscope, it is used for storing the waveform in a digital form. It consists of a sample and hold circuit, control logic and an A/D converter the waveform can be stored in a buffer amplifier
5.	**What are the various types o f Bridges?** BTL1 Different types of bridges are shown below.

	
6.	**What are the different types DVM?** BTL1 • Ramp type DVM • Dual slope type integrating ty pe (voltage to time) • Integrating type DVM (voltage to frequency) • Successive approximation ty pe (SAR)
7.	**Write the working principle of Q-meter.** BTL1 The principle of Q-meter is based on series resonance. The voltage drop across the inductor or capacitor is Q times the applied voltage.
8.	**What are the advantages of digital instruments? (APR/MAY 2019)**BTL1 • Readings speed is very high due to digital display. • They can be programmed and well suited for computerized control.
9.	**Write the main static characteristics.** BTL1 The main static characteristics are: • Accuracy • Sensitivity • Reproducibility • Drift • Static error • Dead zone

	• Resolution • Precision • Repeatability • Stability
10.	**List the functional elements of the measurement systems.** BTL1 The three main functional elements of the measurement systems are: • Primary sensing element • Variable conversion element • Data presentation element
11.	**Write the different types of systematic errors. (APR/MAY 2019)** BTL1 These types of errors are divided into three categories: • Instrument Errors • Environmental Errors • Observational Errors
12.	**Define static error.** BTL1 Static error is defined as the difference between the true value and the measured value of the quantity. Static error = At – Am Where Am =measured value of quantity At =true value of quantity
13.	**What is primary sensing element?** BTL1 The primary sensing element is that which first receives energy from the measured medium and produces an output depending in some way on the measured quantity (measured).
14.	**What is the importance of dynamic characteristic of systems?** BTL1 When the quantity under measurement changes rapidly with time, it is necessary to find the dynamic relations existing between input and output. These types of characteristics are called as Dynamic Characteristics.

15.	**State the disadvantages of PMMC instruments.** BTL1 ➢ Cannot be used for ac m/s. ➢ Some errors are caused by temperature variations.
16.	**Define inverse transducer with example.** BTL1 ➢ An inverse transducer is defined as device which converts an electrical quantity into a non electrical quantity. ➢ It is a precision actuator which has an electrical input and a low power non electrical output.
17.	**Mention any 4 types of analog to digital converter. (APR/MAY 2019)**BTL1 ➢ Flash type of converter ➢ Staircase converter ➢ Tracking converter ➢ Successive approximation type
18.	**Which torque is absence in energy meter?** BTL3 The controlling torque is absence in energy metering energy meter continues rotation of disc is required & it is not necessary to reset it to zero every time & hence controlling torque is absence.
19.	**Define creeping.**BTL1 Slow but continuous rotation of disc when pressure coil is energized and current coil c is not energized.
20.	**State the disadvantages of PMMC instruments.** BTL4 • Cannot be used for ac m/s • Some errors are caused by temperature variations.
21.	**What is the principle of LDR?** BTL1 A Light Dependent Resistor (LDR) is also called a photo resistor or a cadmium sulfide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases.  *(a) Basic Structure* *(b) Symbol* *LDR*

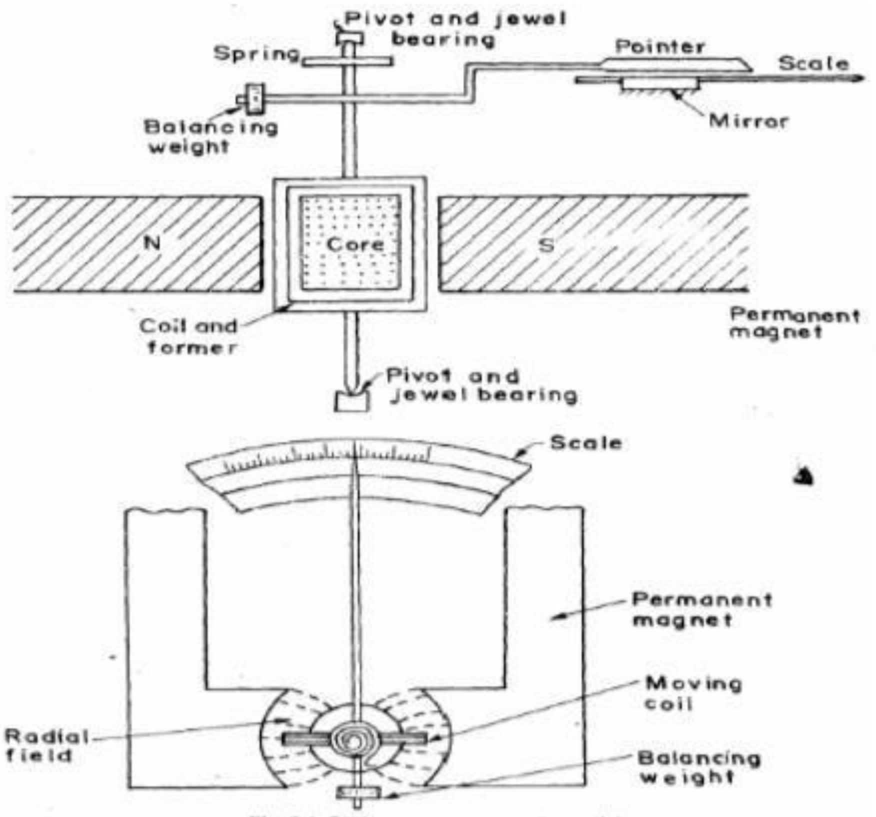
22.	**What is CRO?** BTL1 The **Cathode Ray Oscilloscope** is an instrument which we use in laboratory to display measure and analyze various waveforms of various electrical circuit and electronic circuits. Actually **cathode ray oscilloscope** is very fast X-Y plotters that can display an input signal versus time or other signal. Cathode ray oscilloscope uses luminous spot which is produced by striking the beam of electrons and this luminous spot moves in response variation in the input quantity.

23.	**How do you classify transducers? (APR/MAY 2019)**BTL2
	• On the basis of transduction form used.
	  ○ As primary and secondary transducers.
	  ○ As active and passive transducers.
	• As analog and digital transducers.
	• As transducers and inverse transducers.

24.	**Define the primary and secondary transducers?** BTL1 **Primary Transducer:** When the input signal is directly sensed by the transducer and physical phenomenon is converted into electrical form directly then such a transducer is called the primary transducer. **Secondary Transducer:** When the input signal is sensed first by some detector or sensor and then its output being of some from other than input signals is given as input to a transducer for conversion into electrical form, then such a transducer falls in the category of secondary transducers.
25.	**What are the advantages of digital storage oscilloscope?** BTL2 • It is easier to operate and has more capability. • The storage time is infinite. • The cursor measurement is possible
26.	**What are the factors to be considered for selection of transducers?** BTL2 • Environment conditions • Operating range • Sensitivity • Electrical characteristics • Accuracy
27.	**What is piezo-electric effect?** BTL2 A Piezoelectric material is one in which an electric potential appears across certain surfaces of the crystals if the dimensions of the crystals are changed by the application of a mechanical force this potential is produced by the displacement of charges. This effect is reversible. This phenomenon is known as piezoelectric effect.
28.	**What is LVDT? List the advantages.** BTL2 It is a passive transducers which is used to measure the linear displacement into electrical signal voltage. • High output • High efficiency • Low power consumption into electrical signal voltage

29.	**List the types of strain gauge.** BTL2 • Bounded strain gauge • Unbounded strain gauge • Metallic strain gauge • Foil type strain gauge • Semiconductor strain gauge
	PART B
Q.No	**Question**
1.	**Describe the static and dynamic characteristics of measuring instrument. (13M) (APR/MAY 2019)**BTL2 **Answer: Page 9.1- Dr. C. Ramesh Babu Durai** **Static characteristics: (7M)** • Accuracy: The closeness with which an instrument reading approaches the true value of the quantity being measured. • Precision: It is a measure of reproducibility of the measurements, i.e., given a fixed value of a quantity, precision is a measure of the degree of agreement with in a group of measurements. • Static sensitivity: If the input is slowly increased from some arbitrary (non-zero) input value, it will again be found that output does not change at all until a certain increment is exceeded. • Reproducibility: It is the degree of closeness with which a given value may be repeatedly measured. It may be specified in terms of units for a given period of time. • Drift: Gradual change in instruments measurements. • Static error: Numerical differences between true value of a quantity and its value as obtained by measurement. • Dead zone: It is defined as the largest change of input quantity for which there is no output of the instrument. **Dynamic Characteristics: (6M)** • Speed of response: The rapidity with which an instrument responds changes in measured quantity. • Measuring lag: The difference between the true and measured value with no static error. • Fidelity: Delay in the response of an instrument to changes in the measured variable. • Dynamic error: The degree to which an instrument indicates the changes in the measure variable without dynamic error (faithful reproduction).
2.	**Discuss in detail various types of errors associated in measurement and how these errors can be minimized?(13M)** BTL3

	Answer: Page 9.15- Dr. C. Ramesh Babu Durai **Error: (2M)** The algebraic difference b/w the indicated value and the true value of the quantity to be measured is called an error. **Types: (11M)** • Static error: It is defined as the difference between the measured value and the true value of the quantity under measurement. • Gross errors: is due to human fault. • Systematic errors: 1. Instrumental errors 2. Environmental errors 3. Observational errors • Random errors: due to causes that cannot be directly established. • Hysteresis error: Hysteresis is a non---coincidence of loading and unloading curves. Hysteresis in a system arises due to the fact that all the energy put into the stressed parts when loading is not recoverable upon unloading.
3.	**Describe the construction and working of permanent magnet moving coil instrument. Also derive the expression for deflection. (13M) (APR/MAY 2019)**BTL3 **Answer: Page 9.12 - Dr. C. Ramesh Babu Durai** **Construction and working: (7M)**



A moving-coil meter is a very commonly used form of analogue voltmeter because of its sensitivity, accuracy and linear scale, although it only responds to d.c. signals. As shown schematically in Figure 6.2, it consists of a rectangular coil wound round a soft iron core that is suspended in the field of a permanent magnet. The signal being measured is applied to the coil and this produces a radial magnetic field. Interaction between this induced field and the field produced by the permanent magnet causes a torque, which results in rotation of the coil.

Torque equation: (4M)

Deflecting torque Td= NBAI

N=number of turns of coil

B= Flux density in air gap

A= coil area

I= Current through moving coil

Final steady deflection Tc=Td

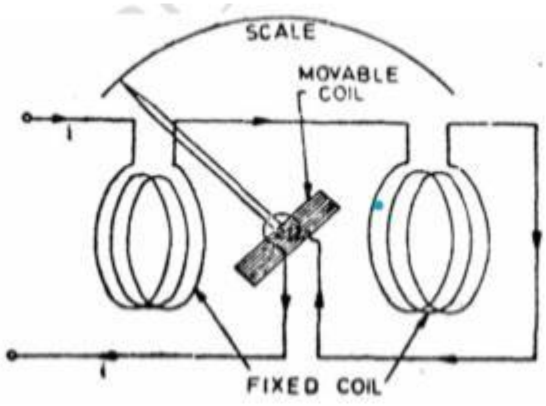
Advantages & disadvantages: (2M)

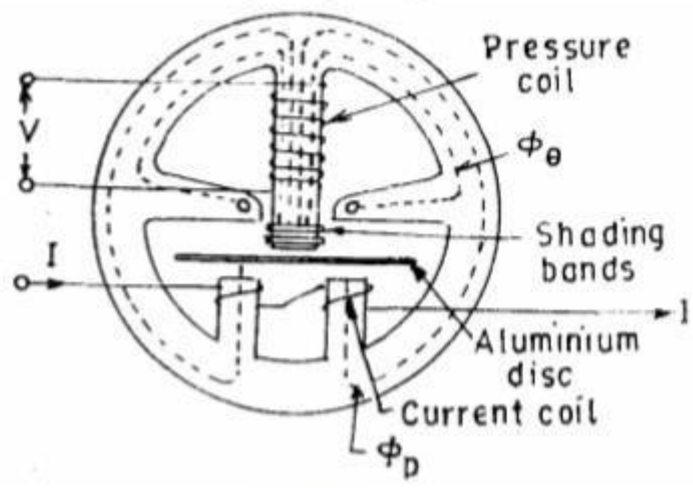
Advantages:

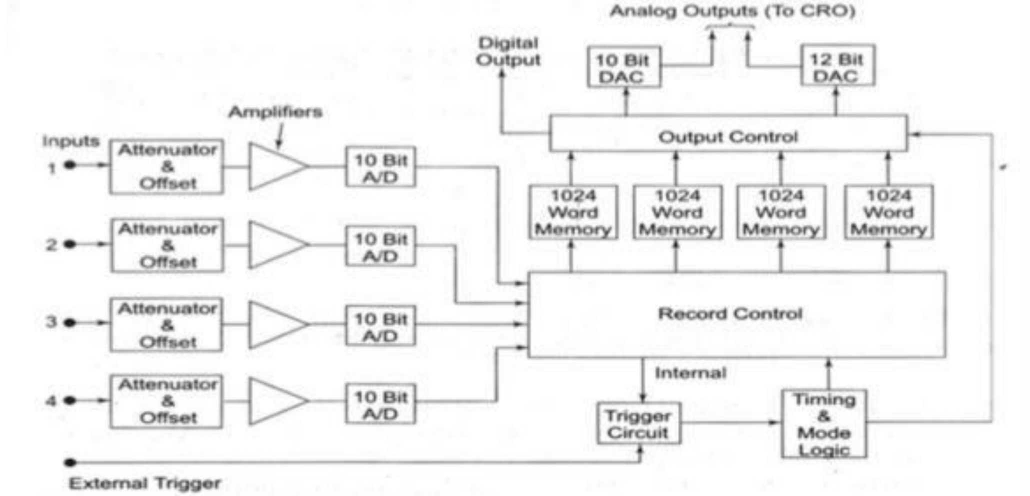
- The sensitivity is high
- Uniform scale
- Operating current is small

Disadvantages:

- Not suitable for AC measurements

	• Ageing of PMMC introduces the errors • Cost is high
4.	**With a neat diagram explain the construction and working of electrodynamometer type instruments. Also derive its torque equation. (13M)** BTL2 **Answer: Page 9.28 - Dr. C. Ramesh Babu Durai** • Circuit diagram **(3M)**  • Operating principle of Electro dynamo meter instruments **(4M)** • Torque equation **(4M)** • Advantages and disadvantages **(2M)** <u>Adv</u> 1. As the coils are air cored, these instruments are free from hysteresis and eddy current losses. 2. They have a precision grade accuracy for frequencies from 40 HZ to 500 Hz. <u>Dis-Adv</u> 1. They have a low torque/ weight ratio hence have a low sensitivity Increases frictional losses.
5.	**Give the construction and principle of operation of single phase induction type energy meter. Also derive its torque equation. 13M** BTL4 **Answer: Page 9.33 - Dr. C. Ramesh Babu Durai** • **Construction & working of single phase energy meter (6M)**

	 (Fig) single phase energy meter • **Explanation (4M)** 1. Driving system 2. Moving system 3. Braking system 4. Counting system/ Registering mechanism • **Errors caused by braking system & advantages (3M)**
6.	**Draw and explain the block diagram of digital CRO. (13M)** BTL2 **Answer: Page 9.42 - Dr. C. Ramesh Babu Durai** • **Block diagram of digital CRO (7M)**



- **Working (6M)**

The input is amplified and attenuated with input amplifier as in any oscilloscope. The sample and hold circuit effectively snaps a picture of the voltage level. The output of S/H circuit is connected to an ADC. CRT accepts only the analog signals and thus the signal in the digital memory is converted in to an analog signal by means of digital to analog converter.

Part*C

Q.No	Question
1.	**Explain the construction and working of LVDT with a neat sketch. (13M) (APR/MAY 2019)** BTL 2 **Answer: Page 9.52 - Dr. C. Ramesh Babu Durai** • **Construction & working of LVDT** (6M & 7M) • An LVDT, or Linear Variable Differential Transformer, is a transducer that converts a linear displacement or position from a mechanical reference (or zero) into a proportional electrical signal containing phase (for direction) and amplitude information (for distance). • The LVDT operation does not require electrical contact between the moving part (probe or core rod assembly) and the transformer, but rather relies on electromagnetic coupling; this and the fact that they operate without any built-in electronic circuitry are the primary reasons why LVDTs have been widely used in applications where long life and high reliability under severe environments are a required, such as Military/Aerospace applications.

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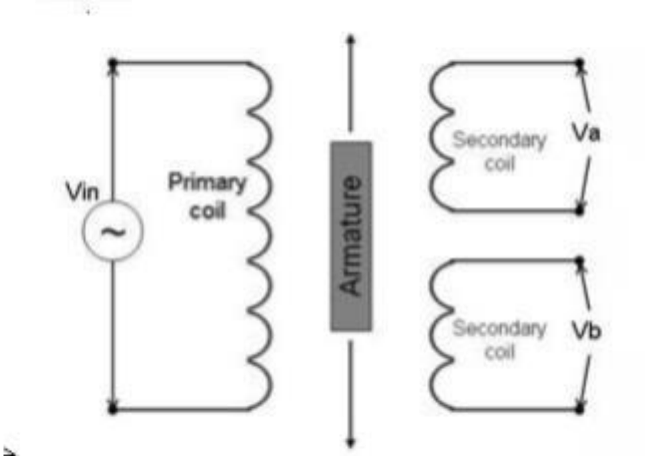

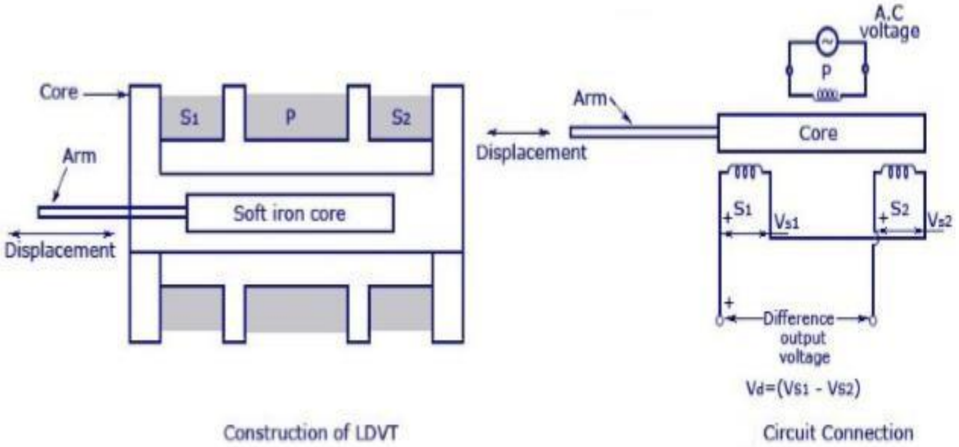

Construction of LDVT Circuit Connection
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Explain the principle of piezo electric transducers and name any two piezo electric materials. (15M) (APR/MAY 2018)BTL3

Answer: Page 9.55 - Dr. C. Ramesh Babu Durai

- **Piezo electric diagram & Principle of operation (10M)**
  1. Piezoelectric transducers produce an output voltage when a force is applied to them. They are frequently used as ultrasonic receivers and also as displacement transducers, particularly as part of devices measuring acceleration, force and pressure.
  2. In ultra- sonic receivers, the sinusoidal amplitude variations in the ultrasound wave received are translated into sinusoidal changes in the amplitude of the force applied to the piezoelectric transducer.
  3. In a similar way, the translational movement in a displacement transducer is caused by mechanical means to apply a force to the piezoelectric transducer.
  4. Piezoelectric transducers are made from piezoelectric materials. These have an asymmetrical lattice of molecules that distorts when a mechanical force is applied to it.
  5. This distortion causes a reorientation of electric charges within the material, resulting in a relative displacement of positive and negative charges.
  6. The charge displacement induces surface charges on the material of opposite polarity between the two sides. By implanting electrodes into the surface of the

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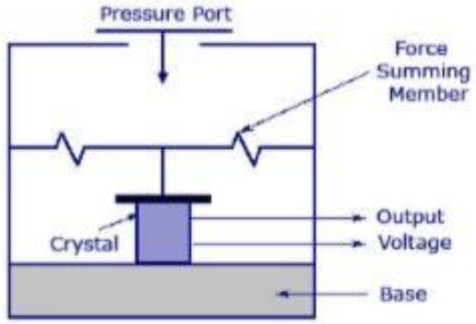
	material, these surface charges can be measured as an output voltage. 7. For a rectangular block of material, the induced voltage is given by: V = kFd/A  Piezo-Electric Transducer - Modes of operation , advantages & dis-advantages **(5M)**
3.	**Explain different strain gauges with the principle of operation. (15M)** BTL3 **Answer: Page 9.49 - Dr. C. Ramesh Babu Durai** - Working principle **(5M)** 1. A strain gauge is an example of a passive transducer that uses the variation in electrical resistances in wires to sense the strain produced by a force on the wires. 2. If a metal conductor is stretched or compressed, its resistances changes on account of the fact that both length and diameter of conductor change. - Theory and operating principle of resistance strain gauge derivation **(10M)**
4.	**Explain in detail about the different types of moving iron instruments.(15M) (APR/MAY 2019)**BTL3 **Answer: Page 9.16 - Dr. C. Ramesh Babu Durai** - Types (2M) 1. Attraction type 2. Repulsion type - Explanation with diagram (10M) - Torque equation (3M)