JEPPIAAR
INSTITUTE OF TECHNOLOGY
"Self-Belief | Self Discipline | Self Respect"

QUESTION BANK

Regulation : 2013

Year : IV

Semester : 08

Batch : 2016-2020

Academic Year : 2020-2021

DEPARTMENT OF ELECTRICAL AND ELECTRONICS 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:

- 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.
- 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.
- To provide excellent infrastructure, serene and stimulating environment that is most conducive to learning.
- To strive for productive partnership between the Industry and the Institute for research and development in the emerging fields and creating opportunities foremployability.
- To serve the global community by instilling ethics, values and life skills among the students needed to enrich theirlives.

Department Vision

To foster contemporary Skills in the field of Electrical and Electronics Engineering with innovatory Skills, Global Understanding and Nation building for the progress of Humankind.

Department Mission

- To Encompass Quality Engineers with skills as persevere to enrich the globaltechnically.
- To engage in research activities leading to innovative application of technology with Industrial approach for the benefit ofmankind.
- To provide quality structure and beneficial learningsystem.
- To enable them as responsible human who value Ethics andenvironment.

PEO's of the Department

PEO1: To provide students with the fundamental Knowledge, methodologies and use of cutting-edge Technologies.

PEO2: To provide students with an awareness and skills in lifelong learning and self-education.

PEO3: To Cultivate Teamwork, Technical writing and Oral communication skills.

PEO4: To provide students with an appreciation of engineering impact on society and the Professional responsibilities of an engineers.

Program Specific Outcomes (PSO's)

PSO1: Apply the fundamentals of mathematics, Science and Engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronics, electrical machines and systems.

PSO2: Apply appropriate technique and modern Engineering hardware and software tools in power systems to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

PSO3: Understand the impact of Professional Engineering solutions in societal and environment context, commit to professional ethical and communicate effectively.

BLOOM'S TAXONOMY

Definition:

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition like thinking, learning, and understanding.

Objectives:

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

Levels in Bloom's Taxonomy:

- **BTL 1** – **Remember** - The learner recalls, restate and remember the learned information.
- **BTL 2** – **Understand** - The learner embraces the meaning of the information by interpreting and translating what has beenlearned.
- **BTL 3** – **Apply** - The learner makes use of the information in a context similar to the one in which it waslearned.
- **BTL 4** – **Analyze** - The learner breaks the learned information into its parts to understand the informationbetter.
- **BTL 5** – **Evaluate** - The learner makes decisions based on in-depth reflection, criticism andassessment.
- **BTL 6** – **Create** - The learner creates new ideas and information using what has been previouslylearned.

TABLE OF CONTENTS

EE6801 ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION

L T P C
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OBJECTIVES:

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors
- To introduce concepts of Wind Energy and its utilization

UNIT I ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION 9

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT III HEATING AND WELDING 9

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV SOLAR RADIATION AND SOLAR ENERGY COLLECTORS 9

Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors - performance analysis of a cylindrical - parabolic concentrating collector – Feedin Invertors.

UNIT V WIND ENERGY 9

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to understand and analyze power system operation, stability, control and protection.

Ability to handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited,1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007.

2. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi, 2004.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International Pvt.Ltd., 2003.
4. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,' Generation and Utilization of Electrical Energy', Pearson Education, 2010.

Subject code: EE6801 **Year/semester:IV/08**

Subject Name: Electric Energy Generation ,Utilization & Conservation

Subject Handler: S.Priya

UNIT- I ELECTRIC DRIVES AND TRACTION

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

PART * A

Q.No	Questions
1.	**What are the advantages of electric traction system? (Dec 2013, 2014)** BTL1 • In electric traction electric motors are used as the drives, the system is clean and pollution free and it has high starting torque therefore high acceleration is possible. • Electric traction is most suitable for urban and suburban areas where frequent starting and stopping and high schedule speeds are required. • The coefficient of adhesion is high, therefore for the same tractive effort electric locomotives are lighter and hence higher speeds on gradients are possible. • Over loading of electric motors is possible. • Centre of gravity of electric locomotive is lower than that of steam locomotive**.**
2.	**What are the requirements of ideal traction system?**BTL1 • The coefficient of adhesion should be high, so that high tractive effort at start is possible and rapid acceleration of the train can be obtained. • It should be possible to overload the equipment for short periods. • It should be pollution free. • The locomotive or train unit should be self-contained. • It should be possible to use regenerative braking.
3.	**What are the supply systems for electric Traction? (APR/MAY 2019)** BTL 1 The direct current system • The Single phase AC system • The 3 phase Ac system
4.	**How would you analyze the speed time curve for electric train?**BTL 3 • Acceleration • Speed Constant or free running • Period of wasting

5.	**Define crest speed of a train? (Dec 2012)** BTL1 It is the maximum speed of train, which affects the schedule speed as for fixed acceleration, retardation, and constant distance between the stops. If the crest speed increases, the actual running time of train decreases. The high crest speed of train will increases its schedule speed.
6.	**Define specific energy consumption and discuss the factors that affects the specific energy Consumption of trains operation at a given schedule speed**. **(Dec 2012) (May 2015)** BTL1 It is the energy consumed (in Wh) per tonne mass of the train per km length of the run. The specific energy consumption of a train running at a given schedule speed is influenced by 1. Distance between stops 2. Acceleration 3.Retardation 4.Maximum speed 5. Type of train and equipment 6. Track configuration.
7.	**What is Schedule speed? (APR/MAY 2019)**BTL1 It is the ratio of the distance between the stops and the total time taken including time for stops to cover the distance isSchedule speed = Distance between stops in km/Actual time of run in hr+ Stop time in hr.
8.	**What are the factors affecting the schedule speed of a train?**BTL 1 • Crest speed • Acceleration • Breaking retardation
9.	**Define dead weight.** BTL1 • It is the gross weight of the train including locomotive to be moved on the rail track. The dead weight of the train comprises of ➢ The weight which has linear acceleration and ➢ The weight which has angular acceleration
10	**Define accelerating weight.** BTL1 Due to rotational inertia for angular acceleration the total effective weight of the train will be more than the dead weight. Thus effective weight is termed as accelerating weight of the train.
11	**What is tractive effort?**BTL2 It is an effective force on the wheel of a locomotive which is required for its propulsion. The tractive effort is a vector quantity and it is tangential to wheel. It is measured in newtons.
12	**Write the formula for tractive effort of an electric train? (Dec 2013)** BTL1 The tractive effort is given by $F_t = F_a + F_g + F_r$ Where F_a = Force to overcome linear or angular motion. F_g = Force to overcome effect of gravity.

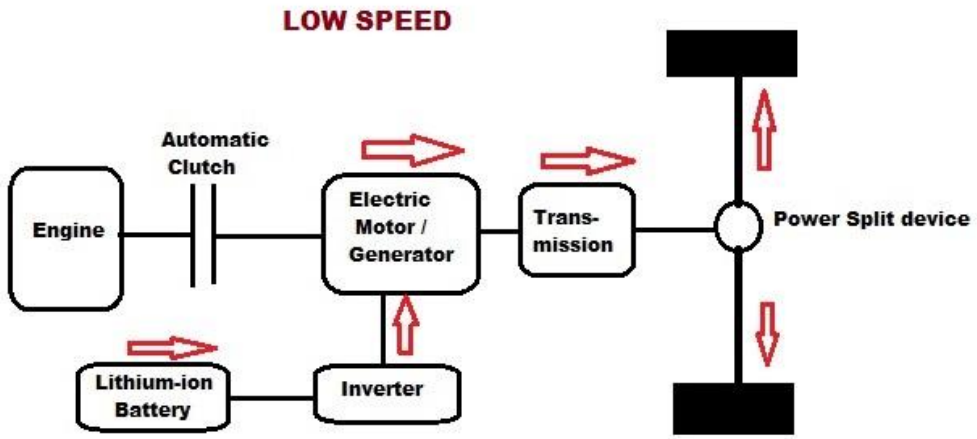
	F_r = Tractive effort to overcome the frictional resistance.
13	**Why dc series motors are preferred for electric traction?**BTL1 • Series motors exert high starting torque. • If the torque is increased the speed of the series motor decreases automatically. • The free running speed of the series motor is sufficiently high.
14	**What are the mechanical characteristics of traction motor? (APR/MAY 2019)**BTL2 • As the motor has to withstand the vibrations continuously the motor should be robust. • The motor should have minimum possible weight.
15	**Why a three phase induction motor is more suitable for traction purpose?**BTL1 • It has constant speed characteristics. • It has shunt type speed torque characteristics even during braking. • Possibility of applying regenerative braking on gradient. • Its robust construction in absence of commutator. • High efficiency.
16	**What is meant by electric braking?**BTL2 Electrical braking cannot do away with the mechanical brakes since a vehicle cannot be held stationary by its use; it nevertheless forms a very important part of traction system. The main advantage is that it reduces the wear on the mechanical brakes and gives a higher value of braking retardation, thus bringing a vehicle quickly to rest and cutting down considerably on the running time.
17	**What are the methods of electric braking?**BTL2 • Plugging • Rheostatic braking • Regenerative braking
18	**What is plugging?**BTL2 Plugging consists in reversing the connections of the armature of the motor so as to reverse its direction of rotation which will oppose the original direction of rotation of motor and will bring it to zero speed when mechanical brakes can be applied.
19	**What is rheostatic braking?**BTL2 In this method of braking, this motor is disconnected from the supply and run as a generator driven by the remaining kinetic energy of the equipment.i.e by the energy stored in motor and load which are to be braked.
20	**What is meant by dead man's handle device?**BTL2 With all types of controllers a dead man's handle device is provided in order to stop the train automatically in case the driver fails and /or is not in a position to control the operation. This is in the form of a contact attached to the knob of the controller handle. If the driver is not able to operate the handle properly, the knob raises which causes the contact to close and operate the main circuit breaker and apply the brakes.
21	**Write the formula for tractive effort of an electric train? (May 2014)** BTL2

	The tractive effort is given by $F_t = F_a + F_g + F_r$ Where F_a = Force to overcome linear or angular motion, F_g = Force to overcome effect of gravity, F_r = Tractive effort to overcome the frictional resistance.
22	**What are the recent trends in electric traction? (May 2013)(May 2014)&(Dec 2014)** BTL1 Development of practical electric vehicles has been completed. Motor selection becomes clear, Battery trend becomes also clear, and Components are almost completed.
	PART * B
1.	**i) Explain the requirements of electric traction system.(3M)(Apr/May 2018)** BTL2 Answer Page: 3.69 – V.THIYAGARAJAN • The starting tractive effort should be high so as to have rapid acceleration. • The wear on the track should be minimum • Pollution free • Low initial and maintenance cost. **ii) Describe the mechanism of train movement with speed time curve. (10M) (Apr/May 2018)** BTL 3 Answer Page: 3.69 – V.THIYAGARAJAN • Diagram representation of transmission of tractive effort (4M) • Coefficient of adhesion (2M) It is defined as ratio of trcative effort to slip the wheels and adhesive weight. • Tractive effort for propulsion of train(4M)
2.	**What are the various types of electric braking used in traction? Discuss in detail. (13M) (May 2015)** BTL 2 Answer Page: 3.32 – V.THIYAGARAJAN **Braking: (2M)** The main theme of braking is to stop the motion or to oppose the motion. In braking, the motor works as a generator developing a negative torque which opposes the motion. **Types: (11M)** • **Regenerative braking**: In regenerative braking, generated energy is supplied to the source under the condition E> V and negative Ia. • **Dynamic or rheostatic braking**: Regenerative braking is not possible if it is impossible for the motor speed to be greater than the no load speed. • **Counter current braking (or) plugging**:

	➢ For quick stopping of the motor ➢ For reversing drives requiring a short time for reversal.
3.	**i) Explain the principle and operation of a modern ac locomotive. (6M) (APR/MAY 2019) (May 2015)**BTL2 Answer Page: 3.32 – V.THIYAGARAJAN • The cost of electronic devices in a modern locomotive can be up to 50% of the cost of the vehicle. Electric traction allows the use of regenerative braking, in which the motors are used as brakes and become generators that transform the motion of the train into electrical power that is then fed back into the lines. **ii) What are the factors influencing the choice of electric drives? (7M) (Apr/May 2017)** BTL1 Answer Page: 3.50 – V.THIYAGARAJAN **Selection of electric motors:** • Speed – torque characteristics matching between motor and load. • Type of power supply available • Initial and running costs • Availability of spare parts and trained personnel.
4.	**Define specific energy consumption and discuss the factors that affects the specific energy consumption of trains operation at a given schedule speed. (13M) (Dec 2012)** BTL 3 Answer Page: 3.101 - V.THIYAGARAJAN • **Factors & explanation (13M)** 1. Distance between the stops: The greater the distance between the stops, the lesser will be specific energy consumption. The specific energy consumption for suburban service is 50 to 75 watts hour/tonne km. 2. Train resistance: The train resistance depends upon the nature of track, speed of the train and shape of rolling stock, particularly the front and rear portions of the train. 3. Acceleration and retardation: If the acceleration and retardation increases, the specific energy consumption is increased. 4. Gradient: The steep gradients will involve more energy consumption through regenerative braking is applied. 5. Train equipment: More efficient train equipment will reduce the specific energy consumption.
5.	**Explain regenerative braking when used for DC series traction motors. How does it differ from the regenerative braking as used for shunt motors? (13M) (Dec 2012)** BTL 2

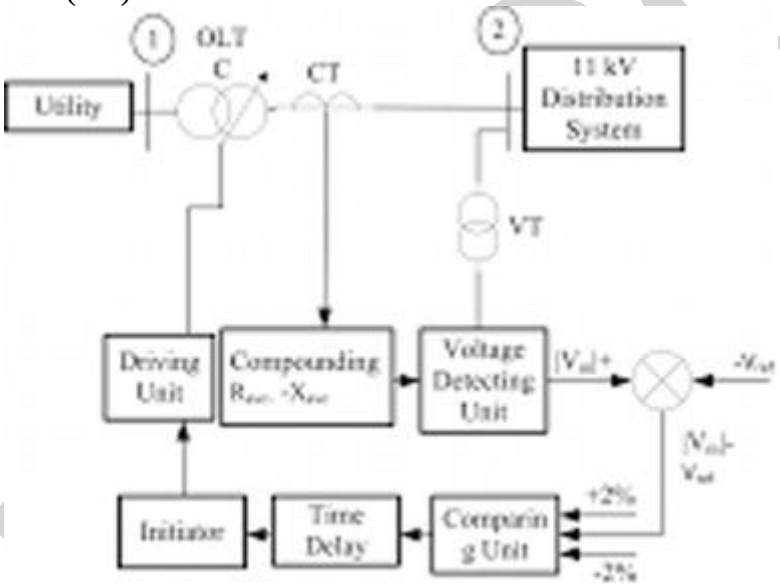
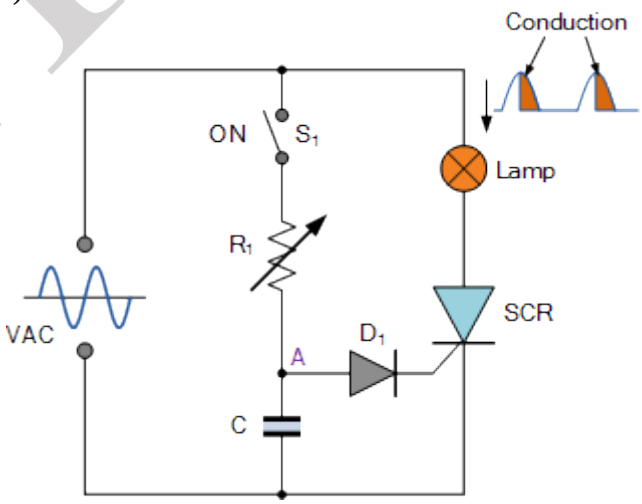
Answer page: 3.36 - V.THIYAGARAJAN

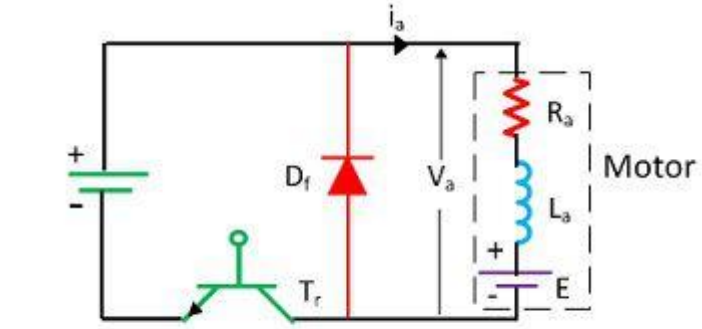
- **Definition (2M):**
  Regenerative braking is an energy recovery mechanism which slows a vehicle or object by converting its kinetic energy into a form which can be either used immediately or stored until needed. In a nutshell, the electric motor is using the vehicle's momentum to recover energy that would be otherwise lost to the brake discs as heat.
- **Regenerative braking (11M):**
- Power input to an induction motor is given by
  Pin= 3V Is cosØs
  Where Øs is the phase angle between stator phasor voltage v and the stator phase current Is. For motoring operation Øs< 90.
- Regenerative braking is not by itself sufficient as the sole means of safely bringing a vehicle to a standstill, or slowing it as required, so it must be used in conjunction with another braking system such as friction-based braking.
- The regenerative braking effect drops off at lower speeds, and cannot bring a vehicle to a complete halt reasonably quickly with current technology, although some cars like the Chevrolet Bolt can bring the vehicle to a complete stop on even surfaces when the driver knows the vehicle's regenerative braking distance. This is referred to as One Pedal Driving.



6. **Draw the speed time curve of a traction system. Also explain various speeds and actions. (13M) (Dec 2013)(APR/MAY 2019)** BTL 4

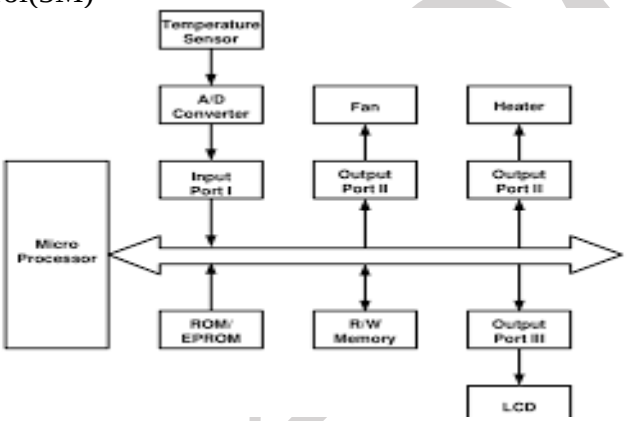
Answer Page: 3.76 – V.THIYAGARAJAN

	Speed – Time curves consists of 1. Acceleration period(4M) 2. Free run or constant speed period(3M) 3. Coasting period(3M) **4.** Retardation period(3M)
7.	**Explain about multi motor speed control. (13M) (May 2015)** BTL 2 Answer Page: 3.111 – V.THIYAGARAJAN Methods & Explanation • Tap changer control(4M)  • Thyristor control(3M)  • Chopper control(3M)



Chopper Control of Seprately Excited Motor

- Microprocessor control(3M)



8. **Explain the DC series traction motor control. (13M) (May 2014)** BTL 2

Answer Page: 3.102 – V.THIYAGARAJAN

Speed control methods: (13M)

1. Rheostatic control

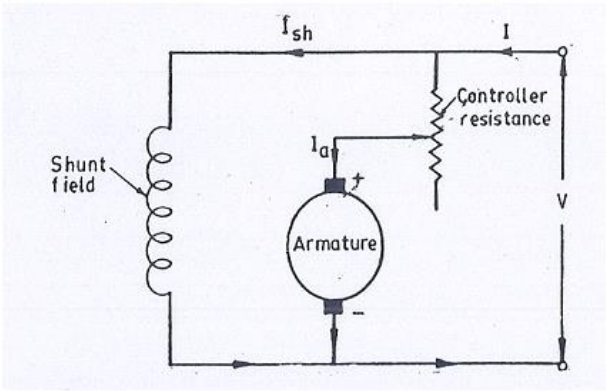
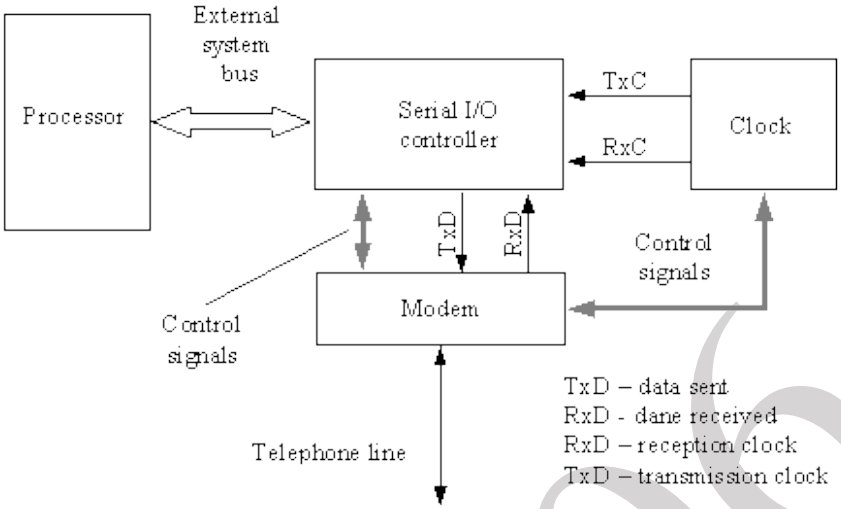


Fig. 86. Armature resistance control for D.C. shunt motor.

2. Series parallel control



3. Field control

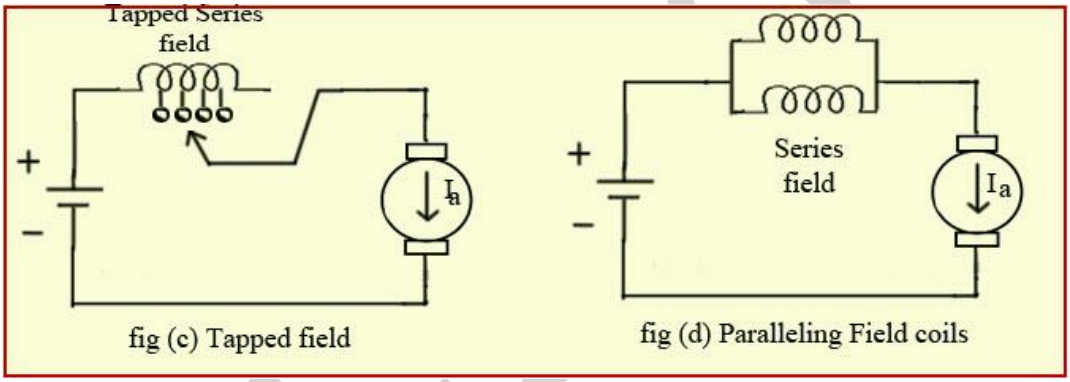
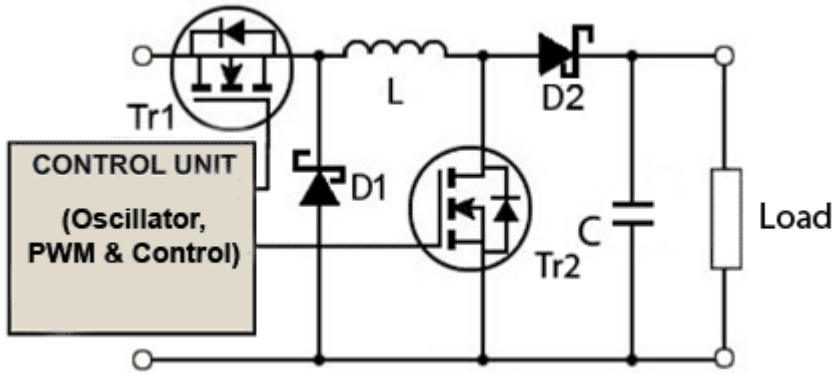


fig (c) Tapped field fig (d) Paralleling Field coils

4. Buck and boost method



5. Metaldyne control
6. Thyristor control

9.	**A 250 tones EMU train is started with a uniform acceleration and reaches a speed of 30km/hr in 20 seconds on level section. Find the specific energy consumption assuming a simplified trapezoidal curve, with rotational inertia as 8 %, retardation as 3 km/hr/sec, the distance between two stations as 4km, efficiency of motor as 0.9 and train resistance 4 kg/tonne.(13 M)(Dec 2012).**BTL 3

	Answer page: M.Q.1- V.Thiyagarajan We/W= 1.08 upon rotational inertia Resistance of motion r= 4 * 9.81 = 39.24 newton/ tonne Braking duration t3= Vc/β = 10 sec Distance travelled during braking is D D= ½ * Vm* t3/3600 = 3.9583 Km Specific energy output Eo= 0.01072 V_M2/D * W_e/W Specific energy consumption = 13.39206/0.9 = 14.88 wh/tonne –Km
	PART*C
1	**A train weighing 200 tones acceleration uniformly from rest to a speed of 50 km/hr up a gradient of 1 in 500, the time taken being 35 seconds. The power is then cut off the train coasts down a uniform gradient of 1 in 1000 for a period of 40 seconds when brakes are applied for period of 15 seconds so as to bring the train uniformly to rest on this gradient.** **Calculate** **1. The maximum power output from the driving axle.** **2. The energy taken from the conductor rails in kWh.** **Assuming an efficiency of 70% and assume tractive effort to be 40 Newtons per tonnes at all speed and allow 10% for rotational inertia. (May 2013)(15M)**BTL 2 **Sol:** W= 200 tonnes V_m = 50 km/hr R= 3 km/hr/sec G= 1/500 = 2% We/W= 1.1 upon rotational inertia Effective weight of train We= 1.1. W=1.1 * 200=200 tones Required tractive effort Ft= 277.8 We α + 9.81 W G Wr Newtons Ft= 99232.5 Newtons The maximum power output from the driving axels = Ft. Vm/ 3600

	Total energy required for the run = Energy required for acceleration as there is no free run.
2	**A suburban electric train has a maximum speed of 80km/hr. The schedule speed including a station stop of 30 seconds is 50 km/hr. If the acceleration is 2 km/hr/sec, find the value of retardation when the average distance between stops is 4KM. (8M)(May 2015)**BTL 2 **Sol:** Vm= 80 km/hr Duration of stop= 30 seconds α = 2km/hr Schedule time of run Ts= 3600 * D/Vs=288 seconds.

UNIT- II ILLUMINATION

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

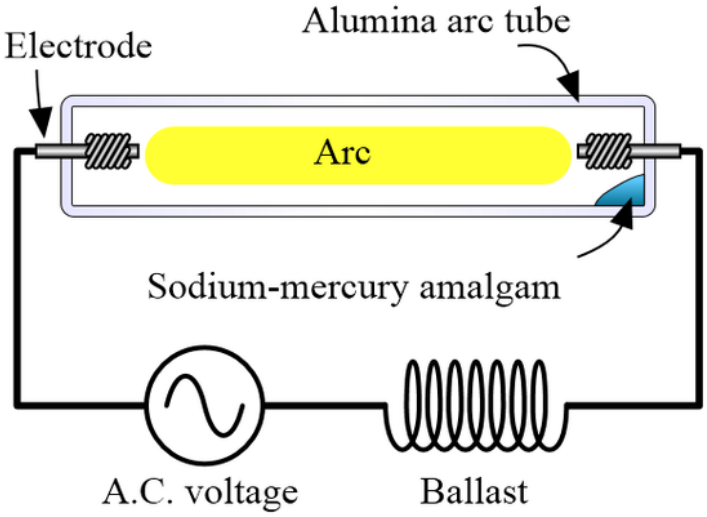
PART * A

Q.No	Questions
1.	**Define light.**BTL 1 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. (APR/MAY 2019)**BTL 1 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.**BTL 1 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 dFthen, Illuminance= dF/dA= lumens/area. = candle power x ω .
4.	**Define candle power.** BTL 1 Candle power is the number of lumens per unit solid angle. Candle power= lumens/ω.
5.	**Define plane angle.**BTL 1 When two straight lines lying in the same plane meet at a point, there will be an angle between these converging lines at the meeting point. This angle is termed as plane angle. The plane angle is represented by radians.
6.	**What is solid angle? (APR/MAY 2019)**BTL 2 The angle subtended by a point in space by an area is termed as solid angle. This solid angle represents the volume which is enclosed by numerous lines lying on the surface and meeting at a point. It is denoted by the symbol ω.
7.	**Define luminous intensity.**BTL 1

	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. $I = \Phi/\omega$
8.	**What are the two laws of illumination?**BTL 2 • Inverse square law. • Lambert's cosine law.
9.	**State inverse square law.**BTL 1 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.
10	**State Lambert's law.**BTL 1 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.
11	**Define MSCP, MHCP, MHSCP. MSCP.**BTL 1 • The mean or average of candle power in all directions in all planes is called MSCP. • **MHCP (Mean horizontal candle power) :** The mean or average of the candle power in all directions on a horizontal plane which passes through the source is called MHCP. MHSCP(Mean hemi spherical candle power). • The mean or average of candle power in all directions within the hemisphere either above the horizontal plane or below the horizontal plane.
12	**Define brightness or luminance.**BTL 1 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.
13	**Define lux. (APR/MAY 2019)**BTL 1 It is defined as the illumination of the inside of the sphere of radius 1 metre at the centre of which there is a source of 1 candle power.
14	**If the total lumens required are 7200 and coefficient of utilization is 0.3, calculate lamp lumens required. (May 2015)** BTL 4 $\text{Utilization factor} = \frac{\text{Total lumens reaching the working plane}}{\text{Total lumens given out by the lamp}}$ $0.3 = \frac{7200}{\text{Total lumens given out by the lamp}}$ $\text{Total lumens given out by the lamp} = \frac{7200}{0.3}$ Total lumens given out by the lamp = 24000

15	**Define utilization factor in the design of the lighting scheme.**BTL 1 Utilization factor is defined as the total lumens utilized on working plane to the total lumens radiated by lamp.
16	**What is depreciation factor?**BTL 2 Depreciation factor is defined as the illumination under normal working condition to illumination when everything is clean. So this occurs when the source is not clean. (eg. Lamps covered with dust, dirt or smoke.
17	**State the different lighting scheme.**BTL 6 Depending upon the requirement of light the lighting schemes can be classified as follows. • Direct lighting • Indirect lighting • Semi direct system of lighting • Semi indirect lighting • General diffusing system.
18	**List the various factors for designing the lighting scheme.** BTL 4 The various factors should be taken into consideration for designing the lighting scheme are • Space height ratio • Utilization factor • Depreciation factor
19	**Define space height ratio.**BTL 1 Space height ratio= the horizontal distance between the lamps/ Mounting height of lamps
20	**Define waste light factor(APR/MAY 2019).**BTL 1 When a surface is illuminated by number of lamps, there is certain amount of wastage due to overlapping of light waves. Its value for rectangular areas= 1.2.Irregular areas= 1.5.
21	**Mention some of the reflectors commonly used in industrial lighting.**BTL 3 • Standard reflectors. • Diffusing fitting. • Concentrating reflectors • Angle reflectors.
22	**Define lumen. (May 201)]/(Dec 2014)** BTL 1 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

23	**List the type of lighting system. (May 2013]/[Dec 2014)** BTL 4 Incandescent, Tungsten-halogen, Compact Fluorescent Lamps, Tubular fluorescent fixtures, High- intensity discharge (HID)
24	**Why tungsten is used as filament material? (Dec 2013)** BTL 6 Pure tungsten has properties including the highest melting point (3695 K), lowest vapour pressure, and greatest tensile strength out of all the metals.
25	**What is the importance of street lighting system? (Dec 2012)** BTL 3 1. To reduce the occurrence of accident. 2. To avoid the theft
	PART * B
1.	**What are the properties of good lighting? Explain in detail about Laws of illumination.(13M)(May 2014,2015)**BTL 1 Answer page : 4.3 & 4.9 – V.THIYAGARAJAN Properties: (4M) • Lighting scheme should be able to produce sufficient light. • It should not produce any glare in the eyes • It should have sufficient shades and reflectors • It should be of correct type as needed Laws of illumination: (9M) • **Laws of inverse squares:** "Illumination at a point is inversely proportional to square of its distance from the point source and directly proportional to the luminous intensity (CP) of the source of light in that direction. • **Lamberts cosine law:** "The illumination at a point on a source is proportional to cosine of the angle which may makes with the normal to the surface at that point.
2.	**Explain with sketch the principle of working of a sodium vapour lamp and enumerate its advantages and disadvantages as source of light?(13M)**BTL 2 Answer page : 4.33 – V.THIYAGARAJAN • Sodium vapour discharge lamp diagram (4M)



- Construction & working (6M)

1. A sodium-vapour lamp is a gas-discharge lamp that uses sodium in an excited state to produce light at a characteristic wavelength near 589 nm.
2. Two varieties of such lamps exist: low pressure and high pressure. Low-pressure sodium lamps are highly efficient electrical light sources, but their yellow light restricts applications to outdoor lighting, such as street lamps.

- Advantages and dis advantages (3M)

Adv:

1. Its efficiency is higher than that of the filament lamp
2. It has a long life.

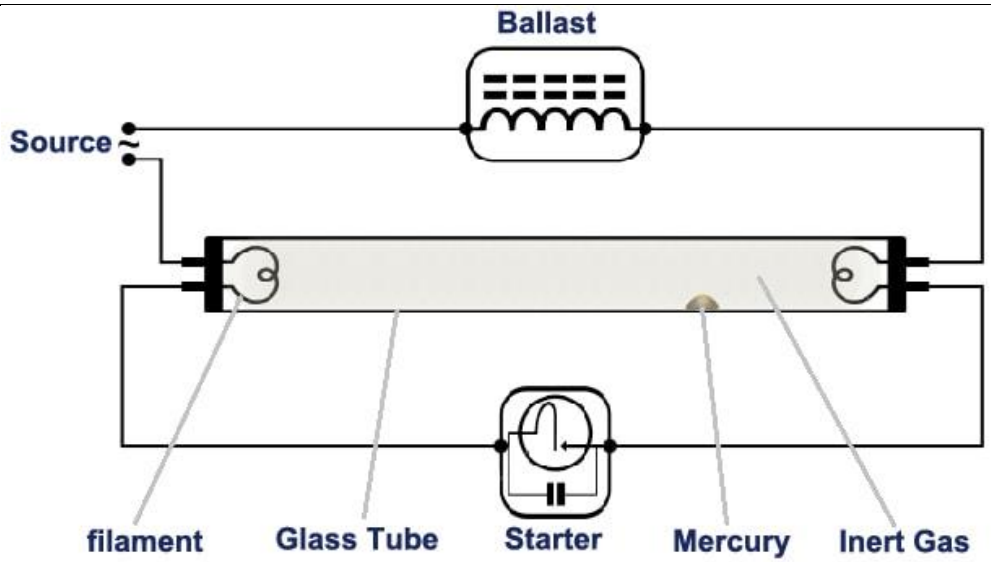
Dis-Adv:

1. The bright yellow colour obtained is not suitable for indoor lighting. So it is not useful in house.
2. For the necessary output, long tubes are required.

3. **Explain the working of fluorescent tube with the help of the circuit diagram giving the function of various parts. How stroboscopic effect is eliminated in fluorescent tube lighting?(13M)**BTL 2

Answer page : 4.43 – V.THIYAGARAJAN

- Fluorescent tube diagram (4M)



- Construction & working (6M)

1. A **fluorescent lamp**, or **fluorescent tube**, is a low-pressure mercury-vaporgas-discharge lamp that uses fluorescence to produce visible light.
2. An electric current in the gas excitesmercury vapor, which produces short-wave ultraviolet light that then causes a phosphor coating on the inside of the lamp to glow.
3. A fluorescent lamp converts electrical energy into useful light much more efficiently than incandescent lamps.
4. The typical luminous efficacy of fluorescent lighting systems is 50–100 lumens per watt, several times the efficacy of incandescent bulbs with comparable light output.

- Advantages and dis advantages (3M)

Adv:

1. No Power factor correction
2. No stroboscopic effect.

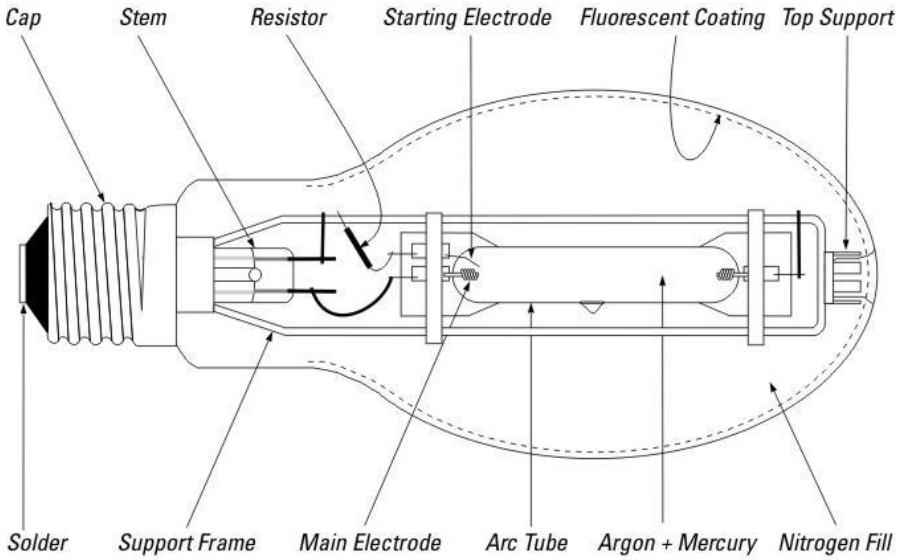
Dis-Adv:

1. Low efficiency
2. More power loss
3. High cost

4. **Describe the construction and working of Mercury – vapour lamp and mention its advantages and disadvantages.(13M)(Dec 2012, May 2014)** BTL 4

Answer page : 4.36 – V.THIYAGARAJAN

- Mercury vapour lamp diagram (4M)



- Construction & working (6M)
  1. A **mercury-vapor lamp** is a gas discharge lamp that uses an electric arc through vaporized mercury to produce light.
  2. The arc discharge is generally confined to a small fused quartzarc tube mounted within a larger borosilicate glass bulb.
  3. The outer bulb may be clear or coated with a phosphor; in either case, the outer bulb provides thermal insulation, protection from the ultraviolet radiation the light produces, and a convenient mounting for the fused quartz arc tube.
- Advantages and dis advantages (3M)

Adv:

1. Its efficiency is high and output is more
2. It has a long life.

Dis-Adv:

1. The initial time required for warming up is more about 5 minutes
2. Each lamp contains mercury which can be harmful to both humans and wildlife.

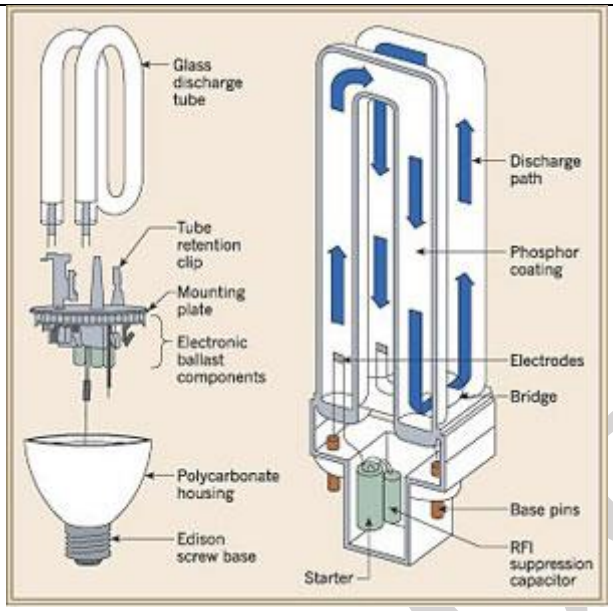
5. **Explain the various factors to betaken into account for designing schemes for 1.Street lighting. 2. Flood lighting. 3. High way lighting.(13M)(Dec 2012 /Dec 2013)/(May 2014)** BTL 2

Answer page : 4.67 – V.THIYAGARAJAN

- Design of outdoor lighting& explanation (8M)

1. Flood lighting:
   a. Aesthetic flood lighting
   b. Industrial and commercial flood lighting
   c. advertising
2. Street lighting
   a. The diffusion principle
   b. The specular reflection principle

	• Flood lighting calculations (5M) Step 1: Illumination level required Step 2: type of projector Step 3: number of projector
6.	**Explain the design procedure of illumination system. Mention the requirements of good lighting.(13M)**BTL 2 Answer page : 4.62 – V.THIYAGARAJAN **Objective:** (4M) • To provide adequate illumination • To provide light distribution all over the area uniformally • To provide light of suitable colour • To avoid glare and hard shadows. **Steps:** (9M) • Calculate area to be illuminated • Decide the level of illumination • Total illumination = area illumination level • Select utilization factor and depreciation factor • Divide total illumination by utilization factor and depreciation factor • Select lamp and luminaries.
7.	**With the neat diagram explain the construction and working of CFL lamp. (13M) (May 2015)** BTL 2 Answer page : 4.47 – V.THIYAGARAJAN • **CFL diagram** (4M)



- **CFL Features**(4M)

1. It is fluorescent lamp designed to replace an incandescent lamp
2. Some types fit into light features formerly used for incandescent lamp.
3. Smaller in size
4. Different shapes-folded, spiral, circular
5. Available in 9 watt to 26 watt
6. It saves 75 % of energy

- **Lamp life and efficiency** (5M)

8. **i) Explain the various steps followed in the calculation of illumination for designing the residential lightning. (13M) (May 2015)** BTL 4

Answer Page: 4.62- J.Gnanavadivel

- Design methodology(13M)
    1. Calculate area to be illuminated
    2. Decide the level of illumination
    3. Total illumination= Area illumination level
    4. Select utilization factor and depreciation factor
    5. Divide total illumination by utilization factor and depreciation factor.

PART * C

1 **A drawing hall 30x15 meters with a ceiling height of 5 meters is to be provided with a general illumination of 120 lux. Taking a coefficient of utilization of 0.5 and depreciation factor 1.4, determine the number of fluorescent tubes required , their spacing mounting height and total wattage. Tasking luminous efficiency of fluorescent tube as 40 lumens/watt for 80 watt tube. (15M) (May 2017)**BTL 4

	Sol: A= 30 * 15 = 450 m^2 E= 120 lumens/m^2 U.F= 0.5 Mf=1/142 Luminous efficiency of fluorescent tube = 40 lumens/watt Gross lumens required = A* E/ UF* MF= 153360 lumens Total wattage required= 3834 W No of fluorescent tubes required = 3834/80= 48.
2	**A lamp rated 250V gives an illumination of 4000 lux and takes 2A from the mains. Find the efficiency of the lamp and MSCP. (8M)(May 2017)** BTL 4 Sol: wattage of the lamp= 250*2 = 500 W MSCP= F/4π= 4000/4π = 318.3 Efficiency of the lamp= 4000/ 500 = 8 lumen per watt

UNIT- III HEATING AND WELDING

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

PART * A

Q.No	Questions
1.	**Why the electric heating is considered to be superior when compared to the other methods of heating? (Nov /Dec 2012)** BTL 3 • Cleanliness, • Ease of control • Uniform heating. • Low attention and maintenance cost.
2.	**What are the classifications of methods of electric heating?**BTL 2 • Power frequency method. ➢ Direct resistance heating ➢ Indirect resistance heating ➢ Direct arc heating. ➢ Indirect arc heating. • High frequency heating. ➢ Induction heating ➢ Dielectric heating
3.	**Write short notes on direct resistance heating.**BTL 2 In this method of heating, current is passed through the body to be heated. The resistance offered by the body to the flow of current produces ohmic losses I^2R which results in heating the body. This method is quite efficient and therefore it is employed in resistance welding, in the electrode boiler for heating water and in the salt furnace.
4.	**Write short notes on indirect resistance heating.**BTL 2 In this method the current is passed through a high resistance wire known as heating element. The heat produced due to I^2R loss in the element is transmitted by radiation or convection to the body to be heated. This method is used in room heater, immersion water heaters, and in various types of resistance ovens and salt bath furnaces.
5.	**What are the requirements of a good heating material? (Dec'14)** BTL 2 • High specific resistance • High melting point • Free from oxidation • Low temperature coefficient of resistance.
6.	**What is the principle of arc furnace?**BTL 2 When voltage across s two electrodes separated by an air gap is increased, a stage is reached when voltage gradients in the air gap is such that air in the gap becomes good conductor of electricity. Arc is said to exist when electric current passes through the air gap.

7. **What are the characteristics of induction heating?**BTL 2

- The current flows on the outer surface of the metal disc and in so doing, heats this surface.
- The current flow is restricted axially to the surface of the metal which is contained within the turn.
- The heat energy is transferred to the metal at an rapid rate, much faster than any conventional method of heating metal.
- The heat energy is generated within the metal without any physical contact between the source of electrical energy and the metal being heated.
- If the current continues to flow in the disc, the surface would attain extremely higher temperatures which can't be obtained by any other method.

8. **Differentiate core type and coreless type induction furnaces.**BTL 4

Core type	Coreless type
The leakage reactance is very high	No leakage reactance
Crucible of any shape can be used	Standard form is used
Operation cost is high	Operation cost is low.

9. **What are the advantages of Ajax Wyatt furnace?**BTL 2

- Good operating conditions for the refractory lining, no part of the furnace being hotter than the metal itself.
- Accurate temperature control, uniform castings, minimum metal losses.

10 **What is the principle of dielectric heating? May 2012** BTL 2

When an insulating material is subjected to an alternating electric field, the atoms get stressed and due to the inter atomic friction heat is produced.

11 **What are the advantages of dielectric heating? Dec 2013**BTL 2

- This method of heating non conducting material can be done in the fast manner.
- Normally material heated by this method is combustible which cannot be heated by the flame.

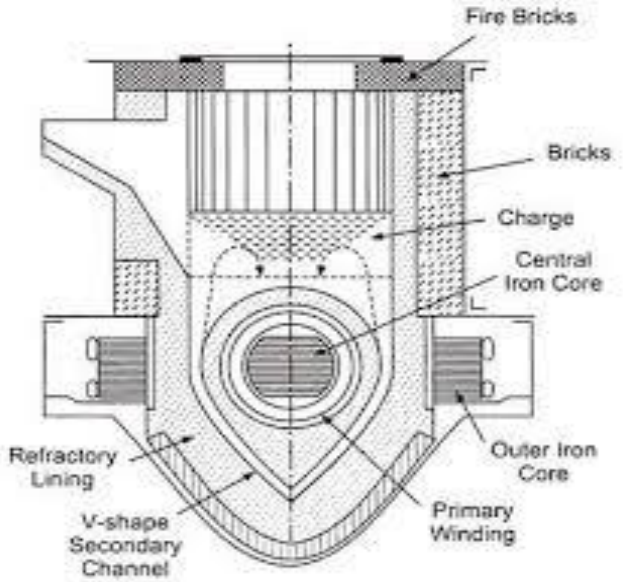
12 **What is meant by welding? (APR/MAY 2019)**BTL 2
Welding is a process where in metals are joined together by fusion.

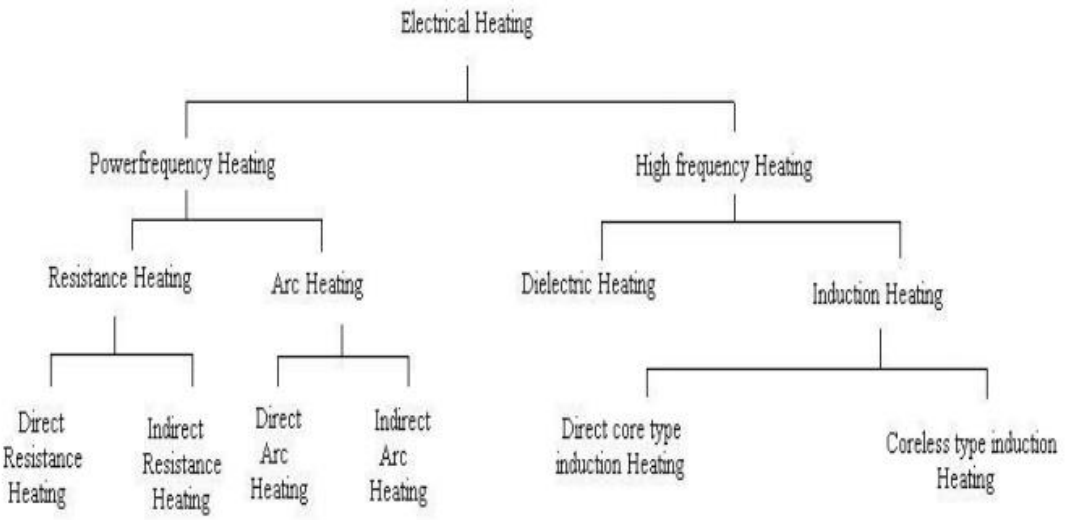
13 **What are the advantages of electric heating? May 2013, May 2014**BTL 2

- Economical
- Cleanliness
- Absence of flue gases
- Ease of control or adaptation

14	**What are the causes of failure of heating elements?**BTL 2 • Formation of hot spots • General oxidation of the element and intermittency of operation • Embrittlement caused by grain growth • Contamination of element or corrosion.
15	**Write short note on infrared heating? Dec, 2015** BTL 3 In radiant heating, the elements are of tungsten operating about 2300 c as at this temperature a greater proportion of infra-red radiation is given off. Heating effect on the charge is greater since the temperature of the heating element is greater than in the case of resistance heating.
16	**What are the different types welding?**BTL 2 1. Gas welding: • Oxy acetylene • Air- acetylene • Oxy-hydrogen 2. Resistance welding • Butt welding • Spot welding • Projection welding • Percussion 3. Solid state welding • Friction • Ultrasonic • Diffusion • Explosive
17	**What are the modern welding techniques? (APR/MAY 2019) June 2009**BTL 2 **Drawbacks of conventional welding methods:** • Excessive melting • Diffusion • Formation of inter metallic compounds • Tower ductility • Difficult to weld some metals Modern welding techniques are • Ultrasonic welding • Laser welding • Electron beam welding

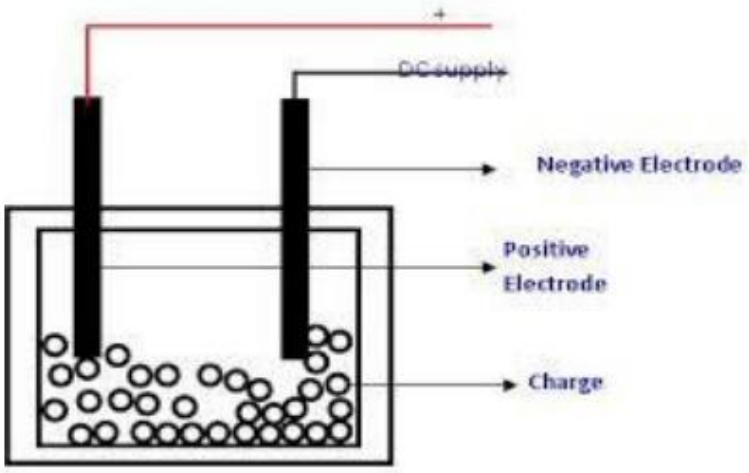
18	**What is LASER welding?** BTL 2 LASER(Light Amplification stimulated emission of radiation) welding is a welding process that uses the heat from a laser beam impinging on the joint. The process is without a shielding gas and pressure.
19	**Compare DC welding & AC welding.**BTL 4 **DC Welding:** • Motor-generator set or rectifier is required in case of availability of ac supply; otherwise oil engine-generator set is required. • Two or three times of transformer • Non coated cheap electrodes can be used. **AC Welding:** • Only a transformer is required. • Operating efficiency is 85% high • Power factor is low
20	**Define resistance welding? (May 2013)** BTL 1 Electric resistance welding (ERW) refers to a group of welding processes such as spot and seam welding that produce coalescence of faying surfaces where heat to form the weld is generated by the electrical resistance of material vs. the time and the force used to hold the materials together during welding.
21	**Give the methods of control temperature in arc furnace? (Dec 2012)**BTL 4 1.Changing the resistance of elements. 2.Changing the applied voltage to the elements (or) current passing through the elements. **3.**Changing the ratio of the on-and-off times of the supply.
22	**List some steps taken to minimize skin effect in induction heating? (Dec 2012)**BTL 4 1.By using copper-clad steel wire 2.By using low frequency 3.By reducing the thickness of the laminate or strips 4.By using hollow conductor
23	**What is meant by electric arc welding? What are the different types of electrodes used and its applicability?[May 2014]/[Dec 2014]**BTL 2 Arc welding is a type of welding that uses a power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. purpose is to join two metals. Fabrication, ship building and riveting.
24	**Mention the factors which limit the choice of frequency in induction and dielectric heating? (May 2015)**BTL 4

	Induction Heating: a) Thickness of the surface to be heated b) Time of continuous heating c) Temperature. **Dielectric Heating:** a) Thickness b) Potential gradient c) breakdown voltage d) insulation
25	**What is meant by arc welding and also list its types? May 2015**BTL 2 Arc welding is a type of welding that uses a power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. Different types of arc welding are Flux-cored arc welding (FCAW), Gas metal arc welding (GMAW)**,**Gas tungsten arc welding (GTAW)**,** Plasma arc welding, Shielded metal arc welding, Submerged arc welding.
	PART * B
1.	**Explain with neat sketch the principle and operation application and control methods of Ajax Wyatt furnace. (13M) (May 2014)**BTL 2 Answer Page: 5.23- V.Thiyagarajan • Ajax wyatt furnaces diagram & Explanation(6M & 7M)  Fig. 3.13 *Ajax-Wyatt Vertical Core type Furnace* • The induction heating works on the transformer principle. It is also known as eddy current heating. The currents are induced by the principle of electromagnetic induction. The induction heating may be low frequency as in the case of core type induction furnace or high frequency as the case with coreless induction furnaces. Types of Induction Heating 1. Direct Induction Heating. 2. Indirect Induction Heating. • Advantages:

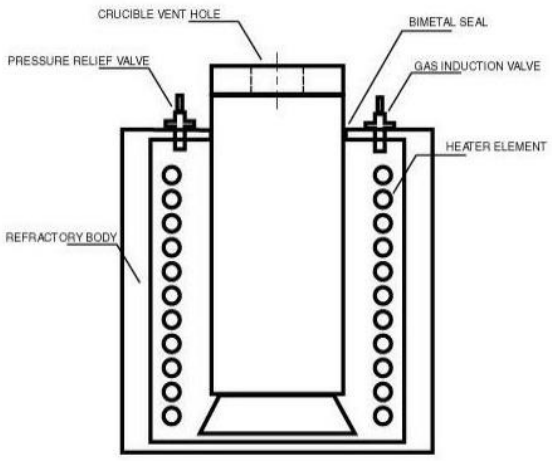
	1. Better power factor 0.8 to 0.93 2. No changes of pinch effect due to heavy weight of the metal over "Vee" portion. 3. It has the shape of a crucible.
2.	**i) Explain the process & various methods of electric arc welding. (May 2013) (8M)** BTL 2 Answer page: 5.53 - V.Thiyagarajan • Carbon arc welding • Metal arc welding • Atomic hydrogen arc welding • Inert gas metal arc welding • Submerged arc welding **ii) Compare AC & DC Welding.(5M)**BTL 4 Answer page: 5.70 - V.Thiyagarajan • Welding is the joining of two or more metal parts by melting them together. • This process is unlike soldering, which is simply attaching two metal surfaces together via a piece of molten metal. • Because the melting points of most metals are so high, specialized welding equipment uses the heat from an electric current to weld metal together.
3.	**What are the different methods of heating? Describe briefly the methods of direct and indirect resistance heating?(13M)**BTL 2 Answer page: 5.10 - V.Thiyagarajan • Classification (3M)  • **Direct Resistance Heating(**5M) • In this method of heating the material or change to be heated is taken as a resistance and current is passed through it. • The charge may be in the form of powder pieces or liquid. The two electrodes are

immersed in the charge and connected to the supply.

- In case of D.C or single phase A.C two electrodes are required but there will be three electrodes in case of three phase supply.
- When metal pieces are to be heated a powder of high resistivity material is sprinkled over the surface of the charge to avoid direct short circuit.

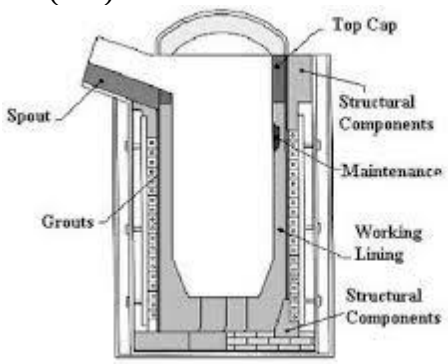


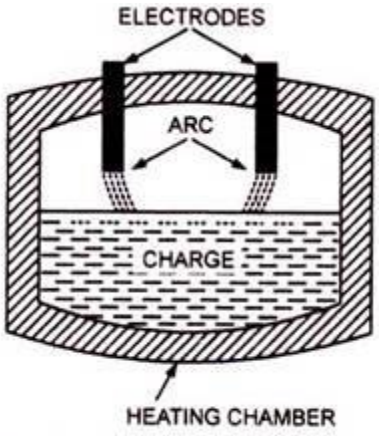
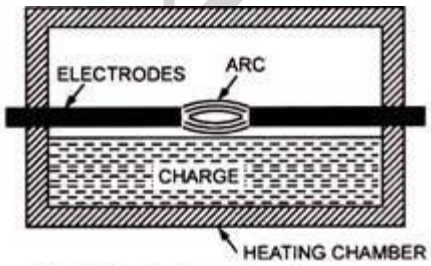
- **Indirect Resistance Heating:** (5M)
- In this method the current is passed through a highly resistance element which is either placed above or below the over depending upon the nature of the job to be performed.



- The heat proportional to I2R losses produced in heating element delivered to the charge either by radiation or by convection.
- Sometimes in case of industrial heating the resistance is placed in a cylinder which is surrounded by the charge placed in the jackes. The arrangement provides as uniform

	temperature.
4.	**(i) Explain the method of controlling temperature in resistance heating? (7M)(Dec 2013)** BTL 3 Answer Page : 5.17- J.Gnanavadivel • Voltage/ current • Using auto – transformer or induction regulator • By series impedance • By variable voltage supply • Time • Resistance **(ii) What are the requirements of good welding? (6M)(Dec 2013)**BTL 2 • **Penetration**: how far the weld penetrates into the joint, often expressed a percentage. This is a combination of how the joint is prepared and set up, the process used and the current/voltage applied. It is possible to have both too little (weak joint) and too much (poor finish in the back side of the joint) penetration. • **Defects** : including porosity caused by contamination of the weld due to inadequate preparation/cleaning or inadequate shielding, craters caused by reducing current too rapidly at the end of a run, cold starts (poor penetration at the start of a run) • **Undercutting**: thinning of the parent metal at the edges of the weld usually caused by not enough filler metal relative to current.
5.	**Mention the properties of heating element. Explain the design procedure of heating element. (13M)** BTL 4 Answer page: 5.18 – V.Thiyagarajan • Properties of heating element:(6M) 1. High resistivity 2. High melting point 3. Free from oxidation 4. Low temperature coefficient 5. Ductile • Design procedure of heating element: (7m) 1. To determine the length and size of the heating element. 2. Stefan's law (H): In high temperature furnace, whatever heat is produced in the resistance of the element has to be radiated to the charge according to Stefan's law. 3. Causes of failure of heating elements: a) Formation of hot spots b) General oxidation of the element and intermittency of operation c) Embrittlement cause by grain growth.
6.	**i) Describe the construction and operation of the coreless induction furnaces.(8M) (Apr 2017)**

	BTL 4 Answer Page: 5.26 – V.Thiyagarajan • Coreless induction furnace (4M)  • Working (4M) 1. The principle of induction melting is that a high voltage electrical source from a primary coil induces a low voltage, high current in the metal, or secondary coil. Induction heating is simply a method of transferring heat energy. 2. Induction furnaces are ideal for melting and alloying a wide variety of metals with minimum melt losses, however, little refining of the metal is possible. There are two main types of induction furnace: coreless and channel. **ii) Explain the process of dielectric heating and derive the expression for total heat energy. (5M) (Apr 2017)**BTL 3 Answer Page: 5.28 – V.Thiyagarajan • Dielectric heating, also known as electronic heating, RF (radio frequency) heating, and high-frequency heating, is the process in which a radio frequency alternating electric field, or radio wave or microwaveelectromagnetic radiation heats a dielectric material. At higher frequencies, this heating is caused by molecular dipole rotation within the dielectric. • RF dielectric heating at intermediatefrequencies, due to its greater penetration over microwave heating, shows greater promise than microwave systems as a method of very rapidly heating and uniformly preparing certainfood items, and also killing parasites and pests in certain harvested crops.
7.	**Explain with neat sketch the principle and operation application and control methods of direct and indirect arc furnaces. (13M)**BTL 3 Answer Page: 5.30 – V.Thiyagarajan • **Introduction (3M)** • When a high voltage is applied across an air gap, the air in the gap gets ionised under the influence of electrostatic forces and becomes conducting medium. • Current flows in the form of a continuous spark, called the arc. It is to be noted that a very high voltage is required to establish an arc across an air gap but to maintain an arc small

	voltage may be sufficient. • **Types (2M)** • **Direct arc furnace** • **Indirect arc furnace** • **Direct Arc Furnace (4M):**  **Fig. 5.4. *Direct Arc Furnace*** • In a direct arc furnace charge acts as one of the electrodes and the charge is heated by producing arc between the electrodes and the charge. • Since in a direct arc furnace, the arc is in direct contact with the charge and heat is also produced by flow of current through the charge itself, the charge can be, therefore, heated to highest temperature. • **Indirect arc furnace(4M)**  **Fig. 5.5. *Indirect Arc Furnace***
8.	**Discuss in detail about any two types of resistance welding. (13M) (Dec 2014)** BTL 3 Answer page: 5.37 – V.Thiyagarajan • Resistance welding (5M) • Electric resistance welding (ERW) refers to a group of welding processes such as spot and seam welding that produce coalescence of faying surfaces where heat to form the weld is generated by the electrical resistance of material combined with the time and the force used to hold the materials together during welding. • Some factors influencing heat or welding temperatures are the proportions of the workpieces, the metal coating or the lack of coating, the electrode materials, electrode geometry, electrode pressing force, electrical current and length of welding time. • Small pools of molten metal are formed at the point of most electrical resistance (the

	connecting or "faying" surfaces) as an electrical current (100–100,000 A) is passed through the metal. • Types & explanation (8M) 1. Spot welding 2. Seam welding 3. Projection welding 4. Butt welding 5. Upset butt welding 6. Flash-butt welding 7. Percussion welding
9.	**i) Explain the principle of arc welding and the difference between carbon and metal arc welding and their relative merits and demerits.(8M)(May 2015)**BTL 2 Answer Page: 5.51 – V.Thiyagarajan • Principle of arc welding: (3M) 1. Arc welding is a welding process that is used to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals when cool result in a binding of the metals. 2. It is a type of welding that uses a welding power supply to create an electric arc between a metal stick ("electrode") and the base material to melt the metals at the point-of-contact. Arc welders can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. • Types of Arc welding(5M) 1. Carbon arc welding 2. Metal arc welding 3. Atomic hydrogen arc welding 4. Inert gas metal arc welding 5. Submerged arc welding **(ii) Explain the characteristicsprinciple and working of welding transformer. (5M) (May 2015)** BTL 2 Answer page: 5.73- V.Thiyagarajan • Welding Transformers are used in AC machines to change alternating current from the power line into a low-voltage, high amperage current in the secondary winding. A combination of primary and/or secondary taps on the welding transformer are commonly used to provide a macro adjustment of the welding current, as well as adjustment of secondary voltage. • Transformer ratings for AC machines are expressed in KVA (kilovolt-amperes) for a specified duty cycle. This duty cycle rating is a thermal rating, and indicates the amount of energy that the transformer can deliver for a stated percentage of a specific time period, usually one minute, without exceeding its temperature rating. • The RMS Short Circuit Secondary Current specification indicates the maximum current that can be obtained from the transformer. Since heating is a function of the welding current, this parameter gives an indication of the thickness of the materials that can be welded.
	PART * C

1	**Calculate the energy required to melt one metric ton of brass in a single phase induction furnace. If the time taken is 1.5 hr, find the power input to the furnace. Specific heat of brass=0.094, latent heat of fusion of brass= 38 kcal/kg, melting point of brass=920 c, furnace efficiency= 80%, Temperature of charge= 20 c. (15M) (May '17)**BTL 4 **Sol:** Heat required to melt 1000kg of brass= 38* 1000= 38,000 kcal Heat required to raise the temperature to 920 C= 84600 kcal Total heat required = 122600 kcal Input heat required for the furnaces= 153200 kcal Power rating of furnace = 118.76 KW-hr.
2	**Estimate the efficiency of a high efficiency induction furnace which takes 15 minutes to melt 2kg of aluminum. The input to the furnace being 5KW and initial temperature 15C.** **(15M) (Apr'16)** BTL 4 **Sol:** Specific heat of aluminum = 880 j/kg/c Melting point of aluminum = 660 c Latent heat of fusion of aluminium= 32 kJ/Kg; 1J= 2.78 x 10^{-7} kWh Quantity of aluminium to be met , m= 2kg Initial temp, t1= 15c Melting temp, t2= 660 c Heat required to melt 2 kg of aluminium =1199200J Energu input= 1.25 kwh Efficiency = output/input * 100=26.64 %

UNIT- IV SOLAR RADIATION & SOLAR COLLECTORS

Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat– flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors - performance analysis of a cylindrical - parabolic concentrating collector – Feeding Invertors.

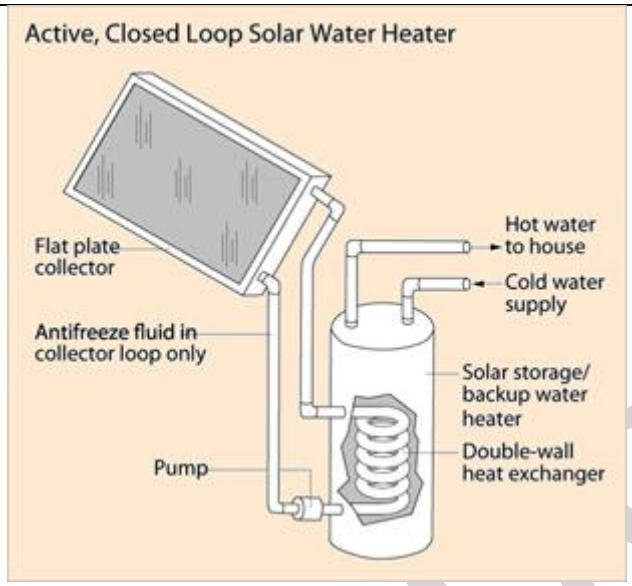
PART * A

Q.No	Questions
1.	**Define solar constant**.BTL 1 The rate at which solar energy arrives at the top of the atmosphere is called solar constant Isc. It is defined as the amount of energy received in unit time for unit area perpendicular to the suns direction of the mean distance of the earth from the sun.
2.	**What is the use of pyranometer?**BTL 2 A Pyranometer is designed to measure global radiation, usually on a horizontal surface, but can also be used on an inclined surface. When shaded from beam radiation by using a shading ring, a pyanometer measures diffused radiation.
3.	**What is the function of pyrheliometer?**BTL 2 An instrument that measures beam radiation by using a long narrow tube to collect only beam radiation from the sun at normal incidence.
4.	**Define Heat Removal factor(F_R). May 2009** BTL 1 Heat Removal factor(F_R) is defined as the ratio of actual useful energy collected to the useful energy collected if the entire collector absorber surface were at the temperature of the fluid entering the collector.Heat Removal factor(F_R) = Actual useful energy collected/ Useful energy collected if the entire collector absorber surface were at the temperature of the fluid entering the collector.
5.	**What is diffusion radiation?**BTL 2 The radiation received on a terrestrial surface scattered by aerosals and dust from all parts of the sky dome is known as diffuse radiation.
6.	**Define solar insolation.** BTL 1 The sum of beam and diffusion radiation is referred to as total radiation. Total radiation

	when measured at a location on the earth's surface it is called solar insulation at the place. .
7.	**Define Albedo of earth.** BTL 1 The earth reflects back nearly 30% pf the total solar radiant energy to the space by reflection from clouds, by scattering and by reflection at the earth's surface. This is called the albedo of the earth's atmosphere.
8.	**List different solar technologies.**BTL 4 • Solar thermal technology • Photovoltaics technology(pv) • Photosynthetic and chemical processes.
9.	**Define performance rating of solar thermal systems.** BTL 1 The solar thermal systems performance rating is an analytically derived set numbers representing the characteristics all-day energy output of the solar thermal systems under standard rating conditions, measured in Btu per square foot per day.(Btu/ft2/day).
10	**Define solar collector efficiency.**BTL 1 Collector efficiency is defined as the ration of the energy actually absorbed and transferred to the heat- transport fluid by the collector (useful energy) to the energy incident on the collector.
11	**What are the advantages of an Air collector over a liquid solar collector?**BTL 2 • It is compact in construction and requires little maintenance. • The need to transfer thermal energy from the working fluid to another fluid is eliminated as air is used directly as the working fluid. • Corrosion is completely eliminated.
12	**What are the advantages of PV technology?**BTL 2 • Reliability • Durability • Low maintenance cost • No fuel cost • Safety
13	**What is photovoltaic effect? (June 2008)** BTL 2 The phenomenon in which the incidence of light or other electromagnetic radiation upon the function of two dissimilar materials, as a metal and a semiconductor induces the generation of an electro motive force.
14	**Define solar cell efficiency?**BTL 1 The efficiency of a solar cell is the ration of the electrical power it delivers to the load, to the optical power incident on the cell.

15	**What is grid connected PV system?**BTL 2 In a grid connected system, the grid acts as a backup and there is no need for battery storage unless there is a power outage problem. This makes grid connected PV systems relatively small.
16	**What are the applications of solar thermal technologies?**BTL 2 • Solar water heater • Solar industrial heating system • Solar refrigeration systems • Solar air- conditioning systems • Solar cookers • Solar furnaces
17	**What are the different losses occurs during performance calculation of collector efficiency?** BTL 2 • Conductive losses • Convective losses • Radiation losses
18	**What is shadow factor?**BTL 2 Shadow factor= surface of the collector receiving light/ total surface of the collector.
19	**What is cosine loss factor?**BTL 2 For maximum power collection, the surface of collector should receive the sunrays perpendicularly. If the angle between the perpendicular to the collector surface and the direction of sunray is θ, the area of solar beam intercepted by the collector surface is proportional to cos θ.
20	**What is helicostats? (May 2010)** BTL 1 'Helicostats' are large, flat reflecting mirrors with a provision to track the sun in two planes. The solar rays are reflected by each individual heliostat on the central receiver mounted on a fall tower.
21	**State Wien's Law.**BTL 1 Wien's Law states that, the emission increases with temperature. The re-emitted light is so progressively shorter wavelength and greater energy as the temperature of blackbody increases. This is expressed by Wien's Law, which can be written as, $\lambda_{max} T$ = Constant = 2989μm Kelvin where, λ—wavelength T—Temperature of the black surface in K.
22	**State Planck's Law.Apr/May 2008**BTL 1

	Planck's Law states that the spectral emissive power of a black surface is given by $$e_{b\lambda} = \frac{2\pi C_1}{\lambda^5\left[\exp\left(C_2/\lambda T\right)-1\right]}$$ Where, C_1 and C_2 are constants whose values are $0.596\text{x}10^{-16}$ M-m^2 and 0.014387m-K respectively, λ—wavelength and T—Temperature of the black surface in K.
23	**State Stefan- Boltzmann Law.**BTL 1 The Stefan- Boltzmann Law is obtained by integrating Planck's law overall the wavelengths from 0 to ∞ and states that the emissive power of a black surface is given by $e_b = \sigma T^4$ Where, T—Temperature of the black surface in K σ -- constant called the Stefan- Boltzmann constant = $5.670\text{x}10^{-18}$W/m^2-K^4.
24	**Define Fin Eficiency.**BTL 1 Fin Eficiency is used to indicate the effectiveness of a fin in transferring a given quantity of heat. Fin efficiency is defined as, Fin Eficiency = $\frac{Actual\ heat\ transfered}{Heat\ which\ would\ be\ transfered\ if\ entire\ fin\ area\ were\ at\ base\ temperature.}$
25	**State Snell's law. (Dec 2011)** BTL 1 The incident and refracted beams are related to each other by Snell's law which states that, $$\frac{Sin\theta_1}{Sin\theta_2} = \frac{n_2}{n_1}$$ Where, θ_1= angle of incidence θ_2 = angle of refraction n_1, n_2 = refractive indices of the two medium.
	PART * B
1.	**With the help of neat diagram explain solar applications in detail.(13M)** BTL 2 **1. Solar water heaters 2. Solar Distillation 3. Solar Pumping Systems 4. Solar Cooker** **5. Solar greenhouse.** Answer page : 6.75 – V.Thiyagarajan • Solar water heater(4M)

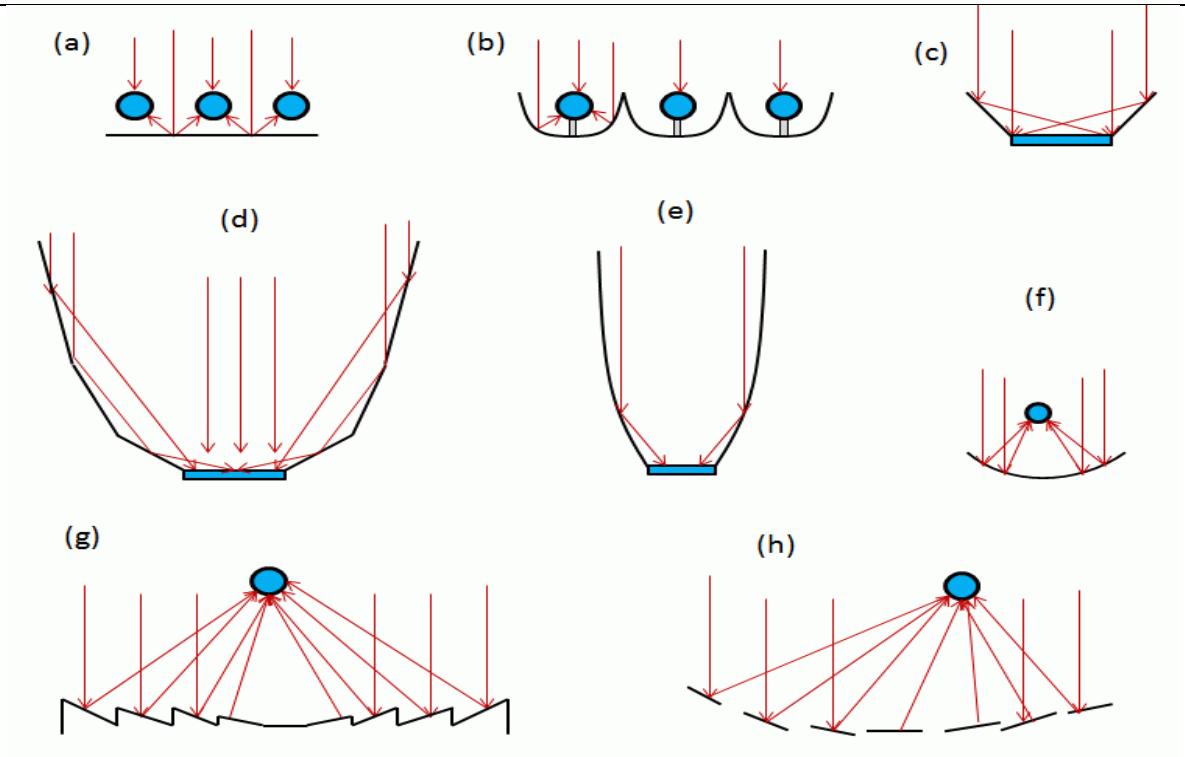


- Solar distillation (4M)
  Solar distillation is the use of solar energy to evaporate water and collect its condensate within the same closed system. Unlike other forms of water purification it can turn salt or brackish water into fresh drinking water (i.e. desalination). The structure that houses the process is known as a solar still and although the size, dimensions, materials, and configuration are varied, all rely on the simple procedure wherein an influent solution enters the system and the more volatile solvents leave in the effluent leaving behind the salty solute behind.
- **Solar pumping system**: (5M)Asolar-powered pump is a pump running on electricity generated by photovoltaic panels or the radiated thermal energy available from collected sunlight as opposed to grid electricity or diesel run water pumps. The operation of solar powered pumps is more economical mainly due to the lower operation and maintenance costs and has less environmental impact than pumps powered by an internal combustion engine (ICE). Solar pumps are useful where grid electricity is unavailable and alternative sources (in particular wind) do not provide sufficient energy.

2. **Explain briefly about concentrating type of solar collectors. 13M (BTL 2)**

Answer page : 6.62 – V.Thiyagarajan

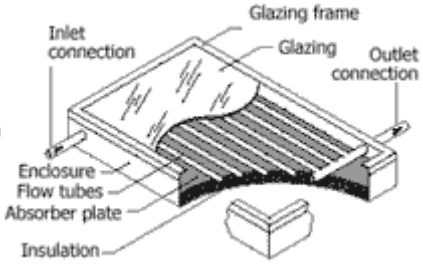
- Types & explanation (13M)
  1. Modified flat plate collector
  2. Parabolic collector
  3. Cylindrical parabolic collector
  4. Fixed mirror solar concentrator



3. **What are the main components of a flat plate solar collector, explain the functions of each. (13 M)(Apr/May 2015).** BTL 2

Answer page : 6.48 – V.Thiyagarajan

- Diagram (6M)



- **Working (4M)**
- A typical flat-plate collector is a metal box with a glass or plastic cover (called glazing) on top and a dark-colored absorber plate on the bottom. The sides and bottom of the collector are usually insulated to minimize heat loss.
- Sunlight passes through the glazing and strikes the absorber plate, which heats up, changing solar energy into heat energy. The heat is transferred to liquid passing through pipes attached to the absorber plate. Absorber plates are commonly painted with "selective coatings," which absorb and retain heat better than ordinary black paint. Absorber plates are usually made of metal—typically copper or aluminum—because the metal is a good heat conductor. Copper is more expensive, but is a better conductor and less prone to corrosion than aluminum. In locations with average available solar energy, flat plate collectors are sized approximately one-half- to one-square foot per gallon of one-day's hot

	water use. • **Applications (3M)** 1. The main use of this technology is in residential buildings where the demand for hot water has a large impact on energy bills. This generally means a situation with a large family, or a situation in which the hot water demand is excessive due to frequent laundry washing. 2. Commercial applications include laundromats, car washes, military laundry facilities and eating establishments. The technology can also be used for space heating if the building is located off-grid or if utility power is subject to frequent outages. Solar water heating systems are most likely to be cost effective for facilities with water heating systems that are expensive to operate, or with operations such as laundries or kitchens that require large quantities of hot water.
4.	**How solar energy be converted into electrical energy? Describe the elements of such a plant in detail.(13M)**BTL 4 Answer page : 6.44- V.Thiyagarajan • **Principle of conversion (Radiant- to – heat) (4M):** 1. The principle of conversion of solar radiation to heat energy is very simple. Whenever an object is exposed to sunlight, it reflects some radiation, it transmits some radiation and it absorbs some radiation. 2. The solar energy that object absorbs gets converted into heat energy. • Absorption, Emission & Transmission(6M) 1. If radiation incidence on material a certain part of the radiation is absorbed. A body's capacity to absorb radiation is called absorption. 2. The emission represents the power radiated by a body. The relationship between absorption α and emission Ɛ is defined by "kirchhoffs law". 3. In addition with absorption and emission, also reflection and transmission play a role. The reflection coefficient ρ describes the ratio of the reflected transmitted through a given material to the entire radiation incident. 4. The sum of absorption, reflection & transmission id one $\alpha + \rho + \tau = 1$ • **Elements of solar power plant** : (3M) 1. Solar panels 2. Solar array mounting racks 3. Inverter 4. Battery pack 5. Backup generator 6. Charge controller
5.	**i) Define solar radiation. Explain the types of radiation in detail.(8M)**BTL 2 Answer page : 6.4- V.Thiyagarajan • The Energy produced and radiated by the sun is called solar energy. Energy is radiated by the sun as electromagnetic waves of which 99% have wavelength in the range of 0.2 to 4.0

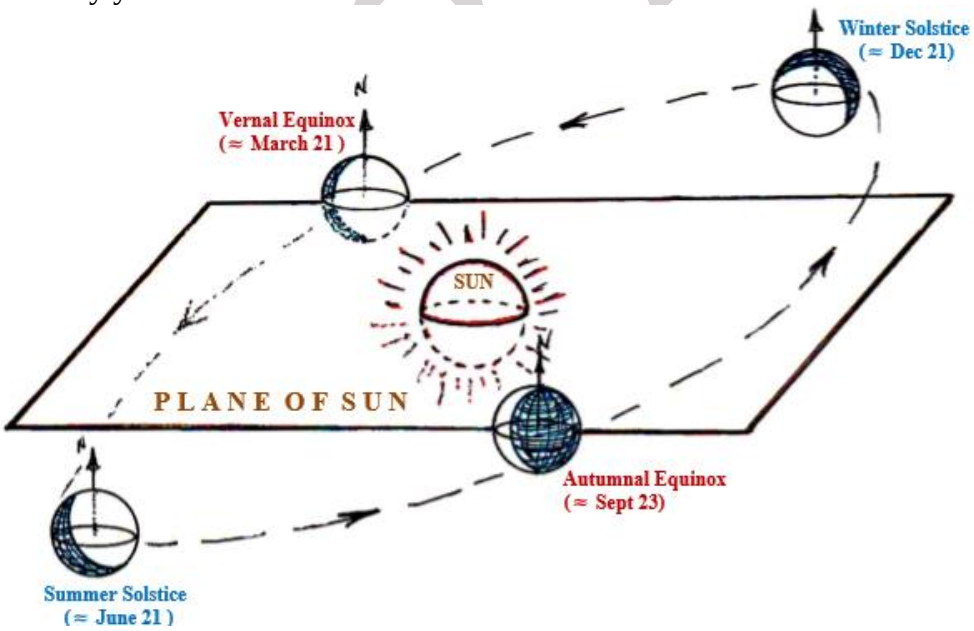
micrometers.

- The energy from the sun reaching the top of earth's atmosphere consists of about 8 % ultraviolet radiation (short wavelength, less than 0.39 micrometer), 46 % visible light (0.39 to 0.78 micrometer) & 46 % infrared radiation.
- Types:
  1. Direct radiation
  2. Indirect
  3. Reflected
  4. Global radiation

ii) Write short notes on solar radiation geometry.(7M) (Apr 2017)BTL 2

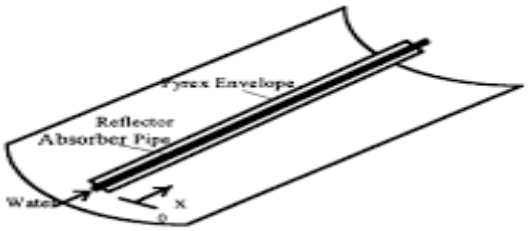
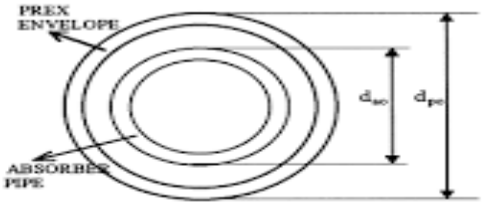
Answer page : 6.16- V.Thiyagarajan

- The Earth's daily rotation about the axis through its two celestial poles (North and South) is perpendicular to the equator, but it is not perpendicular to the plane of the Earth's orbit. In fact, the measure of tilt or obliquity of the Earth's axis to a line perpendicular to the plane of its orbit is currently about 23.5°.
- We call the plane parallel to the Earth's celestial equator and through the center of the sun the plane of the Sun.
- The Earth passes alternately above and below this plane making one complete elliptic cycle every year.



6. **Explain the performance analysis of cylindrical parabolic concentrating collector on detail. (13M) (Apr/May 2014)** BTL 3

- Circuit diagram & explanation (7M & 6M):
- Consider the performance analysis of a cylindrical parabolic concentrating collector whose concentrator has an aperature 'W', length 'L' and rim angle 'ϕr', The absorber tube has an inner diameter 'Di' and an outer diameter 'D0' and it has concentric glass cover of inner

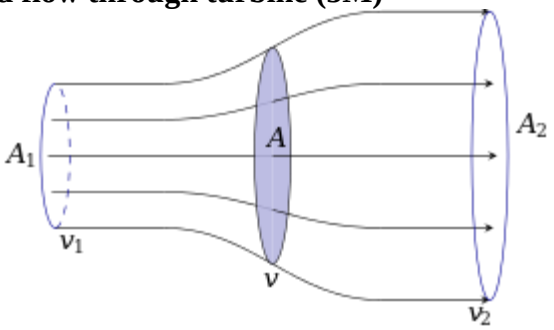
	diameter 'Dci' and outer diameter 'Dco' around it. The fluid being heated in the collector has mass flow rate 'm', a specific heat 'Cp', an inlet temperature 'Tfi' and an outlet temperature 'Tfo'. • The analysis which follows is in many similar to the analysis of a liquid flat plate collectors. An energy balance on an elementary slice '*dx*' of the absorber tube, at a distance '*x*' from the inlet, yields the following equation for a steady state:  
7	**Define the terms (i) Altitude angle. (ii) Incident angle, (ii) Zenith angle, (iv) Solar azimuth angle, (v) Declination angle and (vi) Hour angle.(13M)**BTL 1 Answer page : 6.92- V.Thiyagarajan • **Solar zenith angle(2M**): The solar zenith angle is the angle between the zenith and the centre of the Sun's disc. The solar elevation angle is the altitude of the Sun, the angle between the horizon and the center of the Sun's disc. Since these two angles are complementary, the cosine of either one of them equals the sine of the other. • **Altitude angle(2M):** The Earth is tilted at an angle of 23.5 degrees with respect to the plane of the solar system. Hence, the sun is not always directly overhead at the equator. When the sun is directly overhead, the solar altitude is 90 degrees. This occurs at the equator during the vernal and autumnal equinoxes. • **Incident angle (2M**):As the angle between the sun and the absorbing surface changes, the intensity of light on the surface is reduced. When the surface is parallel to the sun's rays (making the angle from perpendicular to the surface 90°) the intensity of light falls to zero because the light does not strike the surface. • **Solar azimuth angle (2M):** Azimuth is the angle along the horizon, with zero degrees corresponding to North, and increasing in a clockwise fashion. Thus, 90 degrees is east, 180 degrees is south, and 270 degrees is west. Using these two angles, one can describe the apparent position of an object (such as the Sun at a given time). • **Declination angle(3M) :**The declination angle, denoted by δ, varies seasonally due to the tilt of the Earth on its axis of rotation and the rotation of the Earth around the sun. If the Earth were not tilted on its axis of rotation, the declination would always be 0°. However,

	the Earth is tilted by 23.45° and the declination angle varies plus or minus this amount. Only at the spring and fall equinoxes is the declination angle equal to 0°. • **Hour angle (2M):**The angle may be measured in degrees or in time, with 24^h = 360° exactly. In astronomy, hour angle is defined as the angular distance on the celestial sphere measured westward along the celestial equator from the meridian to the hour circle passing through a point.
8	**Calculate the solar time corresponding to 12:00 (IST or Indian standard time) at Pondicherry (π.92^o N, 79.92^o E) on 17 July. The standard meridian for IST is 82.5 E ^{o}. (13M)** BTL 4 Sol: For Indian standard time longtitude, Iu= 82.5^o B= 360(198-8$_I$)/ 364 = 115.7^o. ET= 9.87 sin (2 X 115.7) – 7.53 cos (115.7)- 1.5 sin(115.7) = -5.8 min 4(I_m-I_{local})= 4 (-82.5-(-79.92)) = -10.32 min Solar time = LST + ET+4(Im-I local) = 12:00 – 16.12 min = 11:44 h.

UNIT- V WIND ENERGY	
Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.	
PART * A	
Q.No	**Questions**
1.	**What is wind energy?**BTL 2 The kinetic energy of the wind due to its speed is captured by the turbine and its converted to mechanical energy. Along with the turbine, there is a generator present at the tower which is coupled to the wind turbine by a shaft and often with a gear box. The generator converts mechanical energy of turbine to electrical energy and its feeds of load point.
2.	**Mention the factors affecting the speed of wind?**BTL 2 The movement and speed of wind are affected by three main factors: • Pressure gradient

	• Rotation of the earth • Friction of the earth
3.	**List the types of winds?**BTL 2 • Global winds or planetary winds • Local winds • Trade winds • Westerlies • Polar winds • Periodic winds
4.	**How wind is measured?**BTL 4 The two most important things about the wind are its speed and direction in which it is belong. Wind speed is measured by the Beaufort scale wind socks or by special scientific instruments called anemometers. The unit of measurement is kilometers per hour(km/hr) or knots.
6.	**What is Nacelle?**BTL 2 The nacelle sits at top the tower and contains the gearbox, low and high speed shafts, generator, controller and brake.
7.	**What are the types of wind turbines?**BTL 2 Wind turbines are usually classified into two categories, according to the orientation of the axis of rotation with respect to the direction of wind. • Vertical axis wind tunes • Horizontal axis wind turbines
8.	**Mention the advantages of horizontal axis wind turbines?**BTL 2 • Higher efficiency • Ability to turn the blades • Lower cost to power ratio.
9.	**What is yaw control? Apr 2013** BTL 2 Adjusting the nacelle about the vertical axis to bring the rotar facing the wind is known as yaw control. The yaw control system continuously orients the rotor in the direction of wind.
10	**List the application of wind energy systems.**BTL 4 • Water pumping • Domestic use at remote communities • Farn and ranch • Wind mill for grinding, etc.
11	**Define machine capacity factor.**BTL 1 Machine capacity factor is defined as the ratio of average power output of a turbine during a month or a year to the rated power output.
12	**Define capacity utilization factor.**BTL 1

	CUF= Annual energy generated/ theoretical energy generated
13	**List the application of wind energy.**BTL 4 • Water pumping wind mills • Water heaters • Wind assisted gas- turbine generating mills • Heating in industrial processes.
14	**Mention the sites suitable to install wind mills.**BTL 2 • Plane sites • Hill top sites • Sea shore sites • Off- shore shallow water sites
15	**What is the function of flywheel?** BTL 2 A flywheel used in machine serves as a reservoir which stores energy during the period when the supply of energy is more than the requirement and releases it during the period when the requirement of energy is more than the supply.
16	**Define performance coefficient related to wind turbine?**BTL 1 The coefficient of performance (Kp) is a functions of tip speed ratio which is normally used to classify rotor. Kp= Power delivered by the rotor/ Maximum power available in the wind Kp does not exceed 0.593 for horizontal axis wind machine.
17	**Write down the formula for tip speed ratio?**BTL 3 Tip speed ratio = 0.052* rotor diameter* Rotation speed * wind speed
18	**What is tip speed ratio?**BTL 2 It is defined as the ratio of the speed of the blade tip of a windmill rotor to the speed of the free wind. This is a measure to know the growing ratio of the rotor.
19	**State the characteristics of lift and drag?**BTL 1 • Drag is in the direction of airflow • Lift is perpendicular to the direction of airflow • Generation of lift always causes a certain amount of drag to be developed with good aerofoil. • The lift produced can be 30 times greater than the drag.
20	**Define Solidity.**BTL 1 Solidity is defined as the percentage of the circumference of the rotor which contains

	material instead of air.
21	**What are the conversion losses available in wind energy conversion system?**BTL 2 A 100% efficient aerogenerator would be able to convert upto a maximum 60% of the available energy in wind into mechanical energy. Well- designed blades will typically extract 70% of the theoretical maximum, but losses incurred in the gearbox, transmission system and generator or pump could decrease overall wind turbine efficiency to 35% or less.
22	**Give the expression for available wind power.**BTL 3 Available wind power $P = \frac{1}{8}\rho\pi D^2 V^3 \ (watts)$ Where, ρ—Density of Air (ρ= 1.225kg/m^3 at sea level) D – Circular Diameter in horizontal axis aeroturbines. V—Velocity of Air
23	**Write down the condition for maximum power generation in wind energy conversion system.**BTL 2 The condition for maximum power generation in wind energy conversion system is given by $\frac{dP}{dV_e} = 0, \quad where \ P = \frac{1}{4g_c}\rho A(V_i + V_e)(V_i^2 - V_e^2)$ $3V_e^2 + 2V_iV_e - V_i = 0$, Solving the above quadratic equation we get $V_e = V_i$ and $V_e = \frac{1}{3}V_i$, only the second solution is physically acceptable. Thus, $V_{e\ opt} = \frac{1}{3}V_i$
24	**Define Magnus Effect.**BTL 1 Magnus Effect caused by spinning a cylinder in an air stream at the high speed of rotation. The spinning slow down the air speed on the side where the cylinder is moving into wind and increases it on the other side, the result is similar to an airfoil. This principal has been put to practical use in one or two cases but it is not generally employed.
	PART * B
1.	**Derive the expression for power developed due to wind.(13M)**BTL 3 Answer Page: 7.36 – V.Thiyagarajan • **Representation of wind flow through turbine (5M)**  • Wind turbines extract energy from wind stream by converting the kinetic energy of the

wind to rotational motion required to operate an electric generator.

- **Application of conservation of mass (continuity equation(8M):**

Applying conservation of mass to this control volume, the mass flow rate (the mass of fluid flowing per unit time) is given by:

$$\dot{m} = \rho A_1 v_1 = \rho S v = \rho A_2 v_2$$

- Where v_1 is the speed in the front of the rotor and v_2 is the speed downstream of the rotor, and v is the speed at the fluid power device. ρ is the fluid density, and the area of the turbine is given by S and A_1 are the area of the fluid before and after reaching the turbine.
- So the density times the area and speed should be equal in each of the three regions, before, while going through the turbine and afterwards.
- The force exerted on the wind by the rotor is the mass of air multiplied by its acceleration. In terms of the density, surface area and velocities, this can be written:

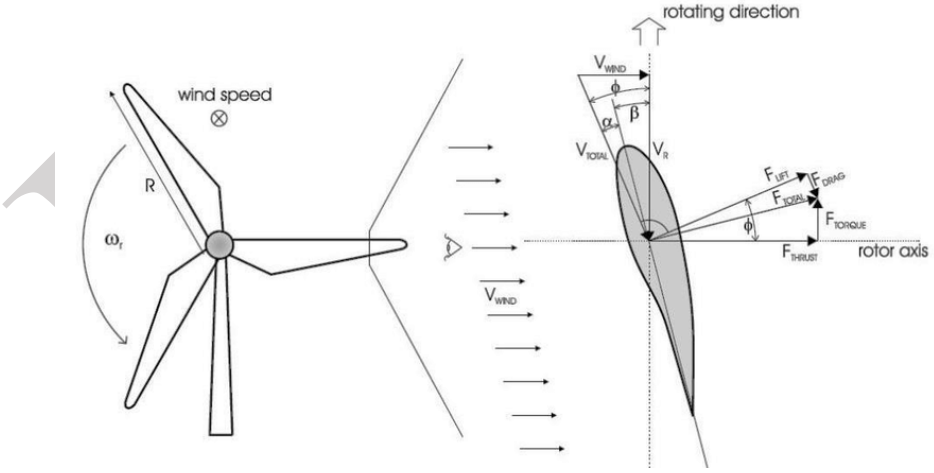
$$F = m a$$
$$= m \frac{dv}{dt}$$
$$= \dot{m} \Delta v$$
$$= \rho S v (v_1 - v_2)$$

2. **Explain the analysis of aerodynamic forces acting on the blade in wind energy. (13M)**

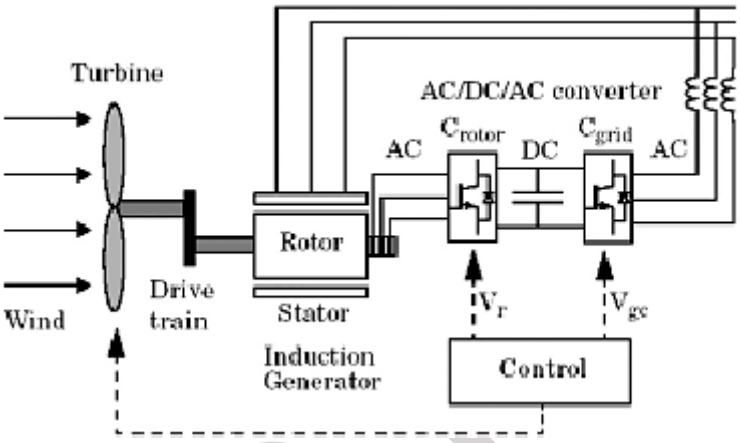
BTL 2

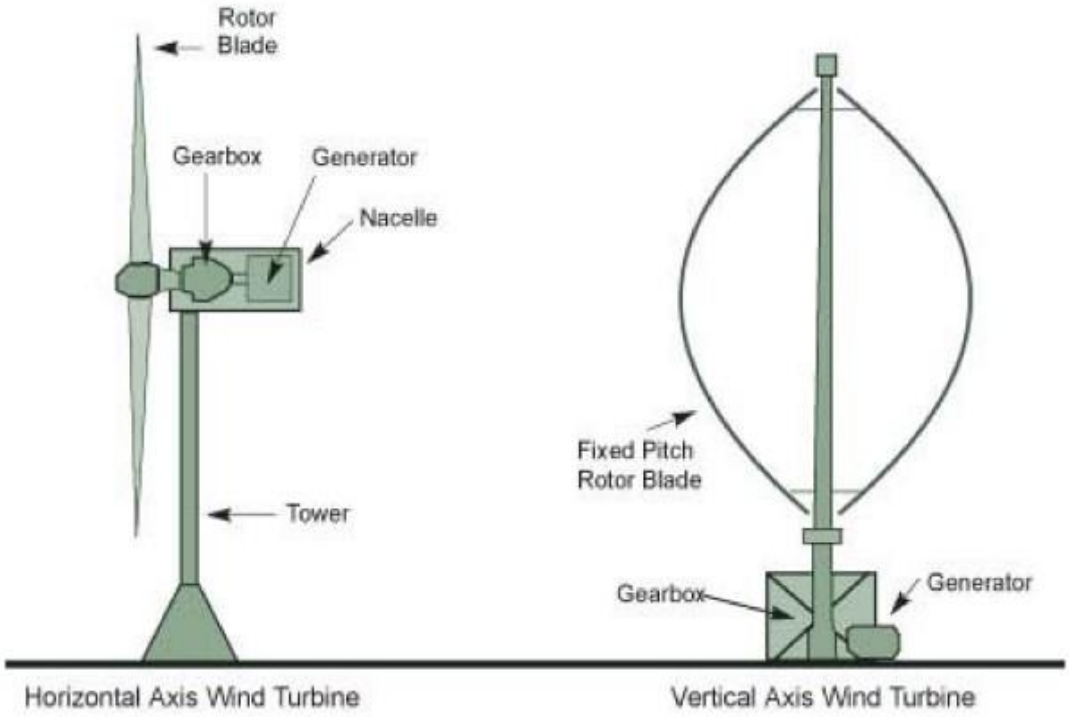
Answer Page: 7.28 – V.Thiyagarajan

- **Aero dynamic wind energy diagram & Explanation (6M& 7M)**



- Lift - which acts perpendicular to the flow
- Drag- which operates is the direction of flow
- Pitch : The blades of a rotor are curved so they can deflect the wind to create lift. The created lift force causes the rotor to rotate.
- Solidity: The greater the solidity of a rotor due to presence of multiple blades, the slower it

	needs to interrupt the wind with the help of rotation.
3.	**i) Describe with a neat sketch the working of a wind energy system (WECS) with main components.(10M) (APR/MAY 2019) (Apr 2017)**BTL 4 Answer Page: 7.46 – V.Thiyagarajan • Basic components of wind power system (5M)& Explanation (5M)  • The most modern generations of windmills are more properly called wind turbines, or wind generators, and are primarily used to generate electricity and electrical energy. Modern windmills are designed to convert the energy of the wind into electricity. The largest wind turbines can generate up to 6MW of power (for comparison a modern fossil fuel power plant generates between 500 and 1,300MW). • With increasing environmental concern, and approaching limits to fossil fuel consumption, wind power has regained interest as a renewable energy source. It is increasingly becoming more useful and sufficient in providing energy for many areas of the world, especially in temperate climates. **ii) Give some important factors that are considered for site selection of WECS.(3M)** BTL 4 • How good is the wind resource on the site? • Is the geography suitable to build wind farm? • How about the traffic conditions? • Power grid access condition • Considering the meteorological disaster
4.	**With the help of neat diagrams explain in detail about the construction and the working principle of different vertical axis wind turbines.(13M)(Apr/May 2017)**BTL 2 Answer Page: 7.60 – V.Thiyagarajan • Vertical axis wind turbine (Darrieus rotor) (5M)



- Components & working (6M):
  1. Tower / rotor shaft
  2. Blades
  3. Support structure
- Advantages & disadvantages of VAWT (2M):

Adv:

1. It can accept wind from any direction, eliminating the need of yaw control.
2. Simple blade design and low cost of fabrication.

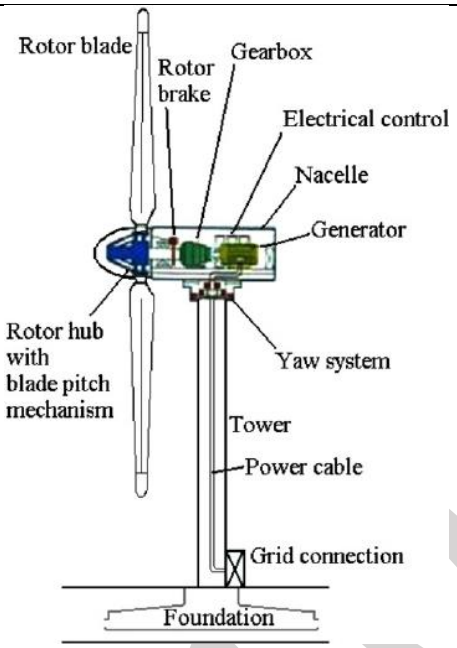
Dis-adv:

1. Not self-starting, thus require generator to run in motor mode at start
2. Lower efficiency.

5. **With the help of neat diagrams explain in detail about the construction and the working principle of different horizontal axis wind turbines. (13M)(Apr/May 2017)**BTL 2

Answer Page: 7.63 – V.Thiyagarajan

- **Horizontal axis wind turbine diagram (5M)**

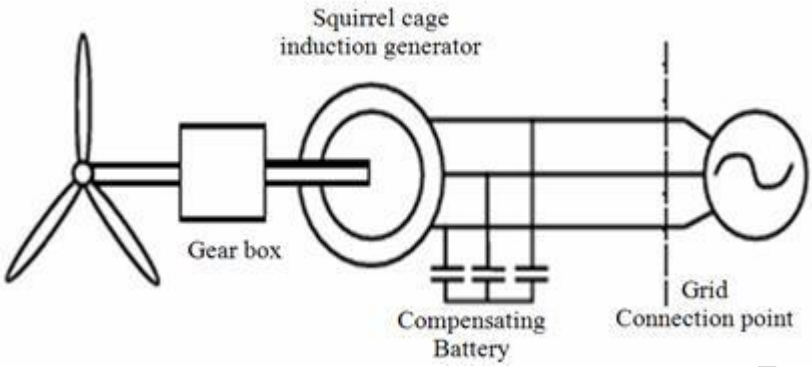


- **Components & Working (8M)**
  1. Horizontal-axis wind turbines (**HAWT**) have the main rotor shaft and electrical generator at the top of a tower, and may be pointed into or out of the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a **wind** sensor coupled with a servo motor. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator.
  2. Blades: The lifting style wind turbine blade. These are the most efficiently designed, especially for capturing energy of strong, fast winds. Some European companies actually manufacture a single blade turbine.
  3. The r**otor** is designed aerodynamically to capture the maximum surface area of wind in order to spin the most ergonomically. The blades are lightweight, durable and corrosion-resistant material. The best materials are composites of fiberglass and reinforced plastic
  4. A gear boxmagnifies or amplifies the energy output of the rotor. The **gear box** is situated directly between the rotor and the generator. A rotor rotates the generator (which is protected by a nacelle), as directed by the tail vane.

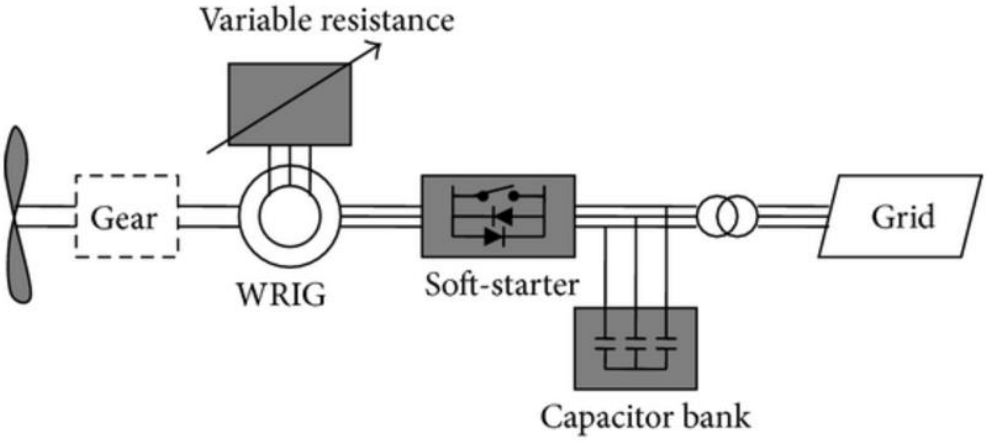
6. **Explain about wind generators and the classification of wind generators for wind power generation.(13M) (APR/MAY 2019)**BTL 2

Answer Page: 7.71 – V.Thiyagarajan

- Features of various types of generators & explanation (4M)
  1. DC generator
  2. Synchronous generator
  3. Induction generator
- Classification of generators for wind power generation & explanation (5M)
  1. Squirrel cage induction generator(SCIG)



2. Wound rotor induction generator(WRIG)



- Classification on the basis of their excitement process (3M)
  1. Grid connected IG
  2. Self – excited IG

7.

i) Explain the major applications of wind power plant.(7M) BTL 2

Answer Page: 7.54 – V.Thiyagarajan

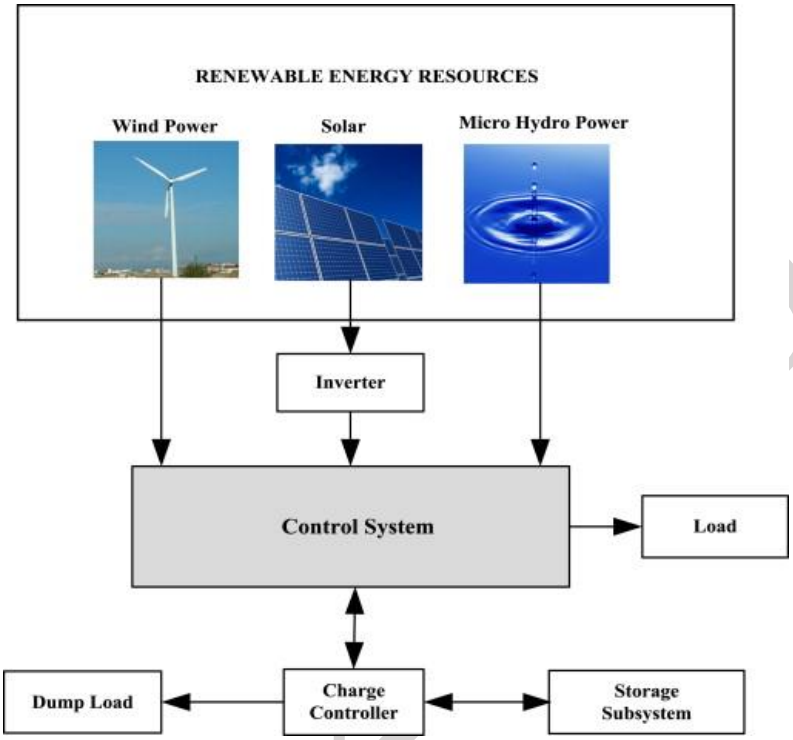
- **Wind farms:** A wind farm or wind park is a group of wind turbines in the same location used to produce electricity. A large wind farm may consist of several hundred individual wind turbines and cover an extended area of hundreds of square miles, but the land between the turbines may be used for agricultural or other purposes.
- **Grid connected wind power plants:** A grid-connected system allows you to power your home or small business with renewable energy during those periods (daily as well as seasonally) when the sun is shining, the water is running, or the wind is blowing. Any excess electricity you produce is fed back into the grid. When renewable resources are unavailable, electricity from the grid supplies your needs, eliminating the expense of electricity storage devices like batteries.
- **Wind power battery chargers**

ii) Explain the modes of wind power generation. (5M) BTL 2

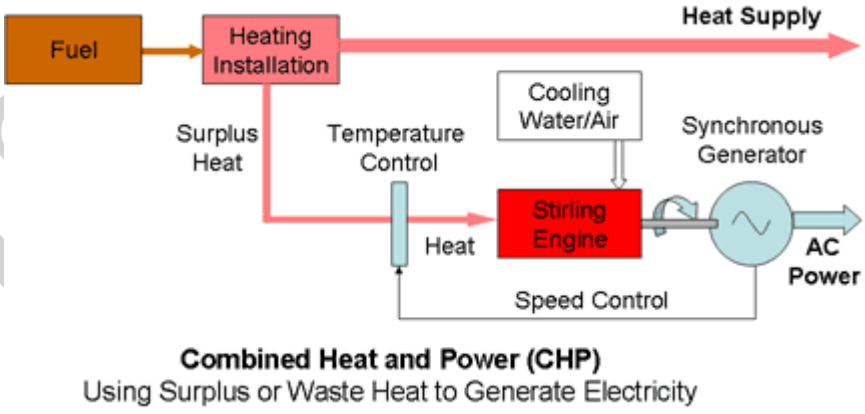
a. Standalone mode b. Back up mode

Answer Page: 7.90 & 7.91 – V.Thiyagarajan

- Standalone mode:



- Backup mode:



Combined Heat and Power (CHP)
Using Surplus or Waste Heat to Generate Electricity

Part *C

1 **Describe about constant/ variable speed operation of wind generator.(15M)(APR/MAY 2019)** BTL 4

Answer page : 7.83- V.Thiyagarajan

- Block diagram of wind generator scheme , types & explanation (5M)

	• Fixed speed drive (5M) 1. One fixed speed drive 2. Two fixed speed drive • **Variable speed operation of wind generator(**5M) **1.** Variable speed-drive using power electronics **2.** Scherbius variable speed drive **3.** Variable speed direct drive.

EE6010 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION LT P C

3 0 0 3

OBJECTIVES:

- To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- To analyze HVDC converters.
- To study about the HVDC system control.
- To analyze harmonics and design of filters.
- To model and analysis the DC system under study state.

UNIT I INTRODUCTION 9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study.

TOTAL: 45 PERIODS

OUTCOMES:

Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

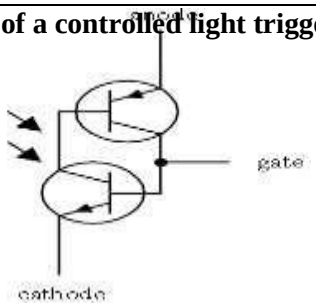
REFERENCES:

1. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London

	UNIT I INTRODUCTION
	DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.
	PART*A
Q.No	**Questions**
1.	**What is the significance of S.C.R?**BTL1 It is the ratio of S.C level at the converter unit to the rated D.C power. If the SCR < 3, then AC system is said to be weak.
2	**Name the principle of HVDC Transmission Systems.**BTL2 • The AC power generated is raised to HVAC and then converted to HVDC by means of converter. • This HVDC is then transmitted to the remote distance (>Breakeven Distance) and at the receiving end this HVDC is converted to HVAC by means of inverters, and then it stepped down to LVAC and then utilized for primary distribution systems.
3	**Define the terms 'Energy Availability' & 'Transient Reliability'.**BTL1 Energy availability = 100*(1- (Equivalent Outage Time/Total Time) %Where Equivalent Outage Time = (Actual Outage Time X Fraction of system Capacity lost due to outage). Transient Reliability is a factor used for specifying the HVDC system performance during recordable faults on the associated AC systems. Transient Reliability = 100.
4	**List the effect of ground impedance in AC and DC Transmission Systems.**BTL1 The presence of ground impedance in AC systems will not only affect the power transfer, but also result in telephone interference but it has negligible effect on DC currents and a DC link can operate using only one conductor with ground return.
5	**What are the main problems associated with interconnection HVAC and HVDC links?**BTL1 • Presence of large power oscillations leads to frequent tripping • Increase in fault level • Transmission of disturbances from one system to other
6	**What are the applications of DC transmission?**BTL1 **(April/May 2014)** Long distance bulk power transmission, Underground or underwater cables, Asynchronous interconnection of AC systems, Control and stabilization of power flows in AC ties in an integrated power system.
7	**Which bipolar Dc line is reliable.**BTL1 The failure of one pole does not affect the operation of the other pole (with ground return). If the DC line conductor has adequate overload rating and if the converters on the failed pole can be paralleled with the converters on the healthy pole, the pre-fault power level can be maintained even with permanent outage of one pole.

8	**Why line compensation is required in AC Transmission systems?**BTL1 To overcome the problems of line charging and stability limitations. Series capacitors and shunt inductors are used for line compensation.
9	**Where is the advancements in HVDC Transmission Systems applied.**BTL1 1) Development of D.C Circuit Breakers 2) Modern Construction of Thyristor Valves 3) 12 Pulse converter operation 4) Application of digital electronics and fiber optics in control converters
10	**What is the significance of using light triggered thyristors in DC transmission? (April/May2014)** BTL1 The LTT has an operating current of 4 KA and a blocking voltage of 8 kV and a light source may trigger and control its operation. Development of such thyristors with a big capacity facilitates convenient control and improves the system's reliability. So, it is highly suited for use in HVDC applications.
11	**What is meant by point to point transmission?**BTL1 Point to point transmission requires two converter stations, role of inverter and rectifier can be reversed by suitable converter control.
12	**State the main criteria to go for HVDC links? (Nov/Dec 2012)**BTL2 The distance above breakeven distance is the main criteria for HVDC links
13	**Mention the advancements in HVDC Transmission Systems.**BTL2 1)Development of D.C Circuit Breakers 2) Modern Construction of Thyristor Valves 3) 12 Pulse converter operation 4) Application of digital electronics and fiber optics in control converters.
14	**What is the significance of using light triggered thyristors in DC transmission? (Apr/May 2014)**BTL2 The LTT has an operating current of 4 KA and a blocking voltage of 8 kV and a light source may trigger and control its operation. Development of such thyristors with a big capacity facilitates convenient control and improves the system's reliability. So, it is highly suited for use in HVDC applications.
15	**Distinguish between AC and DC transmission system. (Nov/Dec 2012)**BTL2 • DC transmission requires only two conductors as compared to three for AC transmission. • Compared to AC transmission the DC voltage cannot be stepped up for transmission of power at high voltages. • There is no skin effect a DC system. • A DC line has less corona loss than for AC
16	**What is the criterion for choosing the voltage level for long distance bulk power transmission? (May/Jun 2013)** For long distance bulk power transmission, the voltage level is chosen to minimize the total costs for a given power level (P). The total costs include investment (C1) and cost of losses (C2).

17 **Draw the equivalent circuit of a controlled light triggered thyristor turn on.**BTL1



18 **What is the need for HVDC Transmission? (April/May 2015)**BTL1

HVDC stands for high voltage direct current, a well-proven technology used to transmit electricity over long distances by overhead transmission lines or submarine cables.

19 **What is the function of smoothing reactor? (April/May 2015)**BTL1

HVDC smoothing reactors are connected in series with the HVDC transmission line or in the intermediate DC circuit of a back-to-back interconnector.

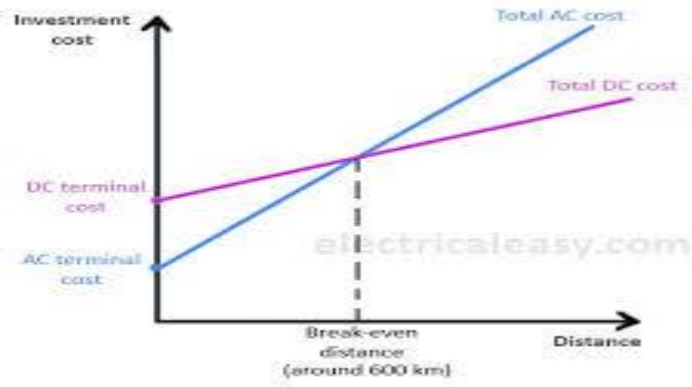
They are installed to reducing the harmonic currents in the DC system, reducing the rate of current increase during fault conditions and of improving the dynamic stability of the HVDC system.

20 **What are the three HVDC projects in operation in India?** BTL1**(May/Jun 2013)**

S.No	System/Project	Year commissioned	Supplier	Power Rating (MW)	Voltage (kV)	Line Length (km)
1.	National HVDC Project-Stage-I	1989	BHEL	100	100	196
2.	NHVDC-Stage-II	2000	BHEL	100	200	196
3.	Rihand-Delhi	1991-92	ABB/BHEL	750/1500	± 500	814
4.	Chandrapur-Padghe	1998	ABB/BHEL	1500	± 500	736

21 **Why voltage control is complicated in AC lines?**BTL1

Due to line charging and inductive voltage drops the voltage profile varies with the line loading

22	**What is fiber optic light guide system?**BTL1 Gate signal is supplied by means of optical signal sensing system
	PART * B
1.	**Compare the HVDC transmission with HVAC transmission in the following aspects, if bulk power is transmitted over a long distance. (13M) (Nov/Dec 2013) (Apr 2014)**BTL2 **(i) Economics of power transmission** **(ii) Technical Performance and** **(iii) Reliability** **Compare AC and DC transmission based on the economic, technical performance aspects and reliability. (May 2015)** **Answer: Page: 1.3-BARANI** **Definition:** Broadly the transients are studied in two categories, based upon their origin--------(2M) Electromagnetic and Electromechanical transients----------(4M) Transient classification with respect to frequency groups----------(2M)  Classification depending on frequency and its nature----------(2M) Explanation: A direct or indirect lightning stroke on a transmission line produces a steep wave in the voltage on the line. The voltage wave may rise from zero to peak value in a about 1 μs-------(3M)
2.	**Explain the types of HVDC links.(13M)** BTL2 **Answer: Page: 1.45-BARANI** **Definition:** A monopolar link has one conductor and uses either ground and/or sea return. A metallic return can also be used where concerns for harmonic interference and/or corrosion exist. In applications with dc cables, a cable return is used. Since the corona effects in a dc line are substantially less with negative polarity of the conductor as compared to the positive polarity, a monopolar link is normally operated with negative polarity----------(2M) Monopolar Link----------(4M) Bipolar Link----------(2M)

	Homopolar Link----------(2M) **Explanation**: In this type of link two conductors having the same polarity (usually negative) can be operated with ground or metallic return. Due to the undesirability of operating a dc link with ground return, bipolar links are mostly used. A homopolar link has the advantage of reduced insulation costs, but the disadvantages of earth return outweigh the advantages.----------(3M)
3.	**Explain how the economic choice of voltage level is selected for a fixed power transfer in DC transmission system.(13M)**BTL2 **Answer: Page: 1.3-BARANI** **Definition:** For long distance bulk power transmission, the voltage level is chosen to minimize the total costs for a given power level (P). The total costs include investment (C1)----------(2M) Selection of optimum system voltage for a fixed power transfer----------(4M) Investment costs per unit length ----------(2M) Back to Back DC converters----------(2M) Explanation: In case of back to back DC ties, the line costs are absent. Hence the voltage level is chosen to minimize converter costs. This level is generally much lower than that in the presence of an overhead line.----------(3M)
4.	**(i)Explain how the modern trends in DC transmission improve the reliability and performance of HVDC transmission system. (10M) (May/June 2013) (April/May 2014) BTL2** **(ii)List out some of the modern trends in DC transmission. (3M) (April/May 2015) BTL1** **Answer: Page: 1.30-BARANI** **Definition:** The cost of the converters can come down if the number of devices to be connected in series and parallel can be brought down. The size of the devices has gone up to 100 mm (in diameters) and there is no need for parallel connection. The increase in the current rating of the devices has made it possible to provide higher overload capability at reasonable costs and reduce the lower limits on transformer leakage impedance thereby improving the power factor.----------(2M) Power Semiconductors and Valves----------(4M) Converter Control----------(2M) DC breakers----------(2M) **Explanation**: The power modulation techniques used to improve dynamic stability of power systems will have to be modified in the presence of weak AC systems. Coordinated reactive and active power modulation has been suggested to overcome the problems of voltage variations that can limit the effectiveness of power modulation.----------(3M)
5.	**Determine the various components of a HVDC converter station and state the applications of HVDC converters.**BTL5 **(Nov/Dec 2013)** **Answer: Page: 1.3-BARANI** **Definition:** The major components of a HVDC transmission system are converter stations where conversions from AC to DC (Rectifier station) and from DC to AC (Inverter station) are performed. A point to point transmission requires two converter stations. The role of rectifier and inverter stations can be reversed (resulting in power

reversals) by suitable converter control.----------(2M)

Converter unit----------(4M)

Converter transformer----------(2M)

Reactive power source----------(2M)

Explanation: A sufficiently large series reactor is used on DC side to smooth DC current and also for protection. The reactor is designed as a linear reactor and is connected on the line side, neutral side or at intermediate location. ----------(3M)

PART *C

1. **Explain the various considerations to be considered into account in the planning for HVDC transmission(15M) (Nov/Dec 2013)**BTL2

Answer: Page: 1.35-BARANI

Definition: Generally, the last two factors are considered as constraints to be met and the minimum cost option is selected among various alternatives that meet the specifications on technical performance and reliability.---------(2M)

Different configurations for asynchronous interconnection----------(4M)

Dynamic over voltages----------(3M)
Harmonic generation and design of filters----------(3M)

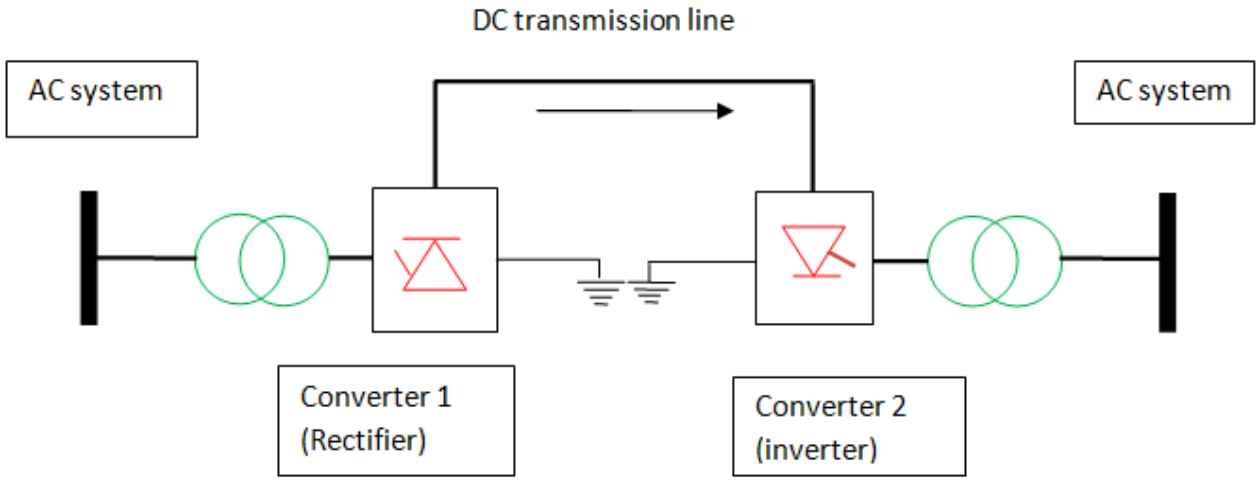


Figure 3: Mono Polar Link

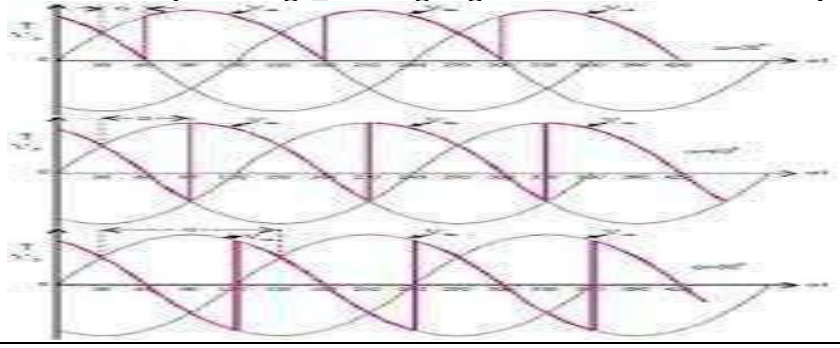
Explanation: A sufficiently large series reactor is used on DC side to smooth DC current and also for protection. The reactor is designed as a linear reactor and is connected on the line side, neutral side or at intermediate location----(3M)

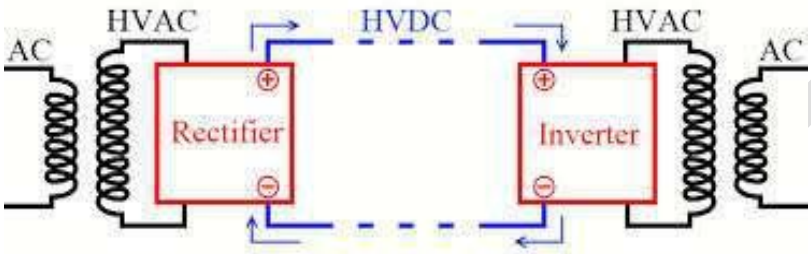
2. **Compare the advantages and disadvantages of HVAC and HVDC transmission system. (15M)**BTL2
Answer: Page: 1.40-BARANI

Definition: It can be said without exaggeration that complexity of control does not pose a problem and can actually be used to provide reliable and fast control of power and converter faults. ----------(2M)

	Inability to use transformers to change voltage levels----------(4M) High cost of conversion equipment----------(3M) Harmonic generation and design of filters----------(3M) **Explanation:**Some of the above advances have resulted in improving the reliability and reduction of conversion costs in DC systems. It can be said without exaggeration that complexity of control does not pose a problem and can actually be used to provide reliable and fast control of power and converter faults. This has removed the need for DC current interruption in two terminal links.----------(3M)
3.	**Compare AC and DC transmission based on the economic, technical performance aspects and reliability. (15M) (April/May 2015)**BLT2 **Answer: Page: 1.38-BARANI** **Definition:** Commonly ran by an AC variable frequency drive, an AC electric motor operates by applying alternating current (AC) power to the electric motor. ... An induction motor uses a magnetic field on the rotor of an induction motor that's created by an induced current.----------(3M) Economic dispatch control----------(3M) Load Equalizations control----------(3M) Ripple connects across the system. ----------(3M) **Explanation:** Generally, a DCdrivechanges an Alternating Current (AC) into Direct Current (DC) using a converter (Rectifier) to operate a DC motor while the AC drive changes the input AC current to DC using converter (Rectifier) and then changes this DC to AC, using an inverter, to operate the motor.---------(3M)

	UNIT II ANALYSIS OF HVDC CONVERTERS
	Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters
Q.No.	**Questions**
1.	**Define Pulse Number of a converter.**BTL1 It is defined as the number of pulsations of direct voltage per cycle of alternating voltage.
2	**What is the significance of the converter resistance?**BTL1 As Rc increases converter output decreases, it is equivalent to armature resistance in D.C machine
3	**Define the term 'Commutation Group'.**BTL1 It is defined as the group of valves in which only one conducts at time (neglecting the overlap). p=q r s
4	**What is meant by Advance Angle?** BTL1 α- p=b. It gives the conduction period beyond the specified value due to **5**overlap
5	**What is the significance of the Inverter resistance?**BTL1 As Ri increases inverter output decreases, it is equivalent to armature resistance in D.C machine
6	**What are main causes of delay in commutation?**BTL1 Commutation resistance and source inductance
7	**What are the effects of source inductance in operation of Inverters?** BTL1 It results in increased unbalanced voltages.
8	**Why series conduction of converter groups is preferred in HVDC transmission?** BTL1 For the ease of control and protection as well as the requirements of high voltage.
9	**What is necessity for providing the upper limit?**BTL1 In order to allow turn off time of the valve a should not be greater than (180 - g). Where g is extinction angle.
10	**What is significance of Power factor in AC current waveform?**BTL1 Cos f = Cosa, The power factor is zero when a = 90, and only reactive power consumed.
11	**What are the additional modes in 12-Pulse converter operation?**BTL1 • 5 Valve conductions • 6-7-8-7 Valve conduction
12	**What are the constraints in detailed analysis of converters in determining the boundary conditions? (Nov/Dec 2013)**BTL1 • Magnetic fluxes and electric charges must be continuous functions of time • The current in the outgoing valve is zero at t = t1

13	**What are the assumptions made in detailed analysis of converters?**BTL1 **(May 2015)** • The system is described by sets of linear differential equations and each set is applicable for a particular conduction pattern of the valves in a bridge. • AC system is symmetrical, and voltages are balanced • Firing pulses are generated at equal intervals of time
14	**What are the assumptions in analysis of graetz circuit with overlap?**BTL1 • The DC current is constant • The valves are modeled as ideal switches • The AC voltage at the converter bus is sinusoidal and remains constant.
15	**What is the effect of maintaining certain minimum margin angle?**BTL1 The operating region of the inverter is different from that for a rectifier; hence a minimum commutation margin angle is necessary, during which voltage across the valve is negative.
16	**Define coupling factor.**BTL1 • K = Xs/(Xs + XT), • Where Xs = source reactance • XT = Transformer leakage reactance.
17	**What are the various modern trends in HVDC Transmission Systems?**BTL1 • Development of D.C Circuit Breakers • Modern Construction of Thyristor Valves • 12 Pulse converter operation • Application of digital electronics and fiber optics in control converters
18	**What is meant by overlap angle?**BTL1 Due to the leakage inductance of the converter transformer and source impedance in the network, the current in the valve cannot change suddenly and for a finite period both valves conduct. This overlap duration is measured by means of overlap angle 'u
19	**What is a twelve pulse converter? (Nov/Dec 2012)**BTL1 A twelve pulse converter is obtained by the series connection of two six pulse converter (graetz) bridges. The 30^o phase displacement between the two sets of source voltages is achieved by the transformer connections, Y/Y for feeding one bridge and Y/Δ for feeding the second bridge. The use of 12 pulse converter is preferable over the six pulse converter because of the reduced filtering requirements.
20	**Draw the output voltage vs. firing angle characteristic of a three phase rectifier. (Nov/Dec 2012)BTL1** 

21	**Why is 3 – phase bridge connection used invariably in converter and inverter circuits in HVDC systems? (May/Jun 2013)BTL3** The three phase bridge configuration provides better utilization of converter transformer and a lower peak inverse voltage across the converter valves when compared with other possible alternatives. Hence it is used invariably in converter and inverter circuits in HVDC systems
22	**Why pulse number > 12 is not preferred in practice?BTL3** Increases the non-characteristic harmonics and elimination such harmonics is not possible and Imbalance in operation increases.
23	**What is effect of increasing the overlap angle u > 60^0.BTL1** The minimum number of valves conducting are three and there are intervals when four valves are conducting, this because the commutation previous conducting valve is not yet completed.
24	**What are the methods employed for cooling of converter valves?BTL1** The valves are cooled by air, oil, water or Freon. Liquid cooling using de-ionized water is more efficient and results in reduction of station losses**.**
25	**Draw the equivalent circuit of a HVDC system used in long distance transmission. (Apr/may2014)BTL2** 
	PART * B
1.	**Explain the characteristics of a twelve pulse converter. (13M)BTL1** **Answer: Page: 2.31-BARANI** **Definition:** The inverter characteristics are similar to the rectifier characteristics. However, theoperation as an inverter requires a minimum commutation angle during which the voltage across the valve is negative. Hence the operating region of an inverter is different from that for a rectifier. ---------(2M) Rectifier----------(4M) Inverter----------(2M)

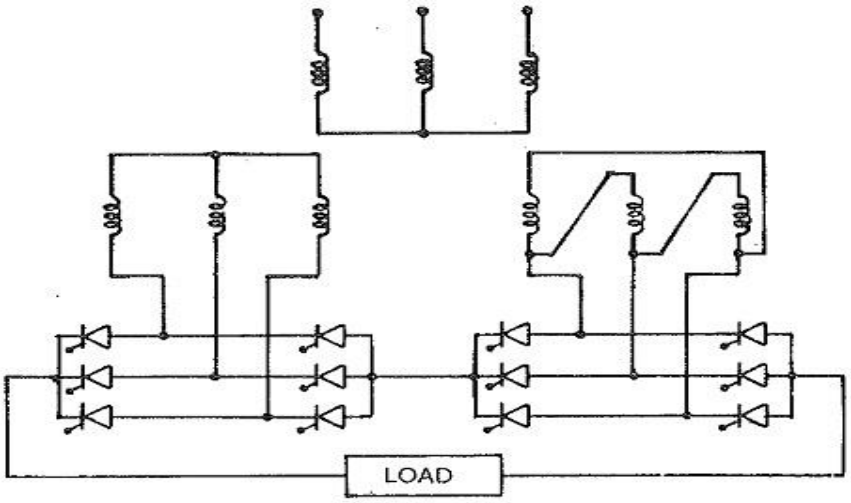


Fig. 3.42 *Twelve pulse converter*

Characteristics of a 12 pulse converter----------(2M)

Explanation: As long the AC voltages at the converter bus remain sinusoidal (with effective filtering), the operation of one bridge is unaffected by the operation of the other bridge connected in series. In this case, the converter characteristics are as shown in the following figure. With the assumption that the AC voltages at the converter bus remain constant...----------(3M)

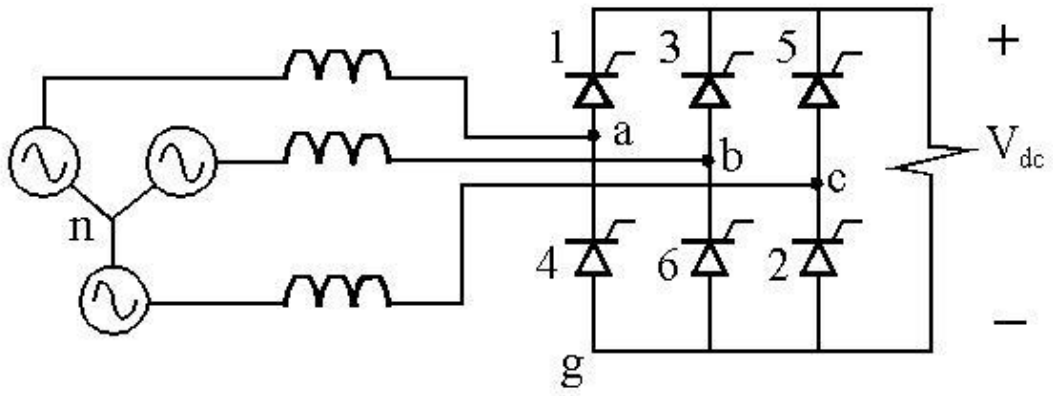
2 **Explain the methods for obtaining the steady state solution of equations for a six pulse HVDC converter bridge with filters. (13M) (May/Jun 2013)BTL1**

Answer: Page: 2.31-BARANI

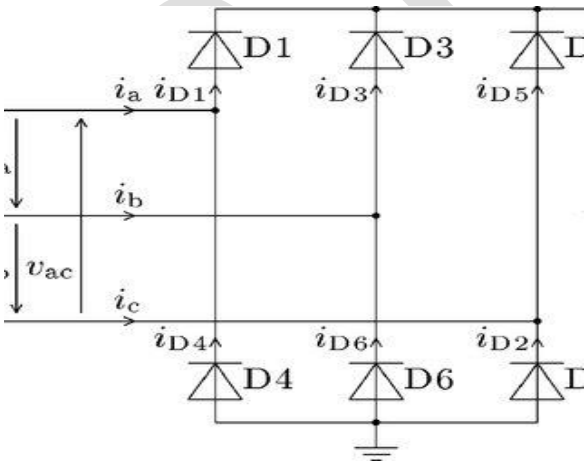
Definition: The steady-state solution of HVDC converter equation is periodic. With linear network elements, the equations are also piecewise linear. A method for obtaining fast steady-state solution of the system equations for the general case in described next.---------(2M)

Development of the method for fast steady-state analysis----------(4M)

Outline of the method----------(2M)



Firing pulses are generated at equal intervals of time.----------(2M)

	Explanation: The orders of the state vectors x1 and x2 are n+1 and n respectively. Since the outgoing valve current becomes zero at t=t1, one state variable is eliminated in the second sub-interval.----------(3M)
3	**Explain the selection of converters for HVDC system. (13M) (Nov/Dec 2013)** **Answer: Page: 2.36-BARANI** **Definition:** Graetz bridge is a six-pulse converter for which the lowest DC voltage harmonic is sixth. Correspondingly, lowest AC current harmonics are 5th and 7 th. To reduce the harmonic content in the AC current and DC voltage, it is desirable to use higher pulse numbers. ---------(2M) Converter made up of series and parallel connection of communication groups----------(4M) Transformer rating----------(2M) The transformer utilization factor----------(2M) **Explanation**: It is convenient to consider a 'p' pulse converter made up of series and parallel connections of a basic valve (commutation) group of 'q' valves or switches as shown in the below figure. Here, the switch is a thyristor valve whose firing can be delayed (from the instant when the valve voltage becomes positive). The voltage sources are actually obtained from the converter transformer windings. Neglecting overlap, only one valve conducts in a commutation group of 'q' valves.----------(3M)
4	**Explain the complete analysis of six pulse graetz converter circuit with overlap for two valve conduction (13M) (Nov/Dec 2013)** **Answer: Page: 2.33-BARANI** **Definition:** Due to the leakage inductance of the converter transformer and the impedance in the supply network, the current in a valve cannot change suddenly and thus commutation from one valve to the next cannot be instantaneous. For example, when valve 3 is fired, the current transfer from valve 1 to valve 3 takes a finite period during which both valves are conducting. This is called overlap and its duration is measured by the overlap (commutation) angle 'u'.---------(2M) Analysis of two and three valve conduction mode----------(4M) Equivalent circuit for 3 valve conduction----------(2M)  Voltage and current waveform during firing of a valve----------(2M) **Explanation**: It is something analogous to armature reaction in DC machines in the sense that it only represents a voltage drop and not a power loss. ----------(3M)

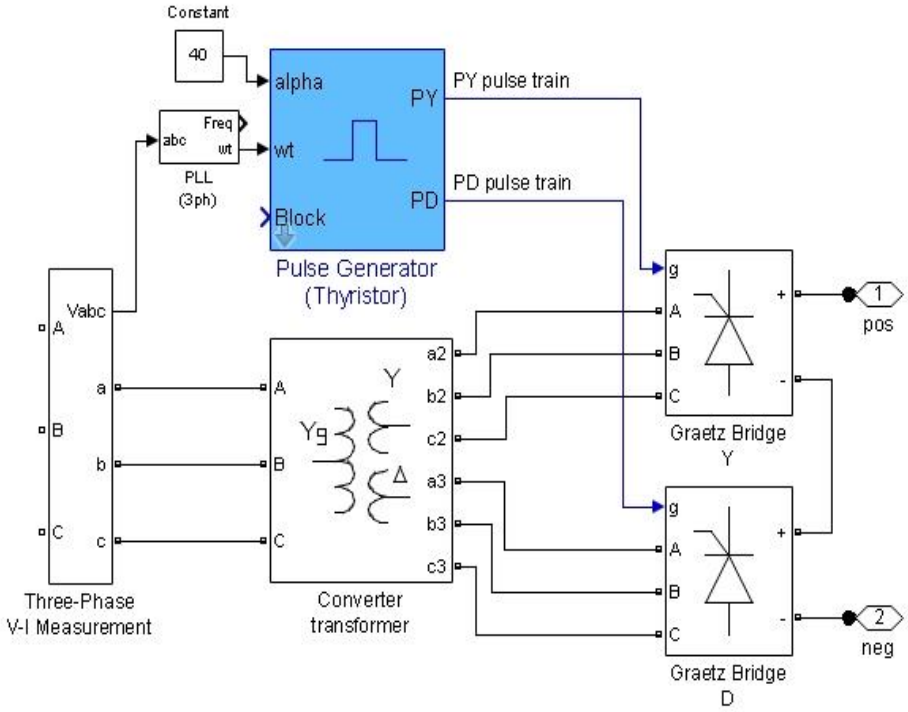
5 **Analyze three and four valve conduction mode of converter using graetz circuit. (13M) (Apr/May 2014)**
Answer: Page: 2.33-BARANI

Definition: Although two and three valve conduction mode is the normal mode of operation, during DC line faults or a dip in the AC voltage, it is likely that the overlap angle u would be larger and may exceed 60º---(2M)

Equivalent circuit for four valve conduction----------(4M)

Average direct voltage ----------(2M)

Three and four values of conduction mode ----------(2M)



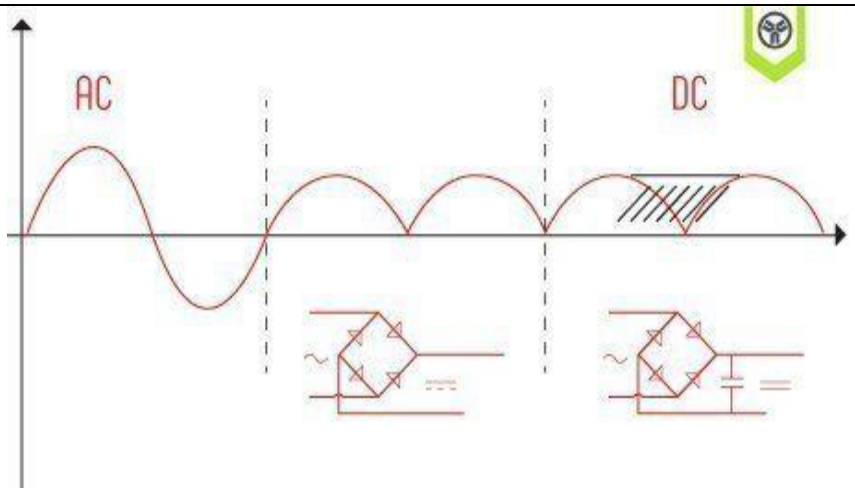
Explanation:When the overlap angle exceeds 60º, the minimum number of valves conducting are three and there are intervals when four valves are conducting. This is because when a commutation process is started, the previous commutation process is not yet completed. For example, when valve 3 is fired, the valves 1,6, and 2 are still conducting. ----------(3M)

6 **With a neat diagram and waveforms explain the 6 pulse Graetz circuit. (13M) (Nov/Dec 2012)**
Answer: Page: 2.35-BARANI

Definition: At any instant, two valves are conducting in the bridge, one from the upper commutation group and the second from the lower commutation group. The firing of the next valve in a particular group results in the turning off of the valve that is already conducting. ---------(2M)

AC voltage waveform and power factor----------(4M)
DC and AC voltages----------(2M)

DC voltage waveform----------(2M)



Explanation: It is assumed that the direct current has no ripple (or harmonics). This is normally valid because of the smoothing reactor provided in series with the bridge circuit. The AC currents flowing through the valve (secondary) and primary windings of the converter transformer contain harmonics. ----------(3M)

PART*C

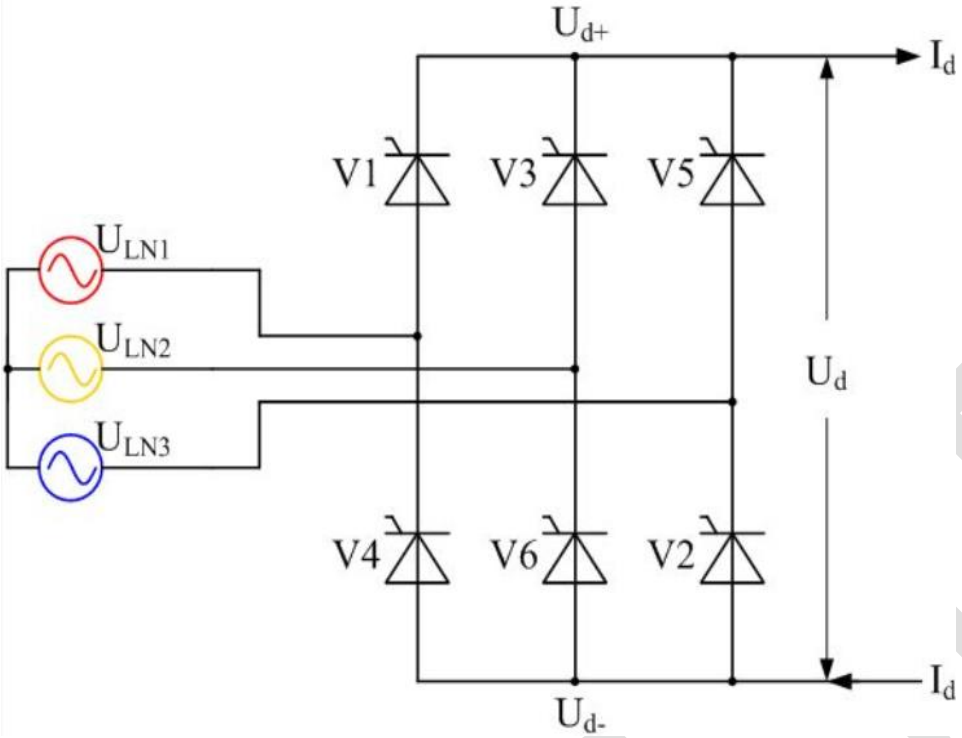
1. **Explain their principle of operation of a six pulse bridge circuit with a neat diagram. (15M)(April/May 2015) BTL2**

Answer: Page: 2.55-BARANI

Definition: Six pulse bridge circuit is a two half-period rectifier. It is used for rectifying alternating voltage when consumer with constant voltage has to be powered. It consists of four diodes connected in series by two. If you mentally divide the diodes in two pairs D1 – D3 and D2 and D4, the alternating voltage is supplied between the anode of D4 and the cathode of D1 of one pair and between the cathode of D2 and the anode of D3. -------(2M)

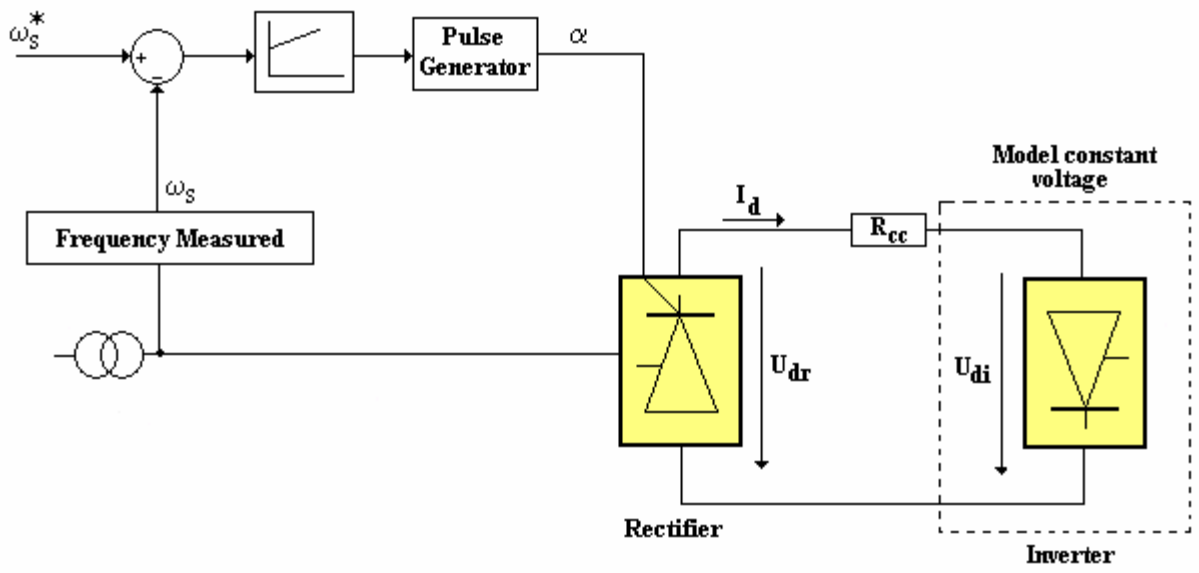
Choosing a transformer ----------(4M)
Output ripple voltage ----------(2M)

Smoothing waveform----------(2M)



Explanation:At the output of the bridge (rectifier), the voltage isn't rectified, but still has a wave character with a frequency two times greater than the input one, therefore a capacitor is used almost every time. It acts as a capacitive filter, i.e. smoothing the waveform. When choosing a capacitor two main parameters need to be observed: the operating voltage, which must be higher than the output value of the rectifier voltage without load and its capacity..----------(3M)

2	**Explain about the frequency control schemes.(15M)BTL2** **Answer: Page: 2.50-BARANI** **Definition:** To analyze the operation of a converter, consider the converter circuit diagram shown below. This shows two transformers with primary windings connected in star and connected to the common supply voltage---------(2M) Waveform for current 14 pulse waveform----------(4M) Bridge voltage in each interval----------(2M)



Average DC voltage equation----------(2M)

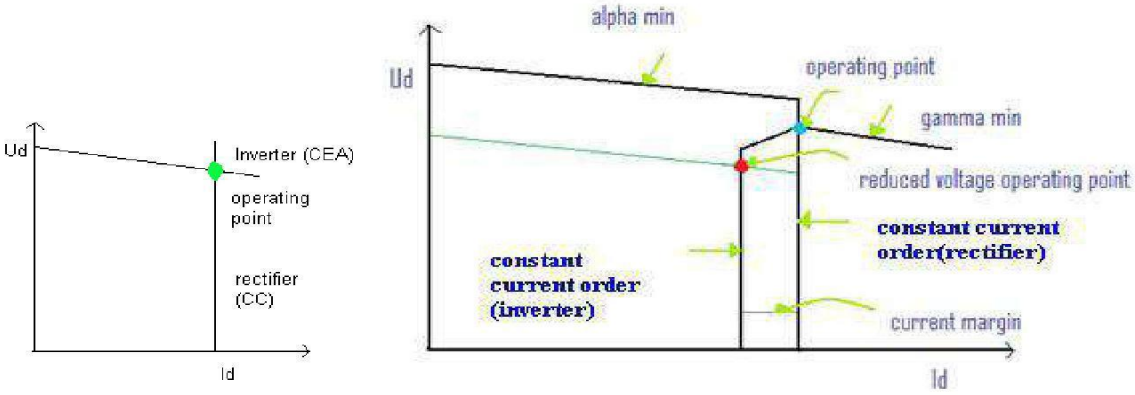
Explanation: In comparing with the harmonic currents of a six-pulse converter, it is obvious that the fifth and seventh harmonics flowing in the two transformers cancel each other. This can be generalized to the case whenever m is an odd integer.----------(3M)

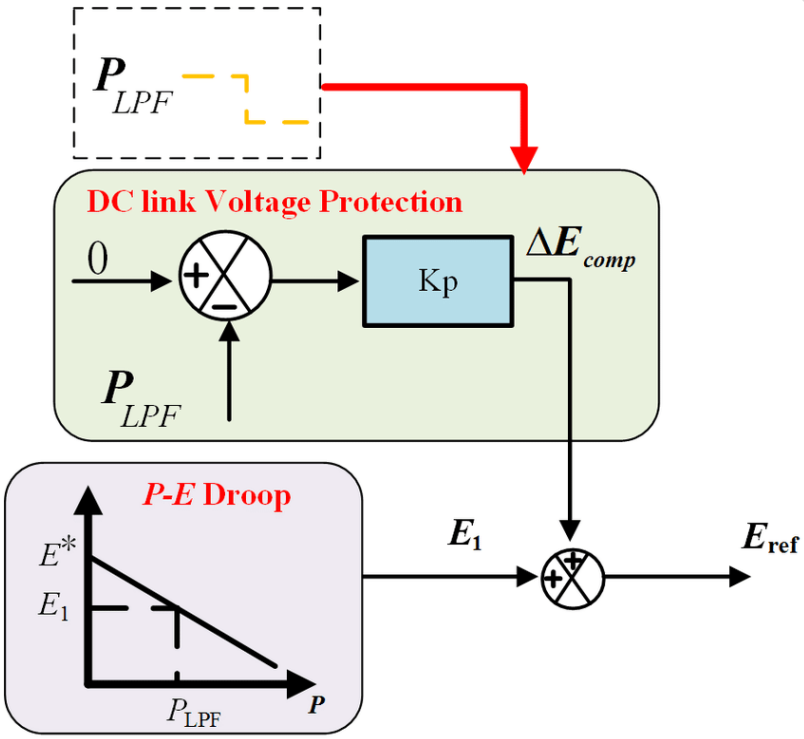
UNIT -III Converter and hvdc system control

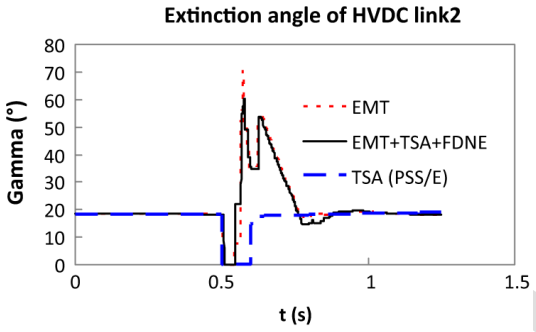
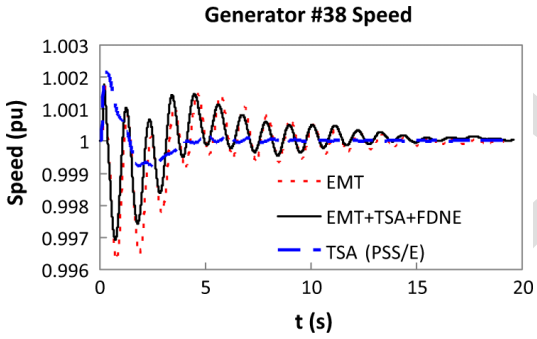
Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

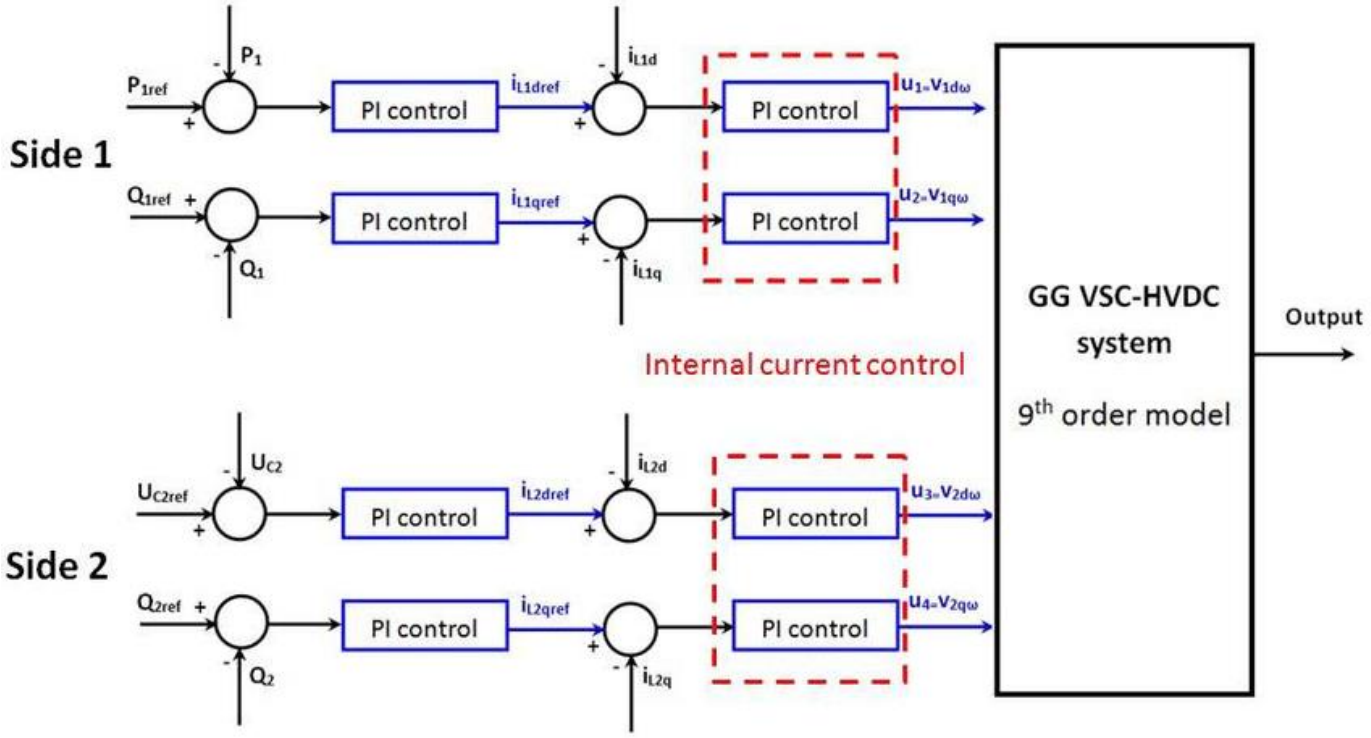
Q.No.	Questions
1.	**What is meant by firing angle control? BTL1** The current or extinction angle co trolled generates a control signal v_c,Which is related to the firing angle required. The firing angle controllerGenerates gate pulses in response to the control signal v_c.
2	**Write the features control?BTL2** i) Current order setting can be quickly and reliably changed depend on the requirement ii) Power reversal can be done easily and quickly iii) Fault current levels are limited to rated values.
3	**Why the necessity of control in a DC link?BTL2** The expression for current through a DC link it can be observed that the denominator has only resistances, which are small when compared with the reactance of the AC system. Hence, current is sensitive to change in voltage resulting in large fluctuations which can damage the thyristors.

4	**What is meant by current and extinction control? BTL1** • The current controller is invariably of feedback type the controller which Is PI type. • The extinction angle controller can be of predictive type or feedback type With EPC control. The predictive controller is considered to be less Prone to commutation failure.
5	**State any four important reasons why the current control is desirable in the Rectifier station under normal operating conditions.BTL2** • The increase of power in the link is achieved by reducing α_r, which improves the power factor at the rectifier. • The inverter can now be operated at minimum ע thereby minimize the reactive power consumption. • The operation at minimum extinction angle at the inverter and current control at the rectifier results in better voltage regulation them the operation with minimum delay angle at the rectifier & current control at the inverter. • The current during line fault are automatically limited with rectifier station in current control.
6	**How power is reversed in HVDC link?BTL3** The power reversal in the link can take place by the rev rsal of the DC Voltage. This isdone easily by increasing the delay angle at the station initially operating as therectifier, while reducing the delay angle at the stationinitially operating as the inverter.
7	**Define current margin.BTL1** The difference between the current controller settings of the two stations is called current margin(Im). In order to avoid conflict between the two current controllers at the both end, the rectifier current controller is provided with a higher current order.Idi = Idr – ImWhere Idi – current order of the inverterIdr - current order of the rectifierIm usually about 10% of rated value
8	**Draw backs of constant current control(CCC**).BTL3 • Increase in the converter valve voltage stress due to the voltages across the series capacitors • Increase in the magnitude of AC harmonics as the overlap angle is the reduced for a specified DC current
9	**What is meant by compounding? BTL1** The term compounding a converter implies selection of converter characteristics in order to meet the requirements of regulation and protection
10	**Define required regulation. BTL1** Converter valves should be operated strictly within their current rating, since there is substantial rise of damage if the current is increased beyond the rated value for a even a short time. Therefore constant current regulation is thus clearly desirable.

11	**Draw the characteristics of compounding of inverter.BTL3** 
12	**What is the use of transformer tap changer control at the inverter side of an HVDC?BTL1** The on-load tap changer control at the inverter is used mainly to maitain a constant DCvoltage. The tap changer control at the rectifier is designed to mainta delay angle within the limits (say 10deg to 20deg) in order to maintain certain voltage margin for the purpose of current control.
13	**What is the use of tap changing transformer in HVDC systems? BTL1** The tap changing transformer used to increase the power factor obtained in the ac side and maintain the operating point at point A or B in the Vd , id characteristics of rectifier and inverter use tap changing transformer.
14	**Draw the communication link of the HVDC transmission. BTL3** A communication link is necessary to carry information from the receiving end to the rectifier regulator and may also be needed for protective purposes, starting purposes and reversal of the direction of power flow There are 3 main possibilities: • Short wave radio link • Pilot wires • The use of carrier frequency on the power conductors.
15	**What is meant by compounding a converter? BTL1** The term compounding a converter implies selection of converter characteristics in order to meet the requirements of regulation and protection
16	**What is the need for transformer tap changer control of HVDC converter? (U)**

	The tap changing transformer used to increase the power factor obtained in the ac side and maintain the operating point at point A or B in the Vd , id characteristics of rectifier and inverter use tap changing transformer.
	PART-B
1	**Briefly explain the principle of DC link control and the converter control basic characteristics.** (13M) BTL2 **Answer: Page :4.34 BHARANI** **Definition:**In power conversion, when AC is converted to low voltage DC, or AC from one frequency to another, the AC is usually rectified and smoothed. ... The DC that is fed into the inverter is called the DC link. As the name implies, the two sources are linked together with a filter capacitor.----------(5M)  ----------(3M) Explanation:In power conversion, when AC is converted to low voltage **DC**, or AC from one frequency to another, the AC is usually rectified and smoothed. ... The **DC** that is fed into the **inverter** is called the **DC link**. As the name implies, the two sources are **linked** together with a filter capacitor----------(5M)
2	**Explain the principle and necessary of control, compounding and regulation.** (13M) BTL2 **Answer: Page :4.34 BHARANI** **Definition:**HVAC is short for Heating, Ventilation and Air Conditioning systems, mostly as implemented in large C&I (Commercial and Industrial) buildings. HVDC is short for High Voltage Direct Current - often used

	in long distance electrical transmission system.----------(5M) Regulation and compounding transients ----------(3M) Explanation:HVDC stands for high voltage direct current, a well-proven technology used to transmit electricity over long distances by overhead transmission lines or submarine cables. It is also used to interconnect separate power systems, where traditional alternating current (AC) connections cannot be used.----------(5M)
3	**Explain the operation of current control and constant extinction angle control**.(13M)BTL1 **Answer: Page :4.34 BHARANI** **Definition:**A method for control of an **extinction angle** of a line-commutated **converter** in dependence on a minimum reference value for the **extinction angle**, the **converter** having a plurality of valves, each one of the plurality of valves having at least one semiconductor element capable of being fired, whereby, for a commutating ---------(5M) Regulation and compounding transients ----------(3M)  (a)  (b) Explanation:HVDC stands for high voltage direct current, a well-proven technology used to transmit electricity over long distances by overhead transmission lines or submarine cables. It is also used to interconnect separate power systems, where traditional alternating current (AC) connections cannot be used.----------(5M)
4	**Explain the operation of current control in high voltage** (13M)BTL1 **Answer: Page :4.45 BHARANI** **Definition:**Voltage mode and current mode are the two regulating conditions that control the output of the supply. Most applications call for a supply to be used as a voltage source. These are fast acting electronic regulating circuits, so automatic crossover between voltage mode to current mode is inherent in the design.----------(5M)



-(3M)

Explanation:Voltage- and **Current-Mode Control** for **PWM** Signal Generation in DC-to-DC Switching Regulators. ... The power stage incorporates the switching elements and converts the input voltage to the desired output. The **controller** supervises the switching operation to regulate the output voltage----------(5M)

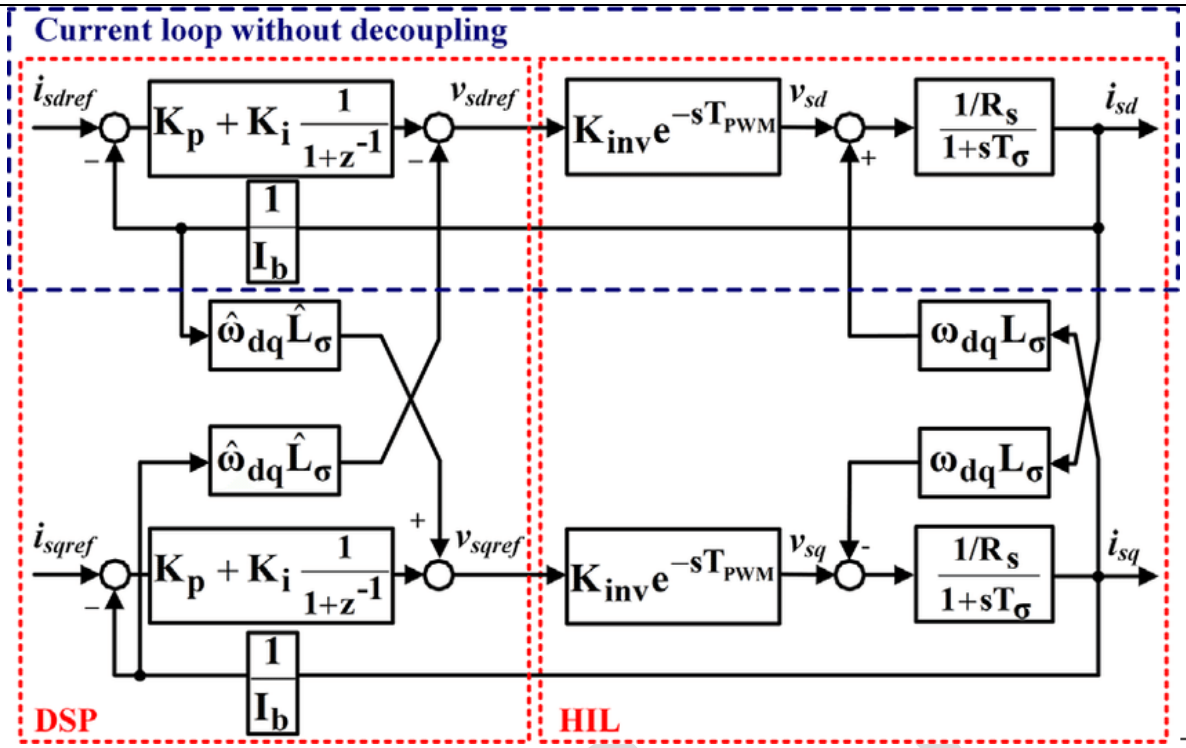
PART*C

1 Describe the operation of current regulation from the inverter side.(15M)BTL2

Answer: Page :4.34 BHARANI

Definition: An **HVDC** converter converts electric power from high voltage alternating current (AC) to high-voltage direct current (**HVDC**), or vice versa. **HVDC** is used as an alternative to AC for transmitting electrical energy over long distances or between AC power systems of different frequencies.---------(5M)

Regulation and compounding transients ----------(3M)



----------(5M)

Explanation:With line commutated converters, the converter has only one degree of freedom – the firing angle, which represents the time delay between the voltage across a valve becoming positive (at which point the valve would start to conduct) and the thyristors being turned on.----------(2M)

2

Explain the operation of rectifier compounding.(15M)BTL2

Definition:Compoundexcitation of DC machines is provided by twofieldwindings: a serieswindingand a shunt(orseparate)winding.Theshuntwindingprovides a magneticexcitationflux in themachinethatcorresponds to thenominalvoltageunderno-loadconditions. ----------(5M)

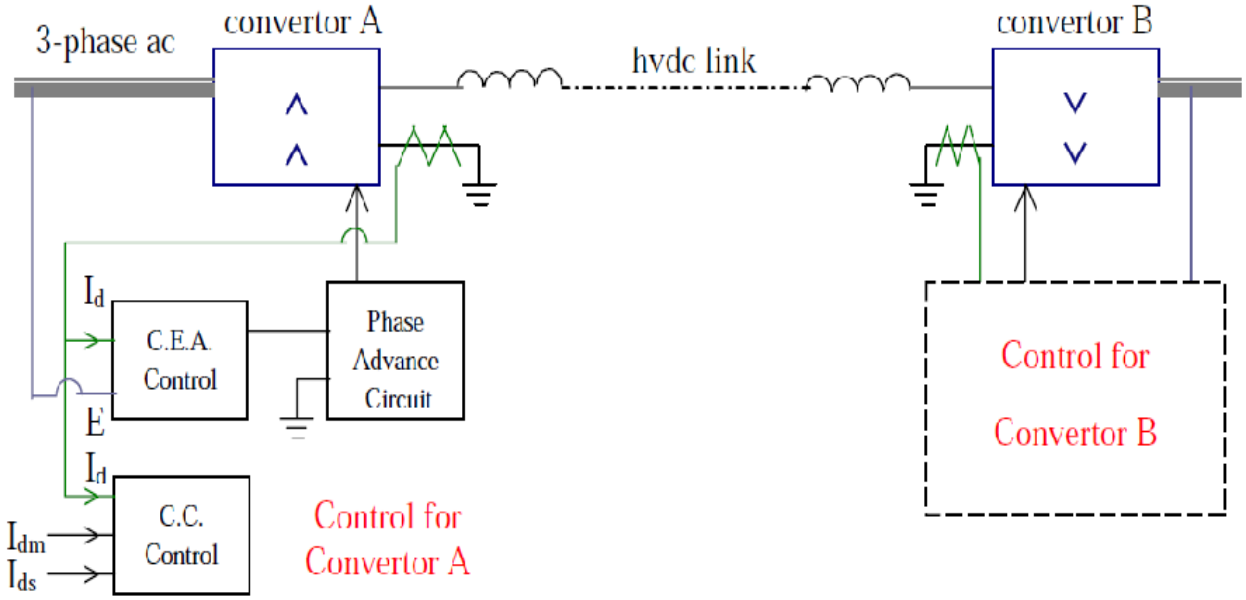


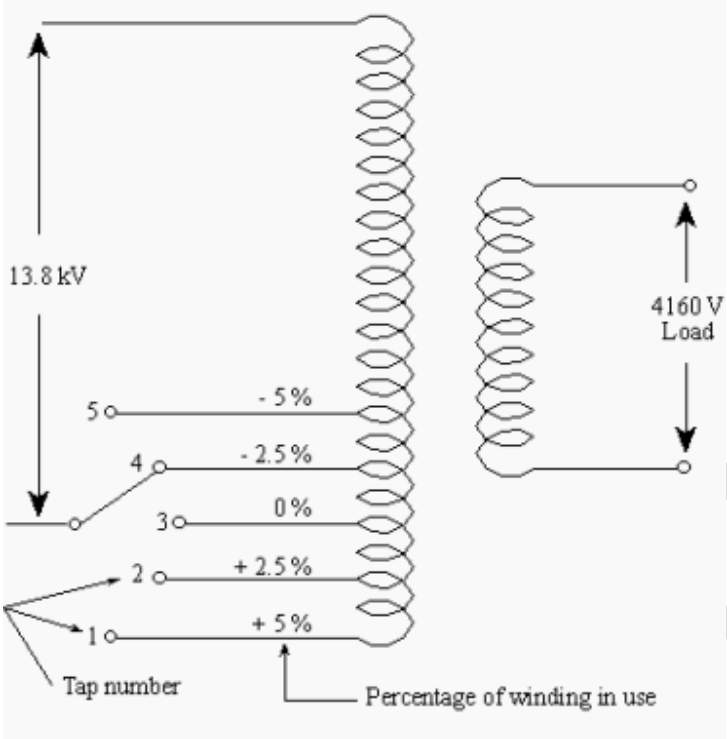
Figure 11.21 - Compounding of Convertors

(5M)

Explanation:Compoundexcitation of AC machines is usedprimarily in automaticvoltageregulationsystemsforhigh-powerturbogeneratorsandhydraulicgenerators. A compoundexcitationcircuitincludescurrenttransformers, a rectifier,andloadresistances.----------(5M)

3 **Explain the operation of transformer tap changing.(15M)BTL2**

Definition:The purpose of a tap changer is to regulate the output voltage of a transformer. It does this by altering the number of turns in one winding and thereby changing the turns ratio of the transformer. There are two types of transformer tap changers: an on-load tap changer (OLTC) and a deenergised tap changer (DETC)----------(5M)



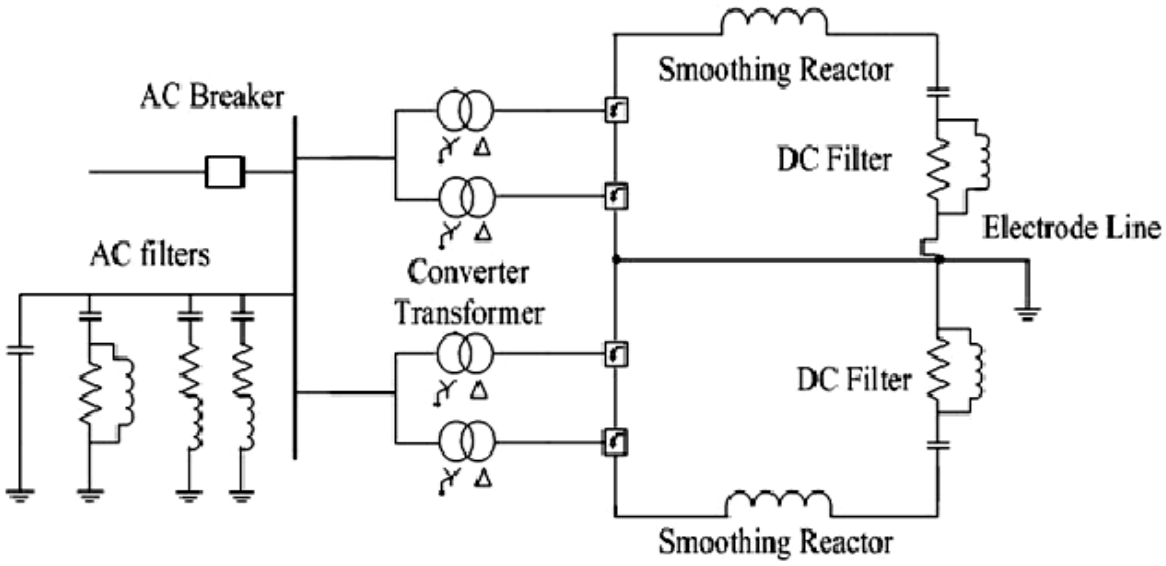
----------(5M)

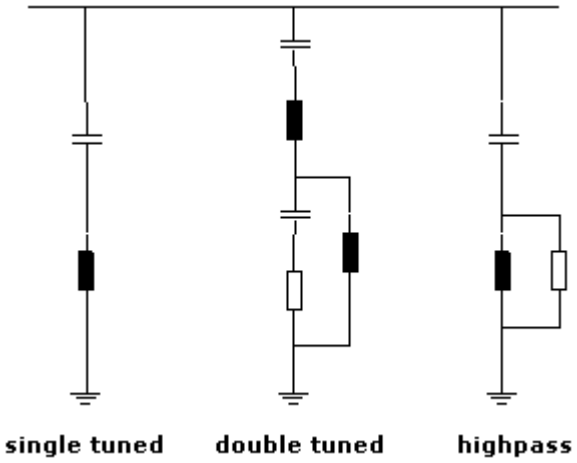
Explanation:A tap changer is a mechanism in transformers which allows for variable turn ratios to be selected in discrete steps. Transformers with this mechanism obtain this variable turn ratio by connecting to a number of access points known as taps along either the primary or secondary winding.----------(5M)

	UNIT IV REACTIVE POWER AND HARMONICS CONTROL
	Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.
Q.No.	**PART*A**
1.	**Mention the performance criteria for selection of harmonic filterBTL2** • Harmonic distortion • Telephone influence factor • Telephone Harmonic form factor IT product
2	**Mention the Types of filtersBTL2** There are basically two types of filters Passive filters---- tuned filters and damped filter; single and double tuned , high pass filters Active filters
3	**State the ill effects of harmonics injected into the AC line?BTL3** • Telephone interference • Extra power looses& consequent heating in machines Over voltages due to resonances • Instability of converter controls • Interference with ripple control system used in load management.
4	**What is radio interference? BTL1** The radio interference is mainly due to the positive conductor. This is Because of the fact that the corona discharges from the negative conductor are in the form of trichel pulses which are uniformly distributed

	ever the conductor surface
5	**What are the sources of harmonics? BTL1** • Magnetization nonlinearities of transformer Rotating machines and Adjustable speed drives. • Arcing devices and Electronic and medical test equipment • PCs and office machines , Induction Heaters • Semiconductor based power supply system • Inverter fed A.C. drives , Thyristor controlled reactors • Phase controllers and A.C. regulators
6	**What are the effects of trouble caused by harmonics? BTL1** 1.Resonance 2. Poor Damping 3. efficiency of motor reduced 4. Overheating of cable 5. Trip of protection 6. Overheating at winding. 7.Increase magnetic losses.
7	**Define THD.BTL2** The THD is a measure of the *effective value of the harmonic components* of a distorted waveform. That is, it is the potential heating value of the harmonics relativeto the fundamental. This index can be calculated for either voltage or current $THD = \frac{\sqrt{\sum_{h=2}^{h_{max}} M_h^2}}{M_1}$
8	**What are the means to reduce harmonics? BTL1** Using filter (passive and active filters)circuit and increasing pulse number

9	**List the causes of non-characteristics harmonics. BTL2** a) Imbalance in the operation of two bridges forming 12 pulse converter b) Firing angle errors c) unbalance and distortion in AC voltage and d) unequal transformer leakage impedances
10	**Write the effects of unbalanced voltages. BTL3** The presence of the negative sequence component in the AC voltages shifts the zero crossing of the commutation voltages.
11	**Mention the criteria for selection of DC filter. BTL2** • Maximum voltage TIF on DC high voltage bus • maximum induced noise voltage in mv/km in a particular test line one km away from the HVDC line • maximum permissible noise to ground in dB in telephone lines close to the HVDC lines.
12	**Define short circuit ratio(SCR)BTL1** The short circuit ratio is defined as $SCR = \frac{\textbf{short}\ circuit\ level\ at\ the\ converter\ bus}{rated\ DC\ power}$
13	**What are the factors depends commutation failure? BTL1** The recovery from a commutation failure depends on the following Factors The response of the gamma controller at the inverter The current control in the link The magnitude of AC voltage
14	**What are the Function of smoothing reactor**?BTL1 A sufficiently large series reactor is used on DC side tosmooth DC current and also for protection. The reactor is designedas a linear reactor and is connected on the line side, neutral side.

	PART*B
1.	**Explain in detail about the passive and active DC filters with the design criteria. APRIL/MAY 2015) (13M) BTL3** **Answer: Page :4.34 BHARANI** • Passive filters---------- (3M) • Active filters ----------(4M) Symmetrical faults----(3M)  **Explanation**:Passive filters. Passive implementations of linear filters are based on combinations of resistors (R), inductors (L) and capacitors (C). These types are collectively known as passive filters, because they do not depend upon an external power supply and/or they do not contain active components such as transistors--------(3 M)
2	**Why are harmonics generated in HVDC converter and what are the problems associated with the harmonics? Suggest some remedial measures. (APRIL/MAY 2015) (13M) BTL3** **Answer : Page:1.57 - M.Jeraldin Ahila** **Definition:**A passive filter component is a combination of capacitors and inductors that are tuned to resonate at a single frequency, or through a band of frequencies. In power systems, passive filters are used to suppress harmonic currents and decrease voltage distortion appearing in sensitive parts of the system.----------(3M) Double tuned filters----------(3M) Harmonics filters----------(4M)

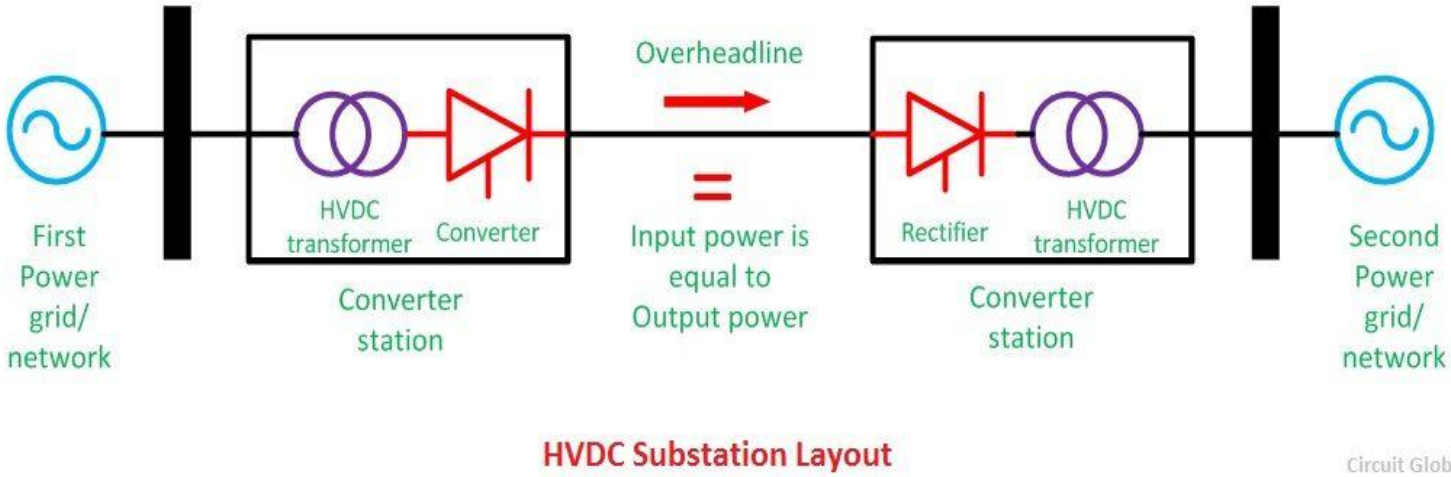


Explanation: Three-phase harmonic filters are shunt elements that are used in power systems for decreasing voltage distortion and for power factor correction. Nonlinear elements such as power electronic converters generate harmonic currents or harmonic voltages, which are injected into the power system.---------- (3M)

3 **Briefly describe a method of recording the occurrence of lightning in an overhead transmission line.(APRIL/MAY 2015) (13M) BTL3**

Answer: Page :1.34 - M.Jeraldin Ahila

- Ferranti effect---------- (3M)
- Symmetrical faults--------(4M)
- Un-Symmetrical faults----(3M)

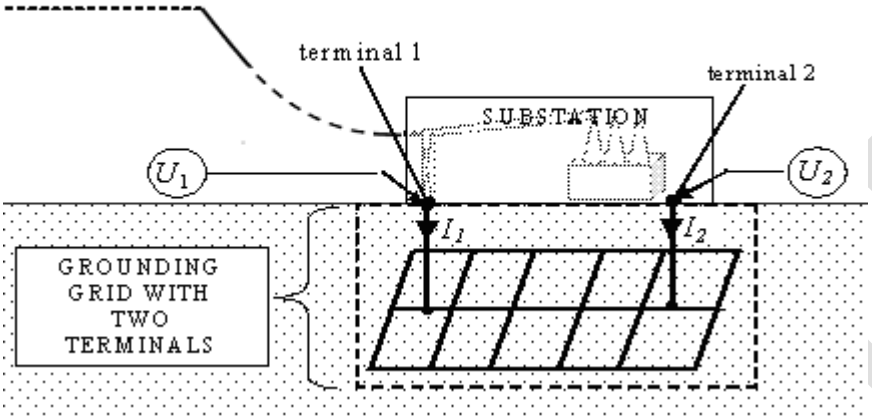


Explanation: Faults which leads unequal currents with unequal phase shifts in a three phase system. The unsymmetrical fault occurs in a system due to presence of an open circuit or short circuit of transmission or distribution line. It can occur either by natural disturbances or by manual errors--------(3 M)

4 **Mention about the technique of reflection of 2 substations system.(13M) BTL5**

Answer : Page:1.57 - M.Jeraldin Ahila

- Under the influence of sufficiently strong fields, large water drops become elongated in the direction of the field and become unstable, and streamers develop at their ends.-----(3M)
- A substation is a part of an electrical generation, transmission, and distribution system.
- Substations transform voltage from high to low, or the reverse, or perform any of several other important functions.----------(6M)

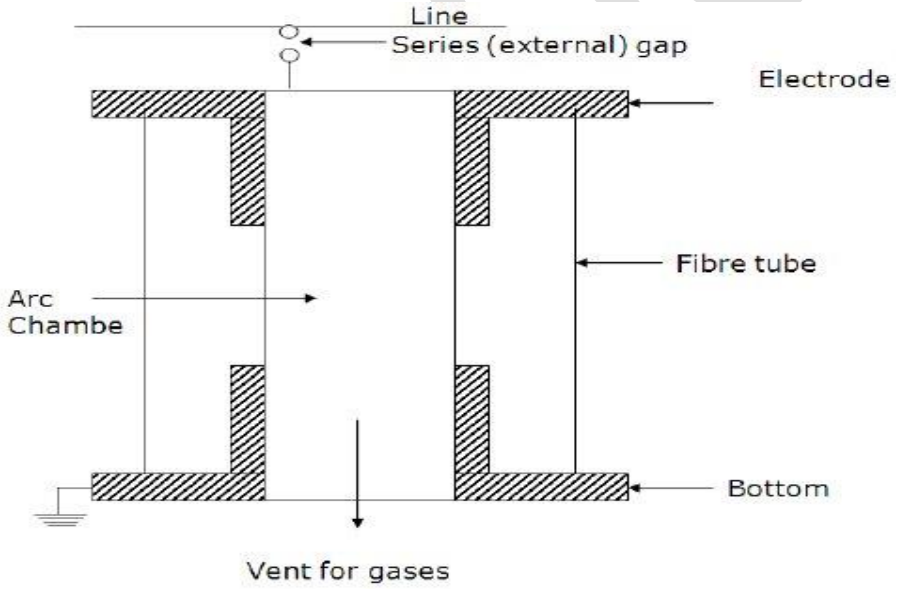


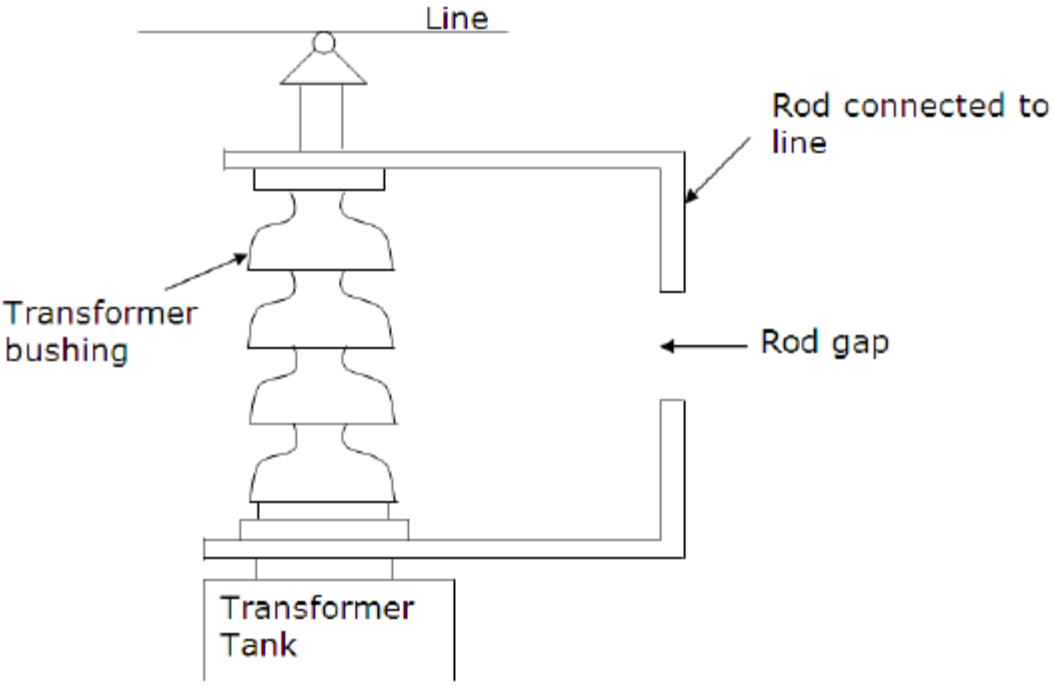
- Electrical substations are the interface between parts of the distribution gridand transmission systems---(4M)

5 **Explain the construction and working principle of expulsion gaps and protector tubes.(13M) (APRIL/MAY 2017) 9**BTL1

Answer :Page:1.40 - M.Jeraldin Ahila

- Rod gaps----------(3M)
- Expulsion gaps----------(4M)





Explanation:During operation arc due to the impulse spark-over inside the fibrous tube causes some fibrous material of the tube volatized in the form of gas, which is expelled through a vent from the bottom of the tube, thus extinguishing the arc just like in circuit breakers----------(6M)

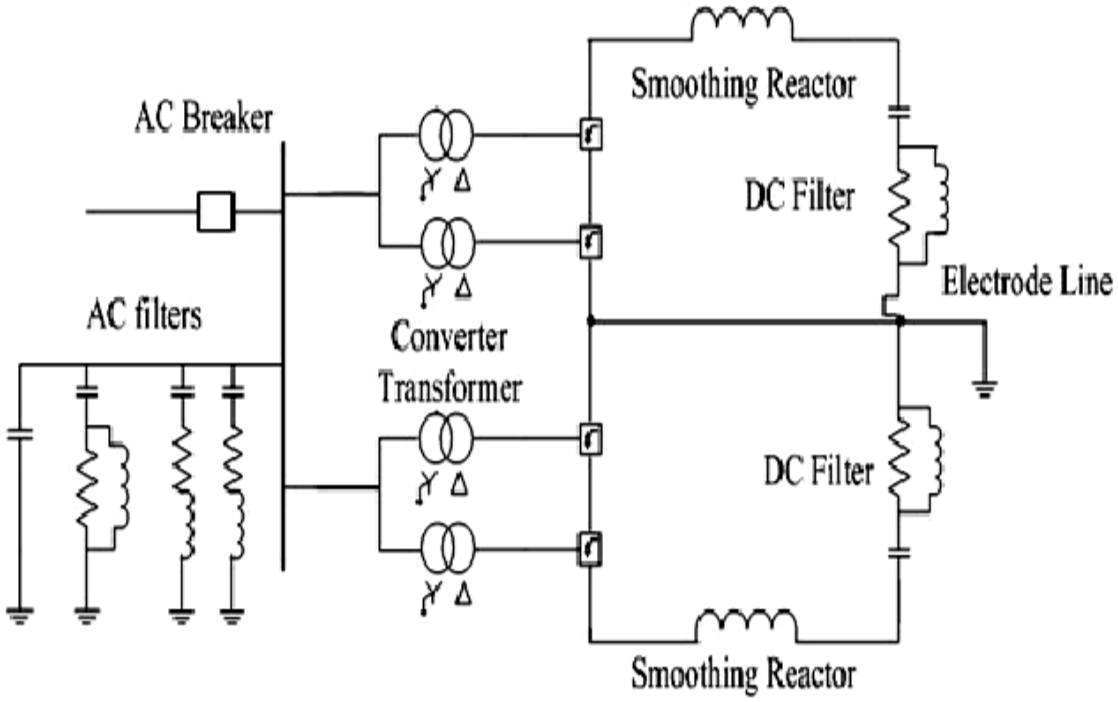
PART*C

1. **Explain in detail various types of filters used in HVDC systems.(15M) BTL2(April/May 2015)**
Answer: Page: 4.30-Bharani

Definition: HVDC filter reactors are installed on the AC side (c) as well as on the DC side (b) of the converter station. AC filters serve two purposes at the same time, providing reactive power and reducing harmonic currents. DC filters are installed on the line side of the HVDC smoothing reactor in shunt with the DC line... ----------(3M)

Active filters used in HVDC transmission systems ----------(3M)

Harmonics and filters used in the power system----------(4M)



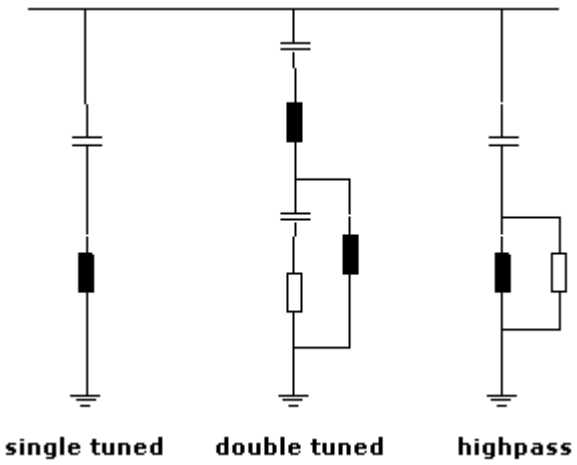
Explanation: Thyristor Bridge in HVDC System itself draws considerable amount of reactive power from its AC Source, it may results in drop of voltage level in AC source. Hence, to supply this Reactive power, tuned AC Filters are provided in AC Yard. The capacitors in AC Filters can supply the required reactive power to the Bridge and it no longer depends on the AC source for reactive power. ----------(3M)

2 **Discuss briefly the design of single tuned filters used in HVDC systems.(15M) BTL2(April/May 2015)**
Answer: Page: 4.35-Bharani

Definition:A passive filter component is a combination of capacitors and inductors that are tuned to resonate at a single frequency, or through a band of frequencies. In power systems, passive filters are used to suppress harmonic currents and decrease voltage distortion appearing in sensitive parts of the system.----------(3M)

Double tuned filters----------(3M)

Harmonics filters----------(4M)



Explanation: Three-phase harmonic filters are shunt elements that are used in power systems for decreasing voltage distortion and for power factor correction. Nonlinear elements such as power electronic converters generate harmonic currents or harmonic voltages, which are injected into the power system.----------(3M)

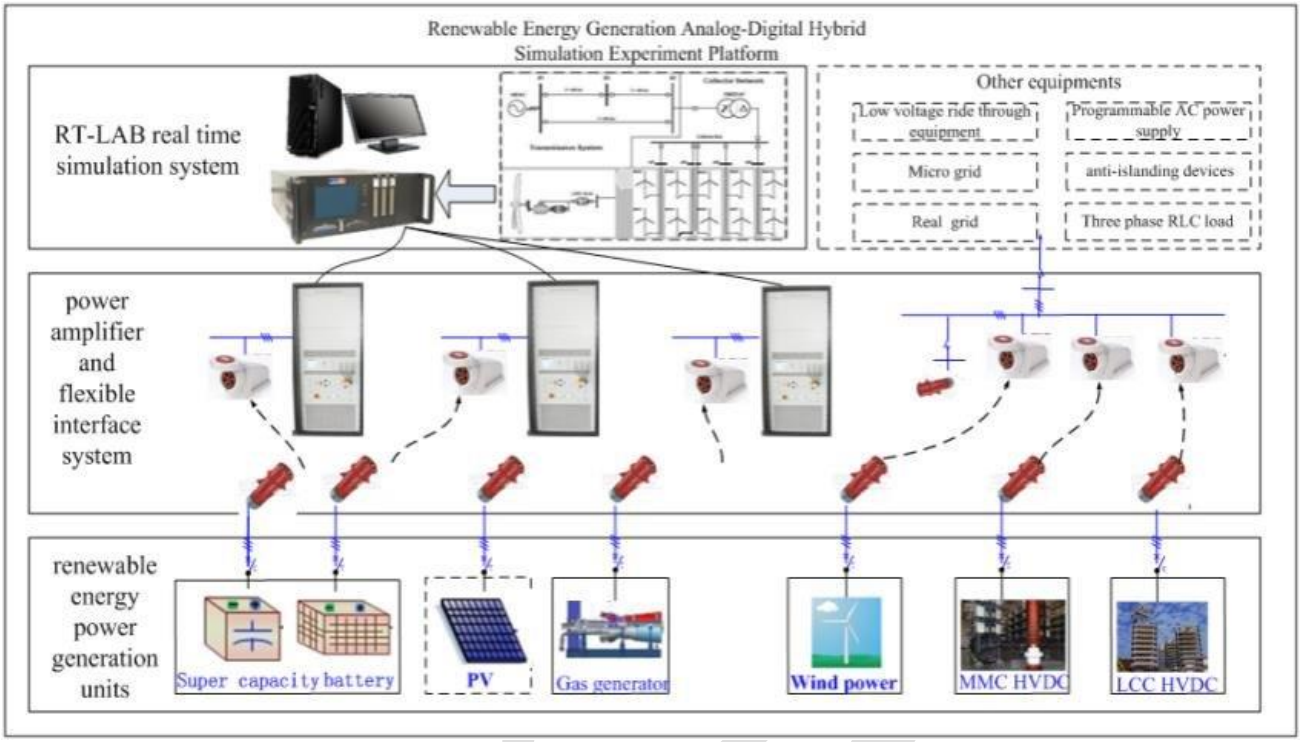
	UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS
	Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study.
Q.No.	**PART*A**
1.	**What is HVDC simulator?BTL1** HVDC simulator is similar to transient network analyzer (TNA) which is Used to determine over voltages in AC systems due to switching surges and load refection.
2	**What are the requirements of a good simulation tool? BTL1** • The requirements of good simulation tool are as follows, • Easy maintenance Accuracy of solution Flexibility of use Reduced cost • Real time simulation • Easy monitoring and control
3	**List some tools used for the simulation of HVDC simulation. BTL2** • Physical simulator • Parity simulator • Analog computer • Digital computer

	• Hybrid computer
4	**Write the application of HVDC transmissionBTL3** • Long distance bulk power transmission Underground or under water cables • Asynchronous interconnection of AC systems operating at different frequencies • Control and stabilization of power flows in AC ties.
5	**What is parity simulator? BTL1** A parity simulator is essentially a synthetic breadboard which Electronically simul tes the physical terminal characteristics of Each network element r ther than its mathematical input/output.
6	**List the assumption made to develop the equivalent circuit of a converter(U)** • Bridge used in dynamic simulation. • All the values in a bridge have identical characteristicsA value offers infinite impedance in the r ve se direction • The grading and damping circuits across the values are ignored The current id is assumed to be continuous and non zero. L/R of each phase of the converter transformer in the same.
7	**What are the applications of DC simulator? (U)** The application of DC simulator are, • Insulation coordination • Testing of controllers and their optimization • Evaluation of surge arrestor ratings • Harmonic analysis
8	**State the advantages of parity simulator? BTL2** • It avoids drawback of an analog computer simulation • The advantages of an analog computer interms of change in • Time scaling are retained while eliminating the drawbacks • The principle of parity simulation permits hybrid structure.
9	**Write the advantages of digital dynamic simulation. BTL2** • Easy Transportability and maintenance • Reduced cost of simulation

	• Flexibility interms of representing any components of the system**.**
10	**Write the disadvantages of digital dynamic simulation. BTL2** • Increased simulation time • Lack of adequate mathematical models • Numerical problems and • Lack of interactive capability
11	**Mention the types of valve model. BTL3** 3 types are: Time varying impedance, ideal switch which is controllable and ideal switch in series with a constant voltage source.
12	**What are the approaches used for transient analysis of electrical network? BTL1** The use of trapezoidal rule of iteration to transform the energy storageelements to resistive elements with current source across them which represent thepast history.Formulation of stage equation for network
13	**What are two types of programs used for HVDC system studies?BTL1** • AC/DC load flow analysis • AC/DC transient stability analysis
14	**What are advantages of EMPT representation of elements in DC system? BTL1** • Easy of obtaining solutions particularly for piece wire linear components • Inclusion of models for distributed lossless elements such as long transmission lines.
15	**Write the equations representing the equivalent circuit of lumped element. BTL2** **For Inductor**: $i(t) = (1/L)\int v(t)\,dt + i(t-h)$ Apply trapezoidal rule $I(t) = (h/2L)\,[\, v(t) + v(t-h) + i)\, t-h)$ **For capacitor** $I(t) = -(2C/h)\,[\, v(t) + v(t-h) + i(\, t-h)$

16	**Drawbacks of parity simulation. (U)** The problem of offset voltages and currents of OP-AMP used. Each component of a parity simulator is electrically isolated, there could be problems of interconnection and EMC.
17	**Comparison between insulation characteristics of DC and AC cable. (U)** • In the ac cable case, the radial dielectric stress distribution is dependent upon the permittivity of the dielectric. Where in the case of dc the stress distribution determined by insulation resistance. • In the case of an ac cable the maximum stress always appears at the conductor surface, but with dc the maximum stress may appear at the conductor surface or at the outer boundary of the dielectric, depending on the temperature. • The dc strength of a dielectric is much higher than AC strength • With ac cables the temperature limitations are set by the physical behaviors of the material and the method of construction whereas with dc cable the temperature limitations are set by the physical behaviors of the material and the method of construction but also by variations in dielectric stressing arising from temperatureeffects.
18	**Write practical dielectrics used in HVDC cables. BTL2** Impregnated paper and polythene
19	**Compare the DC and AC cables from economic point of view. BTL3** DC is particularly applicable to long submarine cable transmission where the cost ratio ishigh. The cost of DC cable is only a fraction of those for the AC cable and in additionmuch less physical space tends to be required in the waterway involved. in DC cablethe problems such as migration of impregnating compound, movement of the ball s onthe sea-bed, under the effects of currents which may affect the economic considerations.
	PART* B
1.	**Explain the modelling of HVDC systems for digital dynamic simulation.(13M)(April/May 2016) BTL1** **Answer: Page: 4.50-Bharani** **Definition:**A high-voltage, direct current (HVDC) electric power transmission system (also called a power superhighway or an electrical superhighway) uses direct current for the bulk transmission of electrical power, in contrast with the more common alternating current (AC) systems.------(3M) Transient stability conditions----------(3M)

Steady state analysis model----------(4M)



Explanation: The power system is modeled using the Dig Silent Power Factory software package. The power system of Crete is modelled for a number of representative scenarios regarding load demand, renewable energy sources penetration and conventional generation loading.----------(3M)

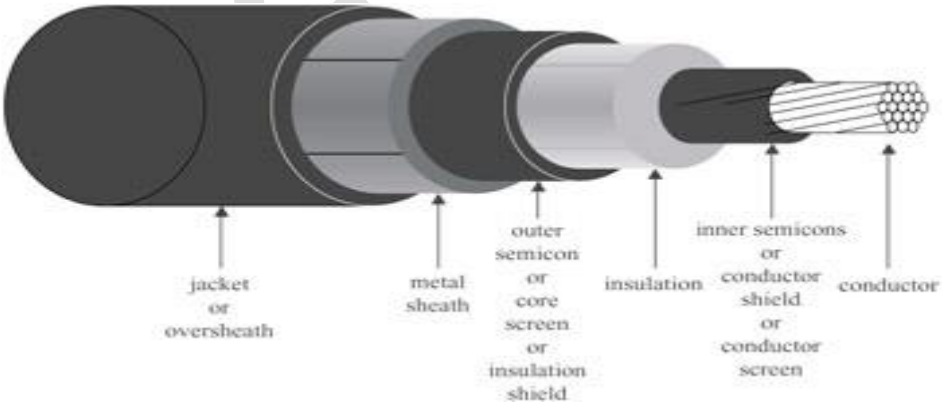
2

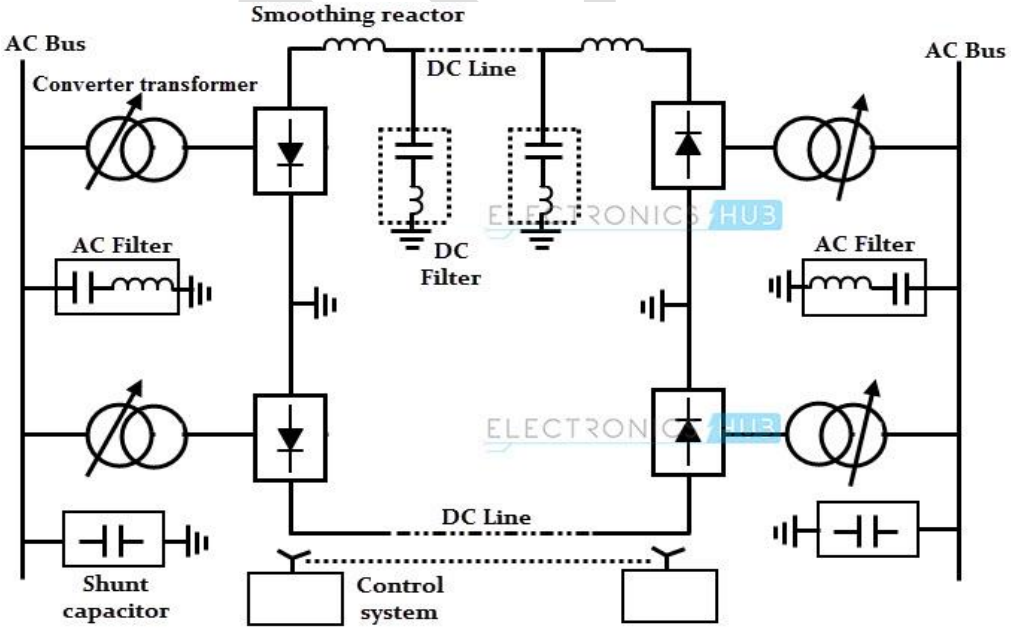
Explain the physical phenomenon considered for the design cable insulation. (13M)BTL1 (April/may 2016)
Answer: Page: 4.55-Bharani

Definition. Most high-voltage conductors used by Hydro-Québec are made of aluminum with a steel core that gives the cable its required strength. Curiously, these conductors are bare: the air around them provides insulation. ----------(3M)

Underground cable----------(3M)

Overhead line in transients----------(4M)



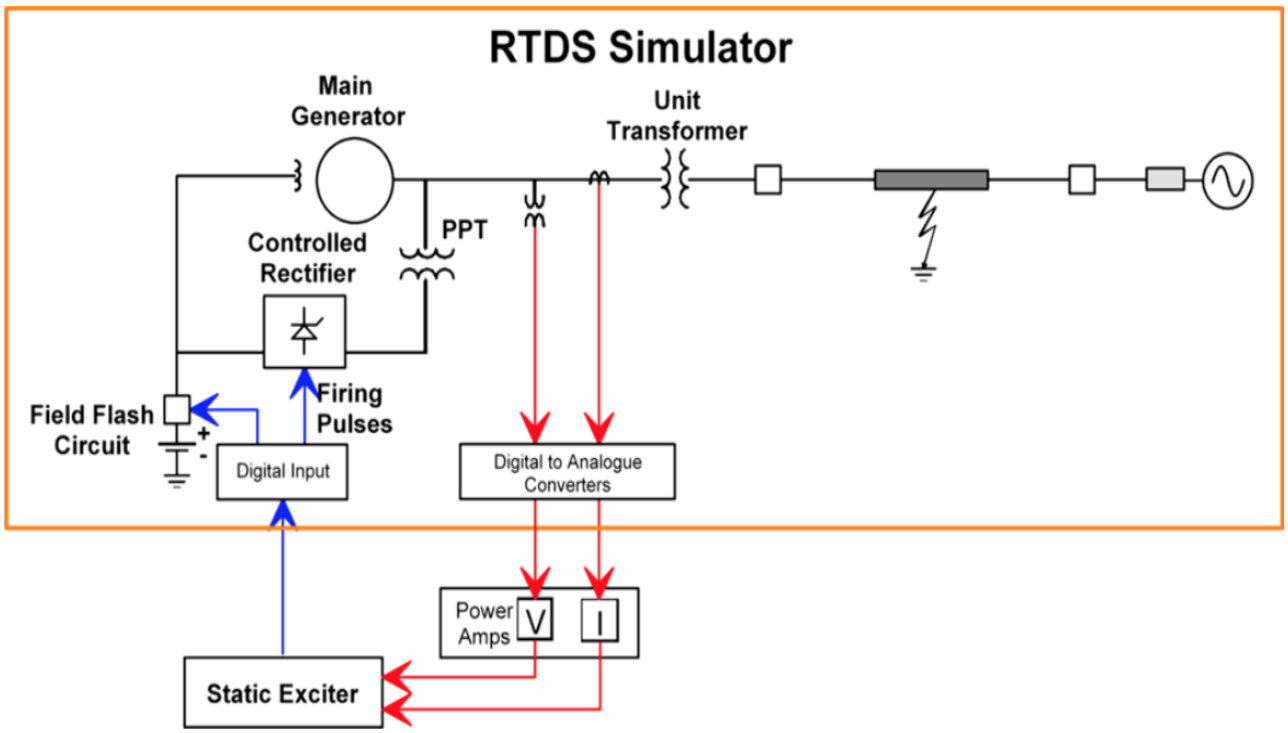
	Explanation:HVDC stands for high voltage direct current, a well-proven technology used to transmit electricity over long distances by overhead transmission lines or submarine cables. It is also used to interconnect separate power systems, where traditional alternating current (AC) connections cannot be used.----------(3M)
3	**Write short notes on Cables. (13M) BTL3 (April/may 2017)** **Definition:** A high-voltage cable (HV cable) is a cable used for electric power transmission at high voltage. A cable includes a conductor and insulation and is suitable for being run underground or underwater. This is in contrast to an overhead line, which does not have insulation. ---------(3M) AC power cables ----------(3M) Cable joints ----------(4M) **Explanation**:There are different causes for faulty cable insulation when considering solid dielectric or paper insulation. Hence, there are various test and measurement methods to prove fully functional cables or to detect faulty ones. ----------(3M)
4	**Explain how the values are modelled to realises the switching action that can be used in dynamic simulation of a HVDC systems. (13M) BTL1 (April/may 2017)** **Answer: Page: 4.55-Bharani** **Definition.**Dynamic simulation (or dynamic system simulation) is the use of a computer program to model the time varying behavior of a system. The systems are typically described by ordinary differential equations or partial differential equations. As mathematical models incorporate real-world constraints, like gear backlash and rebound from a hard stop, equations become nonlinear. ----------(3M) Dynamic simulation and power gradient systems ----------(3M) Micro dynamics analysis model----------(4M)  **Explanation**:A dynamic model represents the behaviour of an object over time. It is used where the object's behaviour is best described as a set of states that occur in a defined sequence.----------(3M)

5 **What are the advantages and disadvantages of digital simulation. (13M)BTL1(April/May 2014)**

Definition: The transient characteristics of magnetizing inrush currents and internal faults, including symmetrical and asymmetrical faults as well as the winding turn-to-turn and turn-to-ground faults of the power transformer are studied in detail.----------(3M)

Real time simulation----------(3M)

Specific voltage variation----------(4M)

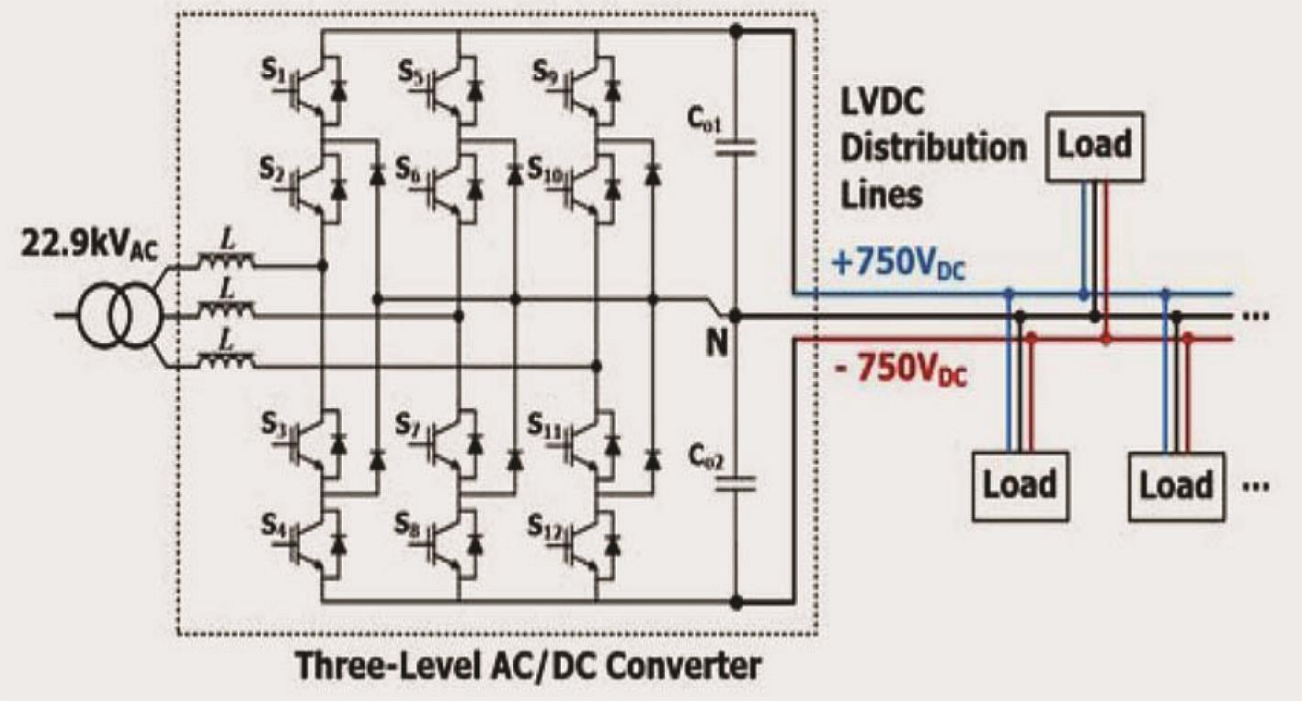


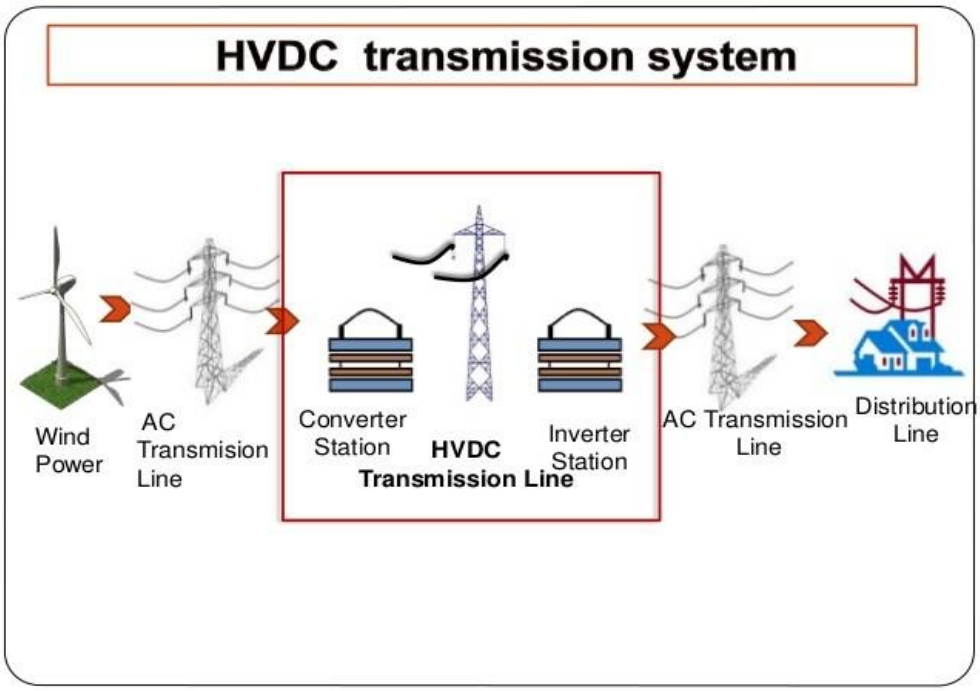
Explanation:The purpose of the simulation is to develop alternative techniques for satisfactorily protecting the power transformer under a whole variety of practically encountered faults and at the same time being able to distinguish internal faults from magnetising inrush current.----------(3M)

PART*C

1. **Explain the parity simulator and bring out its advantages over analogy computer simulation. (15M) BTL1 (April/may 2017)**

Definition:. In an HVDC system, electric power is taken from one point in a three-phase AC network, converted to DC in a converter station, transmitted to the receiving point by an overhead line or cable and then converted back to AC in another converter station and injected into the receiving AC network. Typically, an HVDC transmission has a rated power of more than 100 MW and many are in the 1,000 – 3,000 MW range. ----------(4M)

	Point-to-point transmission ----------(4M) Back-to-back stations ----------(4M)  **Explanation**: One of the most important differences between HVDC and AC is the possibility to accurately control the active power transmitted on a HVDC line. This is in contrast to AC lines, where the power flow cannot be controlled in the same direct way. The controllability of the HVDC power is often used to improve the operating conditions of the AC networks where the converter stations are located..----------(3M)
2	**Briefly explain about various types of system studies in HVDC systems. (15M) BTL1 (April/may 2017)** **Definition:**. HVDC is necessary or desirable from the technical point of view HVDC results in a lower total investment (including lower losses) and/or is environmentally superior. ----------(4M) Improve power quality, stability ----------(4M) Maximize grid performance ----------(4M)



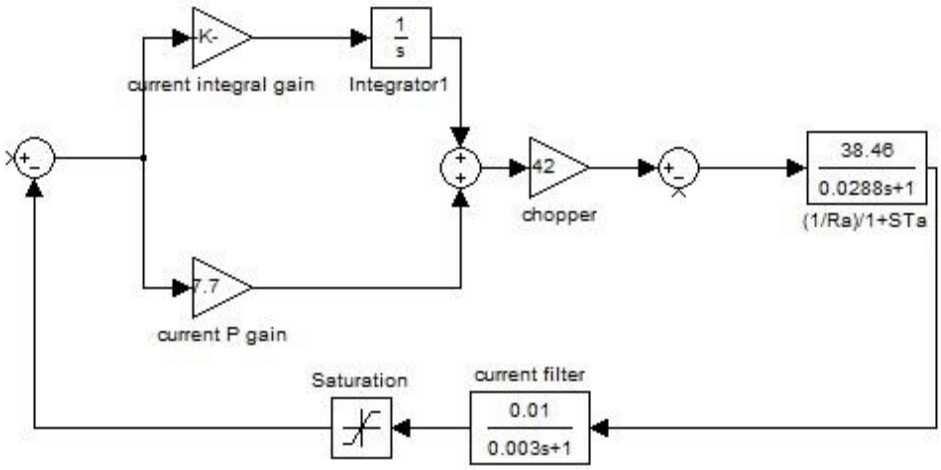
Explanation: HVDC stands for high voltage direct current, a well-proven technology used to transmit electricity over long distances by overhead transmission lines or submarine cables. It is also used to interconnect separate power systems, where traditional alternating current (AC) connections cannot be used----------(3M)

3 **Describe the various problem arise in DC system models. (15M) BTL3 (April/May 2016)**

Definition: The accurate DC system model is the key to fault analysis and harmonic calculation of AC/DC system. In this paper, a frequency domain analysis model of DC system is established, and based on it a unified fundamental frequency and harmonic iterative calculation method is proposed... ----------(4M)

Load flow state analysis system ----------(4M)

DC short circuit systems ----------(4M)



Explanation: Voltage ratings for HVDC point-to-point connections are not standardized and tend to depend on the latest available cable technology. DC/DC conversion at HV is required for interconnection of such HVDC schemes as well as to interface dc wind farms. Modular multilevel voltage source converters (VSCs), such as the modular multilevel converter (MMC) or the alternate arm converter (AAC), have been shown to incur significantly lower switching losses than previous two- or three-level VSCs----------(3M)

GE6075 PROFESSIONAL ETHICS IN ENGINEERING

Objectives:

- To enable the students to create an awareness on engineering ethics and human values, to instill moral and social values and loyalty and to appreciate the rights of others.

Unit I Human Values 10

morals, values and ethics – integrity – work ethic – service learning – civic virtue – respect for others – living peacefully – caring – sharing – honesty – courage – valuing time – cooperation – commitment – empathy – self confidence – character – spirituality – introduction to yoga and meditation for professional excellence and stress management.

Unit II Engineering Ethics 9

senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – kohlberg's theory – gilligan's theory – consensus and controversy – models of professional roles – theories about right action – self-interest – customs and religion –uses of ethical theories.

Unit III Engineering as social experimentation 9

Engineering as experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law.

Unit IV Safety, responsibilities and rights 9

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – intellectual property rights (IPR) – discrimination.

Unit V Global issues 8

Multinational corporations – environmental ethics – computer ethics – weapons development engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership –code of conduct – corporate social responsibility.

Total: 45 Periods

Outcomes:

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

Text Books:

1. Mike W. Martin and Roland Schinzinger, "Ethics In Engineering", Tata Mcgraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall Of India, New Delhi, 2004.

References:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard And Michael J. Rabins, "Engineering Ethics – Concepts And Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics And The Conduct Of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer And Robert L Barry, "Fundamentals Of Ethics For Scientists And Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman And Joe Desjardins, "Business Ethics: Decision Making For Personal Integrity And Social Responsibility" Mc Grawhill Education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri Publications, Erode, 2011

SUB CODE: GE6075 SUB NAME: PROFESSIONAL ETHICS IN ENGINEERING

SUBJECT HANDLER: L.PATTATHURANI YEAR /SEM: IV/08

	UNIT –I HUMAN VALUES
	Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.
Q.NO	**PART * A**
1	**What are human values?**BTL2 Values decide the standard of behavior. Some universally accepted values are freedom justice and equality. Other principles of values are love, care, honesty, integrity, self-respect.
2	**Define ethics. What are ethical values?(MAY-JUNE 2016) (NOV-DEC 2015)** BTL2 The philosophical study of the moral value of human conduct and of the rules and principles that ought to govern it. Trustworthiness, respect, responsibility, fairness, caring is ethical values
3	**Distinguish values from ethics and culture. (MAY-JUNE 2016)** BTL4 Values are mainly related to individuals and since they are related to justice, they remain the same for everyone. E.g. Truth, honesty, empathy, self-respect. Values do not change from individual to individual. Ethics is common to a group of individuals; the group may be religious or professional. Ethics is mostly based on some code or law and judgment of any action is based on code of conduct or law. Ethics change from individual to individual Culture commonly refers to conduct of a group. e.g system of worship, marriage. It may differ from society to society, nation to nation or religion to religion.

4	**What is integrity? (NOV-DEC2018)** BTL2 Integrity is the unity of character based on moral values. Consistency in attitudes, emotions and conduct in relations to morally justified actions and values are also the part of integrity of individual. It implies honesty, trustworthiness.
5	**What is courage as a value?** BTL2 Courage implies self-respect and governs confrontations with danger and risk. It is not excessive rashes or cowardice, but it is the middle ground. Taking calculated risks and boldness in facing crises are the hallmarks of courage as a human value. It defines the mental makeup of an individual in taking bold decisions even under adverse situations.
6	**Define work ethics.**BTL2 By one's work one cannot harm others. Any worker cannot escape accountability. Worker has the moral responsibility to see that no other person's right, private or freedom is impaired or transgressed.
7	**What is service learning? (APR-MAY 2017)** BTL2 Service learning tells that one has moral responsibility to increase the desirable effects and to decrease the harmful effects. Any service should increase the desirable result.
8	**Mention some civic virtues. (NOV/DEC 2018)(APRIL/MAY 2019)** BTL1 Good citizen demand civic virtue. It is the principle of not harming the surroundings .it also includes living peacefully, respect for others, protecting the environment and being normally and ethically good.
9	**Write short notes on caring and sharing.** BTL3 Caring is the essence of moral life. Caring involves feelings, relationship, contends with other persons and protecting others and causing least damage to others. Sharing means sharing of feelings, ideas thoughts, resources and profits. Sharing is always mutually beneficial. Sharing morally acceptable feelings, resources and materials is a value.
10	**Write notes on honesty.** BTL3 Any human being should imbibe honesty-honesty in acts, honesty in speech and honesty in beliefs. Honesty is the fundamental virtue in human relationship even though in may be difficult to follow some times.
11	**Give short notes on co-operation.** BTL1 Co-operation means extending help to others, for a good cause. Co-operation may be through an idea, a suggestion, an assistance or physical work which extends to others for common benefit.
12	**Define empathy. (NOV/DEC 2018)** BTL2 Empathy means putting self in a position of someone else and thinking as the later and reasoning suitable action.
13	**Write a note on Integrity.** BTL2 Integrity is the bridge between responsibility in private and professional life.
14	**What do you mean by Compromise?** BTL2 In a negative sense it means to undetermined integrity by violating one's fundamental moral principles. In a positive sense, however, it means to settle differences by mutual concessions or to reconcile conflicts through adjustments in attitude and conduct.
15	**Give the two aspects of Honesty.(NOV-DEC 2016)(NOV/DEC 2019)** BTL1

	Truthfulness – meeting responsibilities concerning truth-telling. Trustworthiness –Meeting responsibilities concerning trust.
16	**Differentiate Self-respect and Self-esteem.** BTL4 Self-respect: It is a moral concept; refers to the virtue properly valuing oneself. Self-esteem: It is a psychological concept; means having a positive attitude toward Oneself, even if the attitude is excessive or otherwise unwarranted.
17	**What are Human values? (NOV –DEC 2016)** BTL2 Values are the rules by which we make decisions about right and wrong, should and shouldn't, good and bad. "Emotional beliefs in principles regarded as particularly favorable or important for the individual." Types of Values: (a) Right conduct, (b) Peace (c) Truth, (d) Love, (e) Nonviolence.
18	**What are the factors that demonstrate a strong work ethic?** BTL2 1 Integrity, 2 Sense of Responsibility 3 Emphasis on Quality 4 Discipline 5 Sense of Teamwork.
19	**List the characteristics of a Good Work Ethic.** BTL1 Reliability, Dedication, Productivity, Cooperation, and Character
20	**State the term called civic virtue. (NOV/DEC 2018) (APRIL/MAY 2018)**BTL1 Civic virtues are the moral duties and rights, as a citizen of the village or the country or an integral part of the society and environment. **Civic virtues are divided into four categories**: 1. Civic Knowledge 2. Self-Restraint 3. Self-Assertion 4. Self-Reliance
21	**Give short notes on Respect for others.** BTL1 Respect is a positive feeling of admiration or deference for a person. Respect can be a specific feeling of regard for the actual qualities of the one respected. It can also be conduct in accord with a specific ethic of respect. Treating people with respect makes your world a nicer place to live in, whether it's at home, at school, or out in your community. Don't insult people or make fun of them.
22	**Write a note on living peacefully.** BTL3 To live peacefully, one should start install peace within (self). Charity begins at home. Then one can spread peace to family, organization where one works, and then to the world, including the environment. Only who are at peace can spread peace. You cannot gift an article which you do not possess. The essence of oriental philosophy is that one should not fight for peace. It is oxymoron. War or peace can be won only by peace, and not by wars.
23	**Write short notes on various terms Self- Confidence, Character and Spirituality.** BTL3 **(May/June 16)(NOV-DEC2018) (NOV-DEC 2015)** **Self- Confidence**: Certainty in one's own capabilities, values, and goals. These people are usually positive thinking, flexible and willing to change. They respect others so much as they respect themselves.

Character: To determine the ideals.
Spirituality: Spirituality is a way of living that emphasizes the constant awareness and recognition of the spiritual dimension (mind and its development) of nature and people, with a dynamic balance between the material development and the spiritual development.

24 **Define moral values. (APR- MAY 2017) (APR- MAY 2015) (NOV-DEC 2015) (APRIL/MAY 2019)** BTL2

Moral value is value that must be separated with other values. Every value will get quality if it has relation with other values. For example, Honesty is example of moral values; this value has no meaning if it does not be applied with other values. Economic Value is relation of human and thing. Thing is needed because its usefulness. Economic Value relate with purpose value. Loyalty is moral value, but it must be applied with other, humanity value for general, for example, love of husband and wife.

25 **Define spirituality. (NOV-DEC 2015)**BTL2

, "Spirituality is often experienced as a source of inspiration or orientation in life. It can encompass belief in immaterial realities or experiences of the immanent or transcendent nature of the world."

26 **Difference between Mortality and Ethics. [Dec 2012]** BTL4

Mortality	Ethics
Based on customs and tradition.	It is a critical reflection of moral
Concerned with wrong action when done	Concerned with right action when not
Top Priority is given because damage is	Less priority & less serious
Example: corruption and crime	Example: belief about manners

PART * B

1 **Explain some important human values. (13M) (April 2014)(NOV/DEC 2019)** BTL2

Answer :Page 1- V.Jayakumar

Important human values :(9 M)

The five core human values are: (1) Right conduct, (2) Peace, (3) Truth, (4) Love, and (5) Nonviolence.
1. values related to right conduct are:
(a) Self-help skills: care of possessions, diet, hygiene, modesty, posture, self-reliance, and tidy appearance
(b) Social skills: good behavior, good manners, good relationships, helpfulness, no wastage, and good environment.
(c) Ethical skills: code of conduct, courage, dependability, duty, efficiency, ingenuity, initiative, perseverance, punctuality, resourcefulness, respect for all, and responsibility.
2. Values related to peace are: attention, calmness, concentration, contentment, dignity, discipline, equality, equanimity, faithfulness, focus, gratitude, happiness, harmony, humility, inner silence.
3. Values related to truth are: accuracy, curiosity, discernment, fairness, fearlessness, honesty, integrity (unity of thought, word, and deed), intuition, justice.

	4. Values related to love are: acceptance, affection, care, compassion, consideration, dedication, devotion, empathy, forbearance, forgiveness, friendship, generosity. 5. Values related to non-violence are: (a) Psychological: benevolence, compassion, concern for others, consideration , forbearance, forgiveness, manners, happiness, loyalty, morality, and universal love (b) Social: appreciation of other cultures, religions, brotherhood, care of environment, citizenship, equality, harmlessness, c) Perseverance persistence, determination, resolution, tenacity, dedication, commitment, constancy, steadfastness, stamina, endurance and indefatigability. d) Accuracy means freedom from mistake or error; conformity to truth or to a standard or model and exactness. e) Discernment means discrimination, perception, penetration, and insight. Discernment, powers to see not obvious to average mind. Stresses accuracy, especially in reading character, motives. **Evolution of Human Values: (4 M)** The human values evolve because of the following factors: 1. The impact norms of the society, fulfillment of the individual's needs or desires. 2. Developed or modified one's own awareness, choice, and judgment in fulfilling the needs. 3. By the teachings and practice of Preceptors (Gurus) or Saviors or religious leaders. 4. Fostered or modified by social leaders, rulers of kingdom, and by law (government).
2	**Write a detailed note on work ethics. Problems exist in the industrial/business scenario(13M)** BTL3 **Answer :Page 2 - V.Jayakumar** **DEFINITION:(2 M)** Work ethics is defined as a set of attitudes concerned with the value of work, which forms the motivational orientation. The 'work ethics' is aimed at ensuring the economy productivity , safety , health and hygiene, privacy , security , cultural and social development (leisure, hobby, and happiness), welfare (social work), environment (anti-pollution activities), and offer opportunities for all, according to their abilities, but without discrimination. **ELEMENTS OF A STRONG WORK ETHIC: (6 M)** **1.Interpersonal skill:** It include the habits, attitude, manners, appearance and behaviors which affect how we get along with other people

2.Initiative:

Without initiative procrastination and missed opportunities can become problem.

3. Professionalism

Being professional involves everything, how you dress and present yourself in business world, way you treat others.

4. Accountability

Take personal responsibility, actions and out comes, every situation.

Mistakes taken as learning experiences, ability to always better, must be upholder.

5. Respectfulness

Serving a customer, meeting with a client or collaborating with colleagues, do best respect everyone's opinions, especially under difficult circumstances.

Value people's individual worth, their professional contributions.

6. Dedication

Don't stop until job done, and done right.

Fully dedicated, to strive, to achieve, best results alongside putting extra hours,get things right.

7. Determination

Don't let obstacles stop, enthusiastically embrace challenges, job as an entrepreneur solve clients' problems.

8. Humility

Acknowledge everyone's contributions, and freely share credit accomplishments.

Gratitude to colleagues who work hard, and appreciation to loyal clients. 9.**Dependability**

Relates closely to when always on time and prepared for meetings. The ability to deliver work on time.

Many complex social problems exist in the industrial/business scenario, because: (5 M)

1. Desire to be recognized as individuals and treated dignity, living human beings.
2. Work intrinsically valuable, enjoyable or meaningful in allowing personal expression and self-fulfillment.
3. Meaningful work , sense of personal identity and the self-esteem
4. Work, major instrumental good in life.
5. Main source providing income needed to avoid economic dependence ,
6. Pay, pace of work be in commensurate with the expertise required, acquired, utilized in persons.
7. Privacy of employee, including women, protected.
8. Security during job upon retirement, accepted, government jobs, public limited companies, corporate organizations.
9. Recognition non-work activities, leisure, paid holiday day, visit, dignitary, social service, developmental activities.
10. Hard work, productivity essential success industry.
11. Hard labor, undignified jobs, hazardous jobs, made less straining, dignified, safer.
12. Employee alienation, Absence of or inadequate 'recognition and reward system' and 'grievance redressal system', lack of transparency policy implementation, factions trade unions etc.
13. A different view of work ethics: Work is considered as a necessary evil.

	14. Protestant Work Ethics, the financial success sign, favored by God. 15. Obtaining desired materials and services, achieving status and recognition others. 16. Exploitation and bargained pay should be discouraged. 17. Confidentiality of employer to be protected. 18. The quality of work life deserves to be improved. 19. Lead to ethical problems, affecting the work ethics.
3	**Explain integrity and honesty in ethics. (13 M) (NOV-DEC 2015) (NOV-DEC 2016) (NOV/DEC 2018) (NOV/DEC 2019)** BTL2 **Answer: Page :190 - Mike W. Martin** **Answer :Page 10 - V.Jayakumar** **Integrity: (6 M)** 1. Integrity defined unity of thought, word, deed, open mindedness. 2. Capacity to communicate factual information, others make well-informed decisions. 3. Yields, person's 'peace of mind', hence add strength and consistency in character, decisions, and actions. 4. Paves way to one's success. 5. Enthuse people, not only execute job well, and achieve excellence in performance. 6. To own the responsibility, earn self-respect, recognition by doing job. 7. Moral integrity defined as a virtue **8.** Reflects consistency of one's attitudes, emotions, and conduct in relation to justified moral values**.** 9. I self-direction virtues **Honesty:(7 M)** Honesty is a virtue, and it is exhibited in two aspects namely, (1) **Truthfulness** i. Truthfulness faces the responsibilities upon telling truth. ii. One should keep one's word or promise. iii. By admitting one's mistake committed, it is easy to fix them. iv. Reliable engineering judgment, maintenance of truth, defending the truth, and communicating the truth, 'good' to others, (2) **Trustworthiness.** i) Trustworthiness, maintaining integrity and taking responsibility, personal performance. ii) Right way to win, according to the laws or rules (legally and morally). iii. Build trust through reliability and authenticity. iv. Admit their own mistakes and confront unethical actions in others and take tough and principled stand, even if unpopular. v. Honesty is mirrored in many ways. vi. People abides by law and lives by mutual trust. The common reflections are: (a) Beliefs (intellectual honesty). (b) Communication (writing and speech). (c) Decisions (ideas, discretion). (d) Actions (means, timing, place, and the goals). And (e) Intended and unintended results achieved.
4	**Explain the characteristics and importance of self confidence in ethics. (13M) (MAY- JUNE 2016)** BTL2 **Answer :Page 29 - V.Jayakumar**

	SELF-CONFIDENCE: (3 M) 1. Certainty in one's own capabilities, values, and goals, self-confidence. 2. People usually positive thinking, flexible, willing to change. 3. Respect others so much as they respect themselves. 4. Self- confidence positive attitude, individual has some positive and realistic view, with respect to the situations, which one gets involved. 5. The people with self-confidence exhibit courage to get action and unshakable faith, abilities, whatever their positions. 6. Not influenced by threats, challenges and prepared to face the, natural or unexpected consequences. 7. The self- confidence person develops a sense of partnership, respect, and accountability, 8. Helps organization, obtain maximum ideas, efforts, and guidelines from employees. **The people with self- confidence have the following characteristics: (4 M)** 1. A self-assured standing, 2. Willing to listen to learn from others and adopt (flexibility), 3. Frank to speak the truth, and 4. Respect others' efforts and give due credit. On the contrary, some leaders expose others when failure occurs, and own the credit when success comes. **The factors that shape self-confidence in a person are:(3 M)** 1. Heredity (attitudes of parents) and family environment (elders), 2. Friendship (influence of friends/colleagues), 3. Influence of superiors/role models, and 4. Training in the organization (e.g., training by Technical Evangelists at Infosys Technologies). **The following methodologies are effective in developing self-confidence in a person(3 M)** 1. Encouraging SWOT analysis. Evaluating their strength and weakness, anticipate and be prepared to face the results. 2. Training to evaluate risks and face them (self-acceptance). 3. Self-talk, conditioning mind for preparing self to act, without any doubt on his capabilities. 4. Make one accepts himself while striving for improvement. 5. Study, group discussion, on the history of leaders and innovators
5	**Discuss the importance time wasters. How can one manage time properly? (13 M)** BTL1 **Answer :Page 25 - V.Jayakumar** **INTRODUCTION:(2 M)** Time is rare resource. Once spent, lost forever. Cannot be either stored or recovered. Time is the most perishable and most valuable resource too. Resource continuously spent, whether any decision or action is taken or not. History of great reformers and innovators, stressed, importance of time and valuing time. Time management: It is the rational way to ensure that our limited time is always used effectively. **Identifying time wasters: (3M)**

	Unscheduled and scheduled meetings Lack of adequate meetings Poor delegation Too much socializing Ineffective communication Lack of goal objectives Poorly organized supervision Poor use of telephone **Time management principle:(5M)** 1.clear objectives 2.prioritize tasks 3.stick to scheduled tasks 4.Allow time to manage your time 5.The unexpected 6.Managing time wasters **An anecdote to highlight the 'value of time' is as follows:(3 M)** 1 . To realize, value of one year, ask student who failed in the examinations; 2. To realize, value of one month, ask mother who delivered premature baby; 3. To realize, value of one week, ask editor of weekly; 4. To realize the value of one day, ask daily-wage laborer; 5. To realize, value of one hour, ask the lovers longing to meet; 6. To realize, value of one minute, ask person who missed train; 7. To realize value of one second, ask person who survived an accident; 8. To realize, value one Milli second, ask person who won the bronze medal in Olympics; 9. To realize value of one micro second, ask NASA team of scientists; 10. To realize value of one nano-second, ask a Hardware engineer!; If you have still not realized the value of time, wait; are you an Engineer?
6	**Discuss the concept of Caring, Sharing And Living Peacefully in detail. (13 M)** BTL2 **Answer: Page 19 and 20 and 18 - V.Jayakumar** **Caring: (4 M)** 1. Caring, feeling for others. 2. A process which exhibits interest, support, the welfare of others with fairness, impartiality, justice all activities, employees, context of professional ethics. 3. Respect to feelings of others, respecting, preserving interests of others concerned. 4. Caring reflected in activities- friendship, membership in social clubs and professional societies, through various transactions in family, fraternity, community, country and in international councils. 5. In present day context, caring for environment, necessity for our survival. 6. Do not care environment, environment scare us.

SHARING: (4M)

1. Primarily, caring influences 'sharing'.
2. Transfer of knowledge, experience, commodities, facilities with others.
3. Transfer genuine, legal, positive, voluntary, without expectation in return.
4. Proprietary information, not be shared with outsiders.
5. Process of sharing, experience, expertise, wisdom benefits reach more people faster.
6. Sharing voluntary, cannot be driven by force,
7. Motivated successfully through ethical principles.
8. sharing is 'charity' For humanity,
9. 'Sharing' a culture.
10. 'Happiness, wealth' multiplied 'crimes sufferings' reduced, by sharing.
11. Paves way for peace obviates militancy.
12. Philosophically, the sharing maximizes happiness for all human beings.
13. Psychologies, fear, divide, and distrust between 'haves' 'have-nots' disappear.

LIVING PEACEFULLY:(5 M)

1. To live peacefully, start install peace within.
2. Charity begins at home.
3. Then one can spread peace to family, organization where one works, and then to the world, including the environment.
4. Only who are at peace can spread peace.
5. You cannot gift an article which you do not possess.
6. Essence, oriental philosophy, one should not fight for peace. 7, It is oxymoron. War or peace, won by peace, and not by wars!

One should adopt the following means to live peacefully, in the world:
1. Order in one's life
2. Pure thoughts in one's soul
3. Creativity in one's head.
4. Beauty in one's heart

7	**Explain commitment and empathy. (13 M) (NOV/DEC 2018)** BTL2 **Answer: Page 28 -V. Jayakumar** **Commitment:(5 M)** 1. Commitment means acceptance, responsibilities, duties, cooperation means help assistance. 2. By developing team commitment and cooperation in a work team assisting team to meet, goals and objectives. 3. Work teams that committed and cooperative more likely to achieve the goals the business has set. **Empathy: (8 M)** 1. Empathy capacity to understand feel another person, experiencing within other being's frame of reference, i.e., capacity, place oneself another's position. 2. . Empathy seeing, eyes another, listening ears another feelings heart, another. 3. Many definitions, empathy encompass, broad range of emotional states. 4. Types of empathy cognitive empathy, emotional empathy, and somatic empathy. 5. Development human empathy, individual differences appear, ranging. no apparent empathic ability, empathy, harmful, self others 6. To well-balanced empathy, ability to distinguish between self other. **Daniel Goleman identified five key elements of empathy.** 1. Understanding Others. 2. Developing Others. 3. Having a Service Orientation. 4. Leveraging Diversity. 5. Political Awareness.
8	**Explain character and spirituality and their Importance in ethics**.**(13M)(MAY-JUNE 2016) (AAPRIL/MAY 2018)** BTL2 **Answer: Page 32 - V. Jayakumar** **INTRODUCTION: (4 M)** 1.Spirituality way of living emphasizes constant awareness recognition spiritual 2. Dimension, nature people, dynamic balance between material development,

	spiritual developments. 3. Great virtue of Indian philosophy for Indians. 4. Sometimes, spirituality includes faith, belief in supernatural power/ God, regarding worldly events. 5. Functions fertilizer for soil 'character' to blossom into values morals. **Spirituality in Workplace: (9 M)** Building spirituality in workplace: Spirituality promoted workplace by adhering to following activities: 1. Verbally respect individuals as humans recognize, values in all decisions actions. 2. Get to know people with whom you work know what important 3. Know goals, desires, and dreams too. 4. State your personal ethics your beliefs clearly. 5. Support causes outside business. 6. Encourage leaders to use value-based discretion, making decisions. 7. Demonstrate own self-knowledge spirituality in all actions. 8. Do unto others as you would have m do unto you.
9	**Briefly explain terms Values, Morals & Ethics. (13M) (NOV/DEC 2019)** BTL2 **Answer: Page 40 - V. Jayakumar** **Morals: (4 M)** **Morals** principles on which one's judgments of right, wrong based. Morals refer to beliefs what not objectively right, but what considered right for situation What morally correct, not be objectively correct. Some moral principles : 1. Do not cheat 2. Be loyal 3. Be patient 4. Always tell truth 5. Be generous **Ethics: (6 M)** 1. Ethics principles of right conduct. . 2. main difference, morals more abstract, subjective, often personal or religion-based, 3. Ethics more practical conceived principles promoting fairness, social business interactions. Some ethical principles : 1. Truthfulness 2. Honesty 3. Loyalty 4. Respect 5. Fairness 6. Integrity **Values: (3 M)** **Values —**things have an intrinsic worth in usefulness or importance to possessor, or principles, standards, qualities considered worthwhile, desirable. 1. Tend to think of a value as something good, virtually all values morally relative

	neutral, really qualified by asking, –How it good? –Good to whom? **2.** –good sometimes just a matter of opinion, taste, driven by culture, religion, habit, circumstance, environment, etc.
10	**What is integrity? Explain number of accounts viewed under integrity. What are the salient features of courage? (13M) (APRIL/MAY 2019)** BTL2 **Answer: Page 10 - V.Jayakumar** **MEANING: (2M)** 1. Integrity elementary value for profession. 2. Important for all who exhibit strong moral ethical principles. 3. Deals exhibiting fairness honesty, all professional, personal relations. 4. Personal choice which uncompromising under any kind of circumstances. **Number of accounts viewed under integrity. (7M)** **1. Integrity as self-integration** • Establishes a formal relation to self people integrate different facets of ir personality to an intact whole. • Mainly a matter of keeping oneself totally intact uncorrupted. **2. Integrity as identity** • Commitment, one makes, oneself, people, relations, institutions, traditions culture etc. **3. Integrity as sting for something** • Self-integration identity sees integrity, matter of personal choice. • Person, high integrity, consistent endorsements, takes something within community. • Integrity considered, proper regard, role community process deliberation over valuable worth doing. **4. Integrity as purpose** • Places moral checks on kinds, commitments person of integrity must honor. • Integrity, morally correct despite, substantial moral disagreement, some issues with section of society. **5. Integrity as-Individual, Professional Institutional** • Integrity forms building block, ethical conduct competency. • Three different levels essential for an individual's professional survival. 1.Personal integrity Accountability for personal actions conducting personal relationships fairly honestly. 2.Professional integrity Professional duties obligations complete honesty in conformity, professional code of ethics. 3.Institutional integrity • Wider concept driven by mission--vision statements of an organization, established code of conduct procedures. • Ethical conduct throughout organization through personal example, management practices ethical training. **The salient features of courage:(4 M)** **a)**Moral courage b)Physical courage
	PART * C
1	**Distinguish values from ethics. (15M)** BTL4

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Values: (2 M)

- Values can be defined as those things that are important to or valued by someone.
- That someone can be an individual or, collectively, an organization.
- One place where values are important is in relation to vision.
- One of the imperatives for organizational vision is that it must be based on and consistent with the organization's core values.

Ethics: (3 M)

At its simplest, ethics is a system of moral principles. They affect how people make decisions and lead their lives.

Ethics is concerned with what is good for individuals and society and is also described as moral philosophy.

The term is derived from the Greek word *ethos* which can mean custom, habit, character or disposition.

Ethics covers the following dilemmas:

- How to live a good life
- Our rights and responsibilities
- The language of right and wrong
- Moral decisions - what is good and bad?

Explanation: (10 M)

Comparison Chart:

BASIC COMPARISON	ETHICS	VALUES
MEANING	Ethics refers to the guidelines for conduct, that address question about morality.	Value is defined as the principles ideals, that helps them in making judgment of what is more .important
WHAT ARE THEY?	System of moral principles.	Stimuli for thinking.
CONSISTENCY	Uniform	Differs from person to person
TELLS	What is morally correct or incorrect, in the given situation.	What we want to do or achieve.
DETERMINES	Extent of rightness or wrongness of our options.	Level of importance.
WHAT IT DOES	Constrains	Motivates

2	**Briefly explain the importance of Yoga and meditation for successful life. (15M) (NOV- DEC 2015) (NOV-DEC 2016) (Nov/Dec2013)** BTL2 **Answer: Refer notes** Yoga:(2M) Yoga is a type of exercise in which you move your body into various positions in order to become more fit or flexible, to improve your breathing, and to relax your mind. **Yogic exercise recharge body with cosmic energy facilitates: (3M)** 1. Attainment of perfect equilibrium harmony 2. Promotes self- healing. 3. Removes negative blocks from mind toxins from body 4. Enhances personal power 5. Increases self-awareness 6. Helps in attention, focus concentration, especially important for children 7. Reduces stress tension physical body ,activating nerve system **Importance of Yoga(4M)** 1. Yoga for all-round fitness 2. Yoga for weight loss 3. Yoga for stress relief 4. Yoga for inner peace 5. Yoga to improve immunity 6. Yoga to live with greater awareness 7. Yoga for better relationships 8. Yoga to increase energy 9. Yoga for better flexibility & posture 10. Yoga to improve intuition **Meditation:(2M)** Meditation is a precise technique for resting the mind and attaining a state of consciousness that is totally different from the normal waking state. It is the means for fathoming all the levels of ourselves and finally experiencing the Centre of consciousness within. Importance of Meditation: **(4 M)** • Focused attention • Relaxed breathing • Gives a sense of calm • Gaining new perspective on stressful situation

	• Increasing self awareness • Reducing negative emotions
3	**Explain the need of stress management in detail. (15M) (April / May2017) (NOV-DEC 2015)** BTL2 **Answer: Refer Notes**. **INTRODUCTION: (3 M)** i. We all react differently to stress. ii. Based on available resources skills, you decide whether a situation stressful to you. iii. might become aggressive take your stress out on your loved ones or colleagues whilstors hold it in rare use escape techniques such as eating disorders or substance abuse, which ultimately more destructive. **Cause of stress:** a. constantly irritable or having sleep problems b. Snappy short fused c. Feeling anxious or depressed d. Excessively eating, drinking or smoking e. High, cholesterol, high blood pressure, eczema or skin problem f. Struggle with concentration, feeling unmotivated or insecure g. insecure feelings about money, your employment or your relationship **NEED FOR STRESS MANAGEMENT:(12 M)** **1. Set daily goals.** It important to set goals for before going to work next day. Setting specific daily goals for business, help stay focused, saving time money long run. **2. Delegate.** Delegate your business family responsibilities. If your job, delegate some of your responsibilities to qualified employees. **3. Prioritize your tasks.** Determine what needs done right away do those particular task order importance. That way, you won't be constantly worrying about completing se vital projects can relax after complete. **4. Communicate.** Don't waste your time assuming that certain people will do what y need to do. Talk to your co-workers your family so that everybody on same page. Can not only save you a lot of time but also will reduce your stress level. **5. Prepare for unexpected events.** Sometimes certain events may happen that might take everyone by surprise. Be flexible when unexpected events, deal immediately. **6. Don't procrastinate.** Do not put things off when you can do m today. An entrepreneur, important, staff, family members' complete tasks in a timely manner. **7. Reduce any potential conflicts.** When a potential problem starts to develop with workers or family members, try to find a

	solution immediately. Do not let potential conflicts drag on from one week to next. Use your problem-solving skills to prevent any arguments. **8.Get help if you need it.** Sometimes a person might need to speak to a counselor or take some educational classes in time management.

	UNIT II ENGINEERING ETHICS
	Senses of "Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.
	PART * A
1	**Define moral Dilemma. (MAY/JUNE 2012)** BTL2 Dilemmas are certain kind of situations in which a difficult choice has to be made. Moral dilemmas can also be called moral problems. Moral Dilemmas have two or more folding's- moral obligations, duties, rights, goods, or ideals come disagreement with each other.
2	**What are the chief characteristics of a profession? (MAY/JUNE 2012)** BTL2 • It renders an essential social service. • It demands continuous in service training of its members • It involves a code of ethics. • It sets up its own professional organization. • It assures its members a professional career. • It has a truth and loyalty. • It has a transparency of work. • It gives instantaneous results.
3	**Write a note on significance of engineering ethics. (MAY/JUNE 2011)** BTL3 An engineer should have the ability and judgement to refine one's behaviours, decisions and actions in performing the duty to the family, organization and to the society. An engineer needs to be a free thinker. he needs to be an intellectual who has the proficiency in recognizing moral problems in engineering, comprehend and assess those views from different viewpoints
4	**What is engineering ethics? (MAY/JUNE 2011, MAY/JUNE 2014)** BTL2 Study of the moral issues and decisions confronting individuals and organizations engaged in engineering / profession. Study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity. Moral standards /values and system of morals.
5	**What is meant by normative inquiry? (MAY/JUNE 2011)** BTL2 Engineering ethics involves normative inquiry in order to aim at identifying and justifying the morally desirable norms or standards that ought to guide individuals or groups. Normative questions include what ought to be? And what is good?
6	**What do you mean by ethical pluralism?(APRIL/MAY 2010)** BTL2 Ethical pluralism is the view that there may be alternative moral perspectives that are reasonable, but no one of which must be accepted completely by all rational and morally concerned persons.
7	**Differentiate Moral and Ethics. (MAY/JUNE 2010)** BTL4 **Moral:** • Refers only to personal behaviour. • Refers to any aspect of human action. • Social conventions about right or wrong conduct.

	Ethics: Involves defining, analyzing, evaluating and resolving moral problems and Developing moral criteria to guide human behaviour. Critical reflection on what one does and why one does it. Refers only to Professional behaviour.
8	**Write any three uses of ethical theories. (NOV/DEC2010, MAY/JUNE 2014)(APRIL/MAY 2018)** BTL3 Ethical theories are very useful in understanding and resolving moral dilemmas. In estimating the professional obligations and ideals. Determine to what extent, the obligations can be exercised in a given situation.
9	**What are the types of Theories about Morality/ Right action? (MAY/JUNE 2009) (NOV-DEC2018)** BTL2 Virtue ethics – Virtues and vices Utilitarianism – Most good for the most people Duty ethics – Duties to respect people Rights ethics – Human rights
10	**State Ethical Egoism. (MAY/JUNE 2009)** BTL1 It deals with self-interest. Each person is the best judge of their own self-interest and is responsible for maximizing their own interest. Egoism preaches selfishness but morality should encourage love, compassion etc.
11	**Differentiate Ethical Relativism and Ethical Egoism. (MAY/JUNE2008)** BTL4 Ethical egoism – the view that right action consist in producing one's own good. Ethical relativism – the view that right action is merely what the law and customs of one's society require**.**
12	**What is moral integrity? (MAY/JUNE2008)** BTL2 Moral integrity is the strength of character on the basis of moral concern and moral values. Integrity is the bridge that links the responsibilities between personal life and professional carrier.
13	**Differentiate profession and professionalism. (NOV/DEC 2008)** BTL4 Profession is a job through which someone makes living. Professionalism covers comprehensively all areas of practice of a particular profession. It requires skills and responsibilities involved in engineering profession.
14	**Give the importance of Lawrence Kohlberg's and Carol Gilligan's theory. (NOV/DEC2008)** BTL1 Kohlberg gives greater emphasis to recognizing rights and abstract universal rules. Gilligan Stresses the importance of maintaining personal relationships based on mutual caring.
15	**What is consensus and controversy?** BTL2 Consensus means agreement and controversy means disagreement. Both plays the vital roles while considering moral autonomy.
16	**What is the relationship between moral autonomy and authority?** BTL2 Moral' autonomy is exercised on the basis of moral concern for other people and recognition of good moral reasons. Authority provides the frame work in which learning can takes place in class room/work place.
17	**What are the concepts of pre-conventional & conventional level in Gilligan's theory?** BTL2 Carol Gilligan recast the theory of Kohlberg as follows. Pre conventional level: Desire to derive benefits for oneself. Right conduct is viewed in a selfish manner as solely what is good for oneself. Conventional level: Here the basic motive is willingness to sacrifice one's own interests and a strong desire to hurt other's interests. Mostly women are always willing to give up their personal interests in order to serve the needs of others.
18	**Define Ethics. Mention some universally accepted ethical standards. (NOV/DEC 13)** BTL2 "Ethics" as the "discipline dealing with what is good and bad and with moral duty and obligation," "a set of moral principles or value" or "a theory or system of moral values." Ethics assists individuals in deciding when an act is moral or immoral, right or wrong. Ethics can be grounded in natural law, religious tenets,

	parental and family influence, educational experiences, life experiences, and cultural and societal Expectations. Ethical Standard such as Focus on ethics, Corporate culture, Managerial
19	**Define Professionalism. (APRIL/MAY 2015)** BTL2 Professionalism means behaving in an ethical manner while assuming and fulfilling your rightful responsibilities in every situation every time, without fail. To get a bit more granular, one can say that it means, in part, conducting your affairs in such a way as to engender trust and confidence in every aspect of your work.
20	**Define Moral Autonomy (NOV/DEC2014/2018) (APRIL/MAY 2019)** BTL2 Moral autonomy, usually traced back to Kant, is the capacity to deliberate and to give oneself the moral law, rather than merely heeding the injunctions of others. Personal autonomy is the capacity to decide for one self and pursue a course of action in one's life, often regardless of any particular moral content.
	PART * B
1	**What are the stages of moral development according to Gilligan? Discuss it.(13M)(Nov/Dec2006) (Nov/Dec2007) (April/ May2011) (Nov/Dec2012) (Nov/Dec2013)** BTL2 **Answer: Page 1.17 - V. Jayakumar** **INTRODUCTION: (2 M)** • **Carol Gilligan Moral Development Theory Explained** Carol Gilligan moral development theory used, approach to reasoning. Women tended, score lower, scales of morality compared to men. Not agreeing, idea, women morally inferior to men Began, process of interviewing women, make difficult decisions in lives. Process develop a moral development theory, closely associated, women instead, men. **The Three Stages of Gilligan's Moral Development Theory: (6 M)** Gilligan produced, theory, three stages of moral development. • **The Pre-conventional Stage:** Goal of a woman, to survive. Focused on individuality Making sure basic needs been met. Priority to meet others needs. • **The Conventional Stage:** A woman recognizes, self-sacrifice, source "goodness" in life. Finds moral satisfaction, by helping other people Focusing on helping others to survive best way possible. • **The Post-conventional Stage:** "Ends no longer justify the means" to have needs met. A principle of non-violence, applies to every decision. Not wish to hurt or hurt others, looking alternative methods to meet needs. Diagram: (2 M)

	Gilligan's Stages of the Ethic of Care
	Stage / **Goal**
	Preconventional / *Goal is individual survival*
	Transition is from selfishness -- to -- responsibility to others
	Conventional / *Self sacrifice is goodness*
	Transition is from goodness -- to -- truth that she is a person too
	Postconventional / *Principle of nonviolence: do not hurt others or self*
	Gilligan suggests two transitions that occur during the stages. (3 M) The first transition: • Occurs between the pre-conventional and conventional stages • Moves a woman's moral ethics from selfish to shares a responsibility to care others. **The second transition:** • Occurs between the conventional and post-conventional stages • Moves a woman being focused on "good" to being focused on "truth." • Looking, ways to survive for herself and for others • Begins, look, options fueled, need to stay true to certain moral constants.
2	**Explain the uses of ethical theories. (13M) (Nov/Dec2006)(NOV/DEC 2018) (APRIL/MAY 2018)** BTL2 **Answer :Page 60 Mike W. Martin** **Uses of ethical theories.: (13 M)** • Identifying moral considerations, reasons to constitute a dilemma. • Precise sense of information, relevant to solving moral development. • Provide guidance in solving moral problems. • moral ramifications of alternative courses action • Providing systematic framework of comparing alternatives. • Discussing moral issues with colleagues. • By providing frame works development of moral arguments • It strengthens ability to reach balanced and insightful judgments. • Justifying professional obligations and ideas. • Relating ordinary and professional morality.
3	**Explain in detail: (13 M) (Nov/Dec2007)** BTL2 **1. Professional responsibility. Answer: Page 2.3 - V. Jayakumar** **2. Self- respect. Answer: Page 2.5 & 2.6 - V. Jayakumar** **3. Utilitarianism. Answer :Page 55 Mike W. Martin** **Professional responsibility** : **(6 M)** • The **duties** of attorneys to act in a professional manner • Obey the law, avoid conflicts of interest • Put the interests of clients ahead of their own interests. • Being morally responsible as a professional. **Most basic and comprehensive professional virtue.** **A wide variety of more specific virtues grouped as follows:** • **SELF DIRECTION VIRTUES:**

Fundamental virtues in exercising moral autonomy and responsibility.
e.g. self understanding, humility and good moral judgment

- **PUBLIC SPIRITED VIRTUES:**

Focusing on good of clients and public affected by engineers‟ work

- **TEAMWORK VIRTUES:**

Enables professionals to work successfully with others.
E.g. collegiality, cooperativeness, the ability to communicate

- **PROFICIENCY VIRTUES:**

Mastery of one's craft that characterize good engineering practice
e.g. competence, diligence, creativity

- **MORAL INTEGRITY**

The unity of character on the basis of moral concern
Consistency among our attitudes in relation to justified moral values.

SELF-RESPECT (3 M)

- Valuing oneself in morally appropriate ways.
- Integral to finding meaning in one's life and work
- A pre-requisite for pursuing moral ideals and virtues.
- Self-respect is a moral concept of properly valuing oneself
- Self-esteem is a concept of positive attitude towards oneself.

Self-respect takes two forms.

- Recognition self-respect is properly valuing oneself
  One's inherent moral worth, every other human being has.
- Appraisal self-respect is properly valuing ourselves
  How well we meet moral standards, our personal ideals.

- **Utilitarianism: (4 M)**

Utilitarianism is a normative ethical theory

Places the locus of right and wrong solely on the outcomes

There are two main types of Utilitarianism. They are:

- **Act Utilitarianism**

Act Utilitarianism states that "A particular action is right if it is likely to produce the higher level of good for the most people in a given situation, compared to alternative choices that might be made."

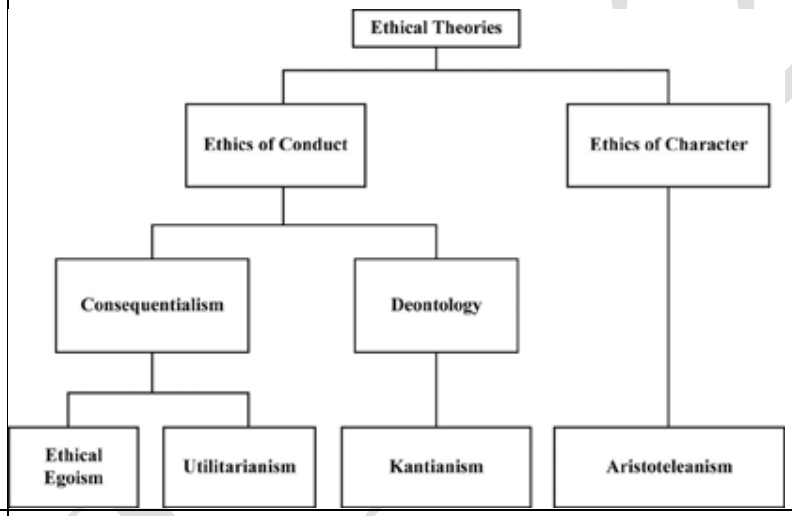
- **Rule Utilitarianism**

The Rule Utilitarianism states that "Right actions are those required by rules that produce the higher level of good for the most people."

Formulation of Ethical Theories

- The concepts of the theory formulated must be coherent.
- The tenets of the theory should never contradict the other.
- The theory should never be defended upon false information.
- Guide in specific situations comprehending all aspects possible.

	• Compatible with individual's moral convictions in any situation.
4	**Explain Kohlber's theory in detail. (13 M) (MAY/JUNE2011) (NOV-DEC2018) (N O V / D E C 2 0 1 9)** BTL2 **Answer :Page 1.15 - V. Jayakumar** **Kohlberg's Stages of Moral Development (6 M)** **Level 1 - Pre-conventional morality (7 M)** • We don't have a personal code of morality. • Our moral code is shaped by the standards of adults • Stage 1. Obedience and Punishment Orientation. • The child/individual good in order to avoid being punished. • Stage 2. Individualism and Exchange. • Different individuals have different viewpoints. **Level 2 - Conventional morality** • To internalize the moral standards of valued adult role models. • Stage 3. Good Interpersonal Relationships. • The child, good in order to be seen as good person by others. • Stage 4. Maintaining the Social Order. • The child/individual becomes aware of wider rules of society. **Level 3 - Post-conventional morality** • Individual judgment is based on self-chosen principles. • Moral reasoning is based on individual rights and justice. • Stage 5. Social Contract and Individual Rights. • The child/individual aware of rules/laws, exist for the good of greatest number. • Stage 6. Universal Principles. • Develop own set of moral guidelines, may or may not fit law.
5	**Discuss the scopes of engineering ethics. (13 M)(April/ May2008) (April/ May2011)** BTL2 **Answer :Page 2 - Mike W. Martin** **INTRODUCTION: (2 M)** • **Engineering Ethics** Moral issues, decisions confronting individuals and organizations engaged in **engineering**. **EXPLANATION: (11 M)** **Moral reasoning and ethical theories:** • By "morality," meant the standards of rightness and goodness • "Ethics" means those moral standards that appropriate to particular occupations **Engineers As Social Experimentation:** • In developing a product, an engineer learns through experimentation. • A trial and error method is the mostly used one to obtain results, **Engineers responsibility for safety:** • To maintain the safety of human beings. • To procure their rights of consent. • To warn them about the probable safety hazards. **Respect to employees and right to engineer:** • A safe and healthful workplace • To ask your employer to correct dangerous conditions. • To file a complaint about workplace hazards **GLOBAL ISSUES:** • Increases through trade, investment, transfer of technology, exchange of ideas, culture.

	Engineers as Managers • An Engineer is responsible in promoting ethics in an organization, • Framing organizational policies, responsibilities and obligations.
6	**Explain the different ethical theories right action, self-interest, duty ethics. (13M) (April / May2007) (NOV/DEC 2018)** BTL2 **Answer: Page 60 - Mike W. Martin** **Duty ethics theory: (3 M)** • Consequences of performance of one's duties. • Being honest, not cause suffering of other • Being fair to others including the meek and week • Being grateful, keeping Promises etc. **The RIGHTS EHICS:(4 M)** • The right to access the truth • The right of privacy • The right not to be injured • The right to what is agreed **Self-Interest Ethics: (3 M)** • Right action consists in seeking self-fulfilment. • Self to be realized, defined by caring relationships with individuals and society. • Ethical egoism, right action consists in always promoting what is good for oneself. **DIAGRAM: (3 M)** 
7	**Discuss the different models of professional roles.(13M)(May/June 2009) (NOV-DEC2018) (APRIL/MAY 2019)** BTL2 **Answer: Page 1.23 - V. Jayakumar** **EXPLANATION: (13 M)** • **SAVIOR:** Redeem society from poverty, inefficiency Waste and the drudgery of manual labour. • **GUARDIAN:** Directions in which, pace at which, technology should develop. • **BUREAUCRATIC SERVANT:** Loyal organization person uses special skills to solve problems. • **SOCIAL SERVANT:**

	Co-Operation with management, task of receiving society's directives, satisfying society's desires • **SOCIAL ENABLER AND CATALYST:** Vital role beyond mere compliance with orders. Management and society understand, own needs, to make informed decisions. • **GAME PLAYER:** Neither servants nor masters of anyone. Economic game rules that happen to be in effect at a given time.
8	**Explain the need of tolerance for different customs and ethical relativism in adverse society with suitable example. (13 M) (April /MAY 2014)** BTL2 **Answer :Page 2.16 - V. Jayakumar** **Customs and Ethical Relativism: (6 M)** • There may be alternative moral attitudes that are reasonable. • Ethical pluralism allows in deciding how we should act. • Moral values are many, varied and flexible. • Reasonable persons always have reasonable disagreement on moral issues • Ethical relativism says actions morally right when they approved by law, custom • Ethical relativism tries to reduce moral values to laws. **Reasons for accepting ethical relativism: (7 M)** • The laws and customs seem to be definite, real and clear – cut. Help reduce the endless disputes about right and wrong. Laws seem to be an objective way to approach values. • It believes values are subjective at cultural level. The moral standards varied from one culture to another. Morality encourages virtue of tolerance of difference among societies. • The moral renationalise or moral contextualise. Making simple and absolute rules are impossible in this way. Customs, laws considered as morally important factors for making judgments.
9	**Explain the vital role of consensus and controversy while considering moral autonomy in Engineering ethics. (13 M) (Nov/Dec2012)** BTL2 **Answer :Page 1.18 - V. Jayakumar** **CONSENSUS AND CONTROVERSY** **Models of professional roles: (6 M)** • **SAVIOR:** Redeem society from poverty, inefficiency Waste and the drudgery of manual labour. • **GUARDIAN:** Directions in which, pace at which, technology should develop. • **BUREAUCRATIC SERVANT:** Loyal organization person uses special skills to solve problems. • **SOCIAL SERVANT:** Co-Operation with management, task of receiving society's directives, satisfying society's desires • **SOCIAL ENABLER AND CATALYST:** Vital role beyond mere compliance with orders. Management and society understand, own needs, to make informed decisions. • **GAME PLAYER:** Neither servants nor masters of anyone. Economic game rules that happen to be in effect at a given time.

Consensus and Controversy (4 M)

- Literally, consensus means _agreement', controversy means _disagreement'.
- Individual exercise moral autonomy, to attain same results as other people obtain
- This kind of controversies i.e., disagreements are inevitable.
- Exercising moral autonomy is not as precise, clear-cut as arithmetic
- The moral disagreements are natural and common.
- Promoting tolerance in practical applications of moral autonomy by engineers.

Relationship between autonomy and authority (3 M)

- Moral autonomy and respect for authority compatible with each other.
- Exercising moral autonomy based on moral concern for other people
- Exercising moral autonomy recognition of good moral reasons.
- Also moral autonomy emphasizes the capabilities and responsibilities of people.
- Authority provides framework, through which learning attitudes are encouraged.
- Conflicts will arise between individuals need for autonomy, consensus about authority.
- This situation can be rescued by having open and frank

State Meaning of moral dilemma. Describe the types and few steps in confronting Moral Dilemma in the life (13 M) (April/ May2007) BTL2

Answer: Page 32 - Mike W. Martin

Definition: (2 M)

A moral dilemma is defined as any situation in which the person making the decision experiences a conflict between the moral rightness of a decision and the quality of the results it produces. Many times, these dilemmas involve a morally wrong decision that produces a desirable result, or vice versa.

The following three categories of complex and gloomy moral situations: (8 M)

- **Vagueness**

The condition where the doubt lies in whether the action refers to good or bad.

- **Conflicting reasons**

10 Fixing the priorities depends upon the knowledge and the moral values one has. The reason why the particular choice makes sense.

- **Disagreement**

When two or more solutions and none among them is mandatory The final solution selected should be best most probable conditions.

- **Steps in Facing Moral Dilemmas (3 M)**

Whenever a person is faced with a moral dilemma, the issue is to be solved with a stepwise approach as this will generate a better output.

The step of identification involves the following −

- The issue has to be thoroughly understood.
- The duties, responsibilities of persons involved to be clearly known.
- The moral factors related to the issue are to be understood.
- The conflicting responsibilities

PART * C

Discuss the moral problems faced by an Indian common man. (15 M) (April / May2008) BTL2

Answer :Page 5 - Mike W. Martin 3rd Edition

1 **Morality: (3 M)**

Morality is the human attempt to define what is right and wrong about our actions and thoughts, and what is good and bad about our being that we are."Moral issue is a working definition of an issue of moral concern is presented as any issue with the potential to help or harm anyone, including oneself."

Types of Moral Issues (5 M)

There are mainly two types of Moral issues. They are –

- **Micro-ethics**

Problems that occur on a daily basis in field of engineering, its practice by engineers.

- **Macro-ethics**

This approach deals with social problems which are unknown.

Problems may unexpectedly face the heat at both regional, national levels.

Examples: (3 M)

1. Animal Welfare - Is it okay to eat meat or dairy?

Moral problems faced by an Indian common man: (4 M)

- Discrimination based on caste, creed and colour.
- Reservation in education and employment field enjoyed by "backward class" for 3 generations and still continue to use.
- To meet basic amenities-food, clothing and shelter.
- Garbage collection and disposal
- Traffic congestion in urban areas
- Farmers not getting support prices for crops
- Corruption

2

Name and explain the various types of Ethical inquiries available. Analyze in detail the *Self –Interest and Ethical Egoism* (15M)BTL4

Answer :Page 72 - Mike W. Martin(*Self –Interest and Ethical Egoism)*

Types of Inquiries (8 M)

Normative inquiries
Conceptual inquiries
Factual or descriptive inquiries

- **Normative Inquiries**

The description that describes what one ought to do under a specific circumstance.

- **Conceptual Inquiries**

The description of meaning of concepts, principles and issues related to engineering ethics.

- **Factual and Descriptive Inquiries**

The descriptive inquiry help to provide the facts for understanding Finding solutions to the value based issues.

Self-interest: (4 M)

It refers to the goodness of oneself in the long run.

- The ethical theories recognize the importance of self-respect.
- Utilitarian considers one's own good as well as the good of others.
- Duty ethicists stress duties to us and for won well-being.
- Ethicists of rights emphasize our rights to pursue our own good.
- Virtue ethicists accent the importance of self – respect.

	• Pursuit of self – interest must be balanced • Kept under control by moral responsibilities to other people. **Ethical Egoism (3 M)** • It tries to reduce morality to the pursuit of self - interest. • The main duty of us is to maximize our own good. • Make a differentiation between narrower and wider forms of self-interest • Ethical Egoists try to protect their positions by arguing • Pursue their self – interest in a very cautious manner to value, interest rationally on facts. • Not a persuasive or probable theory to state what is morality • It is only a convinced rejection of morality.
3.	**Explain the theory of human right ethics and its classification. (15 M) (Nov/Dec 15) (NOV/DEC 2019)** BTL2 **Answer: Page 55 - Mike W. Martin** **THEORIES ABOUT RIGHT ACTION:** These theories are essential for cause of right action and morality. They are: • **"Golden mean"** ethics **(3 M)** The best solution is achieved through reason and logic A compromise or "golden mean" between extremes of excess, deficiency. **Problem:** Variability from one person to another in their powers of reasoning The difficulty in applying the theory to ethical problems**.** • **"Rights –** based" ethics **(4 M)** Every person is free and equal Has the right to life, health, liberty and possessions **Problem:** One person's right may be in conflict with another's rights. • **"Duty –** based" ethics **(4 M)** Each person has a duty to follow a course of action **Problem:** Universal application of a rule can be harmful. • **"Utilitarian"** ethics **(4 M)** The best choice, which produces maximum benefit for greatest number of people **Problem:** Qualification of the benefits can be difficult.

	UNIT –III **ENGINEERING AS SOCIAL EXPERIMENTATION**
	Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook
1	**Write some of the pros and cons of industrial standardization. (MAY/JUNE 2012) (NOV- DEC2018)**BTL2 **Advantages of Standards:** • Reducing costs • Increasing productivity • Reducing unnecessary variety • Ensuring inter changeability • Minimizing waste • Ensuring safety • Quality assurance **Disadvantages of standards:** • The implementation of standard removes the creative element of the program • Standards force people to change their methods • Standards reduce productivity by forcing unnecessary actions • Standards do not prevent bugs.
2	**List out the limitations of ethical code. (MAY/JUNE 2011)(NOV/DEC 2014)(APRIL/MAY 2018)** BTL1 • Some issues cannot be handled in the context of a code. • There are some difficulties with enforcing the code, or at least the public may believe that enforcement committees are not tough enough on their peers. • There is often no way to bring the interests of the client, patient, or research participant systematically into the code-construction process. • There are parallel forums in which the issues in the code may be addressed, with the results sometimes at odds with the findings of the code (for example, in the courts).
3	**Define ethical accountability. (MAY/JUNE 2011)** BTL2 The inherent tendency of accepting moral responsibility for the actions of an individual and also the spontaneous willingness to subject him to the moral scrutiny in an open-minded manner is called ethical accountability.
4	**Name the aerospace ace experts and scientists who were associated with the Launching of challenger. (MAY/JUNE 2010)** BTL2

	Allan McDonald of Morton-Thiokol at Cape Kenned y, Arnold Thomson and Roger Bois joly who were the seal experts at Morton-Thiokol a n d engineering managers, Bob Lund and Joe Kil minster were the experts associated with the launching of challenger space program.
5	**Name some of the important code of ethics published by engineering societies. (MAY/JUNE 2010)** BTL2 National society of professional Engineers. Board of Ethical review. NSPE opinion of the Board of ethical review. American Association of Engineering societies (AAES). Institute of Electrical and Electronics Engineers (IEEE).
6	**What are the problems with the law in engineering?(NOV/DEC 2010)** BTL2 The numerous legal considerations that must be taken into account by engineers, considerations that are typically outside of the traditional knowledge base and experience of an engineer. Patents and the process of obtaining one; maintenance of licensing and certification; and having a firm understanding of codes and standards are just some of the many issues facing engineers in their career path.
7	**How engineering could be regarded as preventive technology? (MAY/JUNE 2009)** BTL2 As per the familiar proverb that "prevention is better than cure", the ultimate process of solving the scientific-based problems is not by curing alone, but effectively by the preventive measures. Such type of defensive measures to prevent scientific ills is called preventive technology.
8	**What are the general features of morally responsible engineers?(MAY/JUNE 2009)** BTL2 • Conscientiousness. • Comprehensive perspective. • Autonomy. • Accountability.
9	**Write some of the specific role of informed consent in engineering experimentation**. BTL2 Informed consent is the vital concept to interact engineers with public society. It reflects the respects for the fundamental rights of minority people involved in the experimental procedures.

	It enables both the public and clients to be aware of the practical risks and benefits of that experimentation.
10	**Write the differentiation between engineering and standard experiments.** BTL2 Engineering experimentation involves human subjects as control groups, Unlike in the standard experimentation .The process of obtaining the informed consent from the human-engineering experimentation. Unlike in the scientific experiments, new knowledge is not gained in engineering experiment.
11	**Differentiate scientific experiments and engineering projects** BTL4 Scientific experiments are conducted to gain new knowledge, while ―engineering projects are experiments that are not necessarily designed to produce very much knowledge.
12	**How Titanic tragedy be brought under engineering as social experimentation?** BTL2 Failure in the far-sighted approach of not providing enough number of lifeboat sand non- availability of proper safe exits handled to the sinking of titanic ship that caused the death toll of 1522 persons on b o a r d .These in designing a r e the reasons for bringing titanic tragedy under engineering as social experimentation
13	**Write down some of the uncertainties occur in the model designs.(APR-MAY2017)** BTL3 Model used for the design calculations. Exact characteristics of the materials purchased. Constancies of materials used for processing and fabrication. Nature of the pressure, the finished product will encounter.
14	**Give short notes on engineering as experimentation. (MAY/JUNE2014) (APR/MAY 2015)(NOV/DEC 2014)** BTL1 Experimentation (Preliminary tests or Simulations) plays a vital role in the design of a product or process.In all stages of converting a new engineering concept into a design likes, first rough cut design,Usage of different types of materials and processes, detailed design, Further stages of work design.
15	**State the importance of Ethics codes. (MAY/JUNE2014)** BTL1 Engineers shall uphold and advance the integrity, honour, and dignity of the engineering Profession by: •Using their knowledge and skill for the enhancement of the human race; •Being honest and impartial and serving with fidelity the public, their employers, and clients. •Striving to increase the competence and prestige of the engineering profession.

	•Supporting the professional and technical societies of their discipline
16	**List the conditions required to define a valid Consent.** BTL1 It must be voluntary and informed, and the person consenting must have the capacity to make the decision. Capacity – the person must be capable of giving consent, which means they understand the information given to them and they can use it to make an informed decision.
17	**Give some universally accepted ethical principles.** BTL2 • Honesty • Commitment • Empathy • respect for the dignity • Competent Caring for the Well-Being of Persons and Peoples • Integrity • Professional And Scientific Responsibilities To Society
18	**List out the advantages of industrial standards. (APR/MAY 2015)** BTL1 • Increased marketability • Reduced operational expenses • Better management control • Increased customer satisfaction • Improved internal communication
19	**What do you understand by balanced outlook on Law?** BTL2 A balanced outlook on laws stresses the necessity of laws and regulations and their limitations in directing engineering practice. In order to live, work and play together in harmony as a society, there must be a balance between individual needs and desires against collective needs and desires. Only ethical conduct can provide such a balance. This ethical conduct can be applied only with the help of laws. Laws are important as the people are not fully responsible and because of the competitive nature of the free enterprise system which does not encourage moral initiative.
20	**Define Whistle Blowing.** BTL2 This is an act by an employee informing the public or higher management of unethical or illegal behavior by an employee or supervisor. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers.
21	**List the advantages of code of ethics.(NOV-DEC2018)** BTL1 • Guide employees in situations where the ethical course of action is not immediately obvious.

	• A code can help create a climate of integrity and excellence. • Help the company communicate its expectations to the staff to suppliers, vendors and customers. • Minimize subjective and inconsistent management standards. • Help a company remain in compliance with complex government regulations. • Build public trust and enhance business reputations. • Offer protection in preempting or defending against lawsuits. • Enhance morale, employee pride, loyalty and the recruiting of outstanding employees. • Help promote constructive social change by raising awareness of the community's needs and encouraging employees and other stakeholders to help. • Promote market efficiency – especially in areas where laws are weak or inefficient – by rewarding the best and most ethical producers of goods and services.
21	**How does the law facilitate the ethics in engineering?(APR-MAY 2017)** BTL2 Engineering ethics is the field of system of moral principles that apply to the practice of engineering. The field examines and sets the obligations by engineers to society, to their clients, and to the profession. As a scholarly discipline, it is closely related to subjects such as the philosophy of science, the philosophy of engineering, and the ethics of technology.
	PART * B
1	**i. Assess how Engineering societies can promote ethics.** **ii. Evaluate the General responsibilities of moral engineers. (13M)** BTL5 **Answer: Refer notes.** **Engineering societies and promoting ethics.(4 M)** • Hold paramount safety, health, welfare of public. • Perform services in areas of their competence. • Issue public statements in an objective, truthful manner. • Act for each employer, client as faithful agents, trustees. • Avoid deceptive acts. • Conduct them honorably, responsibly, ethically, lawfully • To enhance the honor, reputation, usefulness of profession. • **The responsibilities of moral engineer.(7 M)** Loyalty to corporations, respect for authority, collegiality. Teamwork is a few important virtues in the field of Engineering. • **Loyalty**

	Loyalty is the faithful adherence to an organization, employer. **Loyalty to an employer can be either of the two types:** • **Agency-loyalty:** Acting to fulfill one's contractual duties to an employer. • **Attitude-loyalty :** A lot to do with attitudes, emotions A sense of personal identity as it does with actions. • **Collegiality** A work environment where responsibility, authority shared among colleagues. **Main factors that help in maintain harmony among members at a workplace are (2 M)** Respect Commitment Connectedness
2	**Explain a Balanced Outlook on Law. (13 M) (NOV/DEC2010)** BTL2 **Answer: Page 100- Mike W. Martin** **Explanation – (6 M)** • It stresses the necessity of laws and regulations • Limitations can understand with an overview of laws in engineering profession. • Individual needs, collective needs of the society stimulate harmony in society. • The ethical conduct can be applied with the help of laws. • Laws are important as people are not completely responsible. • The competitive nature of free enterprise system, does not encourage moral initiative. **Let us look at a few examples from the past that represent the importance of law.(7 M)** Babylon's Building Code Bhopal disaster
3	**Express in detail about engineers as responsible Experimenters. (13 M) (APR-MAY2017) (NOV/DEC 2019)** BTL2 **Answer: Page 95 - Mike W. Martin** **General responsibility of engineering as society(4 M)** • Engineers primarily considered as technical enablers, facilitators, rather than sole experimenters. • Responsibility is shared with management, the public and others. • The engineers should display virtue of being morally responsible person. **General features of moral responsible engineers(9 M)**

	• Conscientiousness • Relevant information • Moral Autonomy • Accountability **Conscientiousness:** Commitment to live according to certain values. **Relevant information:** Engineers properly gauge all information related to meeting one's moral obligations. **Moral autonomy:** The ability to think critically and independently about moral issues Apply moral thinking to situations, arise during professional engineering practice. **Accountability:** 'Accountability 'means being responsible, liable, answerable or obligated. Willingness to present morally convincing reason for ones action, conduct.
4	**Illustrate the codes of ethics set by professional societies. (13 M)** BTL2 **Answer: Refer notes.** **Codes of ethics set by professional societies (13 M)** • Guided in all their relations by the highest standards of honesty and integrity. • Engineers shall at all times strive to serve the public interest. • Engineers shall avoid all conduct or practice that deceives the public. • Not disclose, without consent, confidential information concerning business affairs. • Engineers shall not influence in their professional duties by conflicting interests. • Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly. • Guilty of unethical, illegal practice shall present information to proper authority for action. • Credit for engineering work to those to whom credit is due, recognize proprietary Interests of others.
5	**Examine the roles played by the codes of ethics. (13 M) (MAY/JUNE2011,NOV/DEC 2013)(NOV/DEC2014)** BTL1 **Answer :Page 44 - Mike W. Martin** **Code of ethics Meaning:(2 M)**

	To provide basic framework for ethical judgment for a professional. **Roles of Code of Ethics: (11 M)** **The code of ethics propagated by professional societies play a vital role. They are,** • Inspiration • Guidance • Support for responsible conduct • Deterring and disciplining unethical professional conduct • Educational and promotion of mutual understanding • Contributing to positive public image of profession • Protecting the status quo suppressing dissent within the profession • Promoting business interest through restraint of trade.
6	**How engineering project differ from standard experimentation? (13 M)(NOV/DEC 2013)** BTL2 **Answer :Page 91- Mike W. Martin** **The scientific experiments in the laboratory and the engineering experiments in the field exhibit several contrasts as listed below: (13 M)** **Experimental control:** • Members for study selected into two Groups namely A, B at random. • Group A are given special treatment. • The group B Given no treatment, called 'controlled group'. • Placed in the same Environment as other group A. • Engineering, through random sampling, survey made among users • To assess results on product. **Humane touch:** • Engineering experiments involve human souls, their needs, views,& expectations, • Creative use as in case of social experimentation. • This view not agreed by many of engineers. • Quality engineers, managers fully realized this humane aspect. **Informed consent:**

	• Engineering experimentation viewed as Societal Experiment • Since subject, the beneficiary is human beings. • Medical practice- moral, legal rights Have recognized while planning experiments
7	**i. Explain limitations of code of ethics.** **ii. Briefly discuss the importance of code of ethics. (13M) (APR-MAY2017)** BTL4 **Answer: (Refer notes)** **Definition of code of ethics (2 M)** The definition of a code of ethics is "a collection of principles and practices that a business believes in and aims to live by." It should be a document that goes along with the company mission and vision statement. Anyone who interacts with the company or works for the company should understand the code. Much of this is part of employee policy and guidelines, but it also carries over to dealing with vendors and partners. ***Limitations of Codes:*** **(3 M)** • Codes are restricted to general and vague wordings. • Engineering codes often have internal conflicts. • They cannot be treated as final moral authority for professional conduct. • Only a few practicing engineers are members of Professional Societies • Members of Professional Societies not aware of existence of codes of their societies never go through it. • Codes can be reproduced in a very rapid manner. • Codes said to be coercive i.e., implemented by threat, force. **The importance of code of ethics.(8 M)** • Step one: Get your priorities straight • Step two: Where to get your input • Step three: Common major pitfalls • Step four: Where to get help • Step five: Assigning someone to be in charge
8	**Discuss ethics in research (13M) (NOV/DEC2013/2018)** BTL2 **Answers refer notes. INTRODUCTION: (3 M)** People think of ethics, think of rules for distinguishing between right, wrong, such as Golden Rule. **EXPLANATION: (10 M)**

	The following is a rough and general summary of some ethical principles: • Honesty • Integrity • Carefulness • Openness • Respect for Intellectual Property • Confidentiality • Responsible Publication • Responsible Mentoring • Respect for colleagues • Social Responsibility • Non-Discrimination • Competence • Legality • Animal Care • Human Subjects Protection
9	**Illustrate in detail about engineering as experimentation. (13M)(NOV/DEC 2019)** BTL3 **Answer: Page 89 - Mike W. Martin.** **Engineers as Experimenters: (4 M)** • Process of developing a product, an engineer generally learns through experimentation. a trial and error method is mostly used one to obtain results • Hence, primarily any experiment carried out with partial ignorance. • Outcomes of the experiments may not be as expected. • An engineer should always be ready for unexpected output. **Consider following points which are related to moral aspects of human behaviour(9 M)** • To maintain safety of human beings. • To procure their rights of consent. • To keep them aware regarding experimental nature of project. • To warn them about probable safety hazards. • Monitor results of experiment continuously.

	• Having autonomy in conducting experiments. • Accepting accountability for results of project. • Exhibiting their technical competence, characteristics of professionalism.
10	**How the ethical codes provide discipline among the engineers? (13M) (MAY/JUNE2014), (APR/MAY2015) (NOV/DEC 2014) (APRIL/MAY 2019)** BTL2 **Answer refer notes. EXPLANATION: (13 M)** • Engineers hold paramount safety, health, welfare of public • To comply with principles of sustainable development in performance of professional duties. • Engineers perform services only in areas of their competence. • Engineers issue public statements only in an objective, truthful manner. • Engineers act in professional matters for each employer • Avoid conflicts of interest. • Engineers build their professional reputation on the merit of their services • Not compete unfairly with others. • Engineers act in such a manner as to uphold and enhance the honor, integrity. • Act with zero tolerance for bribery, fraud, and corruption.
	PART * C
1	**Express in detail about the types and importance of industrial standards. (15M) (APRIL/MAY 2015)** BTL2 **Answer :Refer notes.** **Types of standards:(11 M)** **Optimum standards:** • Facilitate the creation of political as well as business related advantages. **Formal standards:** • Strategic initiatives with broad applicability, with roles for ANSI, standards developers, industry, government. **Private standards:** • Developed by an organization or a trade association. **Testing standards:** • They provide a method to test products or materials.

	Performance standards: • Performance requirements usually measured using a specified test procedure, standard. **Dimensional standards:** • They establish a number of key dimensions that must be met. • This allows product inter changeability. **Quality standards:** • They describe certain characteristics that must be met • Insuring the buyer that some minimum level of quality is met. **Importance of standards (4 M)** • Administration, legislative bodies also benefited by Industry standard. • Standardization facilitates a healthy competition, designing of new concepts. • It ascertains the rank of an industry in the economic set up of a country. • Optimum standards facilitate creation of political, business related advantages. • Setting industry standard, to provide a platform for giving shape to new creations.
2	**Discuss the various ethical issues involved in Bhopal disaster. (15M) (May/June2009) (NOV/DEC 2018) (APRIL/MAY 2018)** BTL2 **Answer refer notes. EXPLANATION:(15 M)** • In case of Bhopal tragedy all of them were neglected. • The poor quality of the facility • Lack of many instruments was the reason for the leak. • Two out of three main safety systems unable to cope with situations. • The flare tower, water sprays for not functioning properly. • Public were never given any information about MIC, safety measures. • Location of plant close to settlement also one of ethical question to be raised. • "Perform services only in areas of their competence". • leak started after wash out of a pipe, had not sealed properly by a worker • Training did not meet standards and was ordered by novice supervisors.

3	**Compare and contrast engineering experiments with standard experiments. (15M) (MaY/June 2009) (NOV-DEC 2018) (APRIL/MAY 2018)** BTL4 **Answer : Page 89 - Mike W. Martin** **Similarity to Standard Experiments(6 M)** • Carried out in partial uncertainties. • Outcomes of engineering projects, generally uncertain like other experiments • Requires thorough knowledge about products at pre-production, post-production stages. • Requires constant monitoring, alertness, • Vigil on part of the engineers at every stage of the project. **Differences between engineering experiments and other standard experiments. Experimental control (9 M)** **Experimental control:** • Members for study selected into two Groups namely A, B at random. • Group A are given special treatment. • The group B Given no treatment, called 'controlled group'. • Placed in the same Environment as other group A. • Engineering, through random sampling, survey made among users • To assess results on product. **Humane touch:** • Engineering experiments involve human souls, their needs, views,& expectations, • Creative use as in case of social experimentation. • This view not agreed by many of engineers. • Quality engineers, managers fully realized this humane aspect. **Informed consent:** • Engineering experimentation viewed as Societal Experiment • Since subject, the beneficiary is human beings. **Informed consent consists of two main elements:** • Knowledge: Human subjects should be given all information to make a reasonable decision. • Voluntariness: Human subjects, show their willingness to be a human model voluntarily. The person should not be forced, deceived, fraud, etc.

	UNIT-IV **SAFETY, RESPONSIBILITIES AND RIGHTS**
	Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.
	PART * A
1	**What is conflict Interest?(MAY/JUNE 2012) (NOV-DEC 2018)** BTL2 A situation that has the potential to undermine the impartiality of a person because of the possibility of a clash between the person's self-interest and professional interest or public interest. Types of Conflicts of interest: Actual conflict of interest Potential conflict of interest Apparent conflict of interest
2	**What are the reasons for Risk-Benefit Analysis?(NOV/DEC 2011, NOV/DEC 2013) (MAY/JUNE 2016)** BTL2 A risk-benefit analysis is a comparison between the risks of a situation and its benefits. The goal is to figure out whether the risk or benefit is most significant. It's used often in medicine, because every medical procedure has risks associated with it, and some procedures that could be beneficial actually turn out to statistically cause more harm than good. That's how medical researchers figure out whether certain procedures are worth doing and what types of people will benefit. • Risk-benefit analysis is concerned with the advisability of undertaking a project. • It helps in deciding which design has greater advantages. • It assists the engineers to identify a particular designs core higher with that of the another**.**
3	**Give few steps to reduce risks. (MAY/JUNE 2009)** BTL2 The factors are: • The engineer must have the right data. • Engineer should satisfy with the present design. • Engineer must test the safety of a product. • Engineer must measure and weight he risks with benefits for a product.
4	**Give the reasons for the Three Mile Island disaster? ((MAY/JUNE 2014)**BTL1

	In adequate training to the operators. Use of B&W reactors.
5	**List the two types of Risk.((MAY/JUNE 2012)** BTL1 • Personal Risk: An individual, who is given sufficient information, will be in a position to decide whether to take part in a risky activity or not . They are more ready to take on voluntary risks than in voluntary risks. • Public Risks: Risks and benefits to the public are more easily determined than to individuals, as larger number of people is taken in to account .Involuntary risks are found here.
6	**Define "risk".(May/June 2011)(NOV/DEC2014) (NOV-DEC 2016) (NOV/DEC 2018) (APRIL/MAY 2018)** BTL2 A risk is the potential that something unwanted and harmful may occur. Risk = Probability X Consequences.
7	**What do you mean by voluntary risk? (May/June 2010, May/June 2010)** BTL2 If a person knowingly takes any risk, then he feels it safe. In contrast, if the same risk is forced to him, then he feels it unsafe. In simple terms the voluntary risks are considered as safe and the involuntary risks are considered as unsafe.
8	**What is safe risk and acceptability of risk? (IT Dec 2009,May 2010)** BTL2 Acceptability of risk: A risk is acceptable when those affected are generally no longer apprehensive about it. Apprehensiveness mainly depends on how the risk is perceived by the people. Safe Risk: If a person knowingly takes any risk then he feels it safe. In the same way voluntary risks are considered as safe risk
9	**List the methods that can be applied when testing is inappropriate. (May/June 2009)(NOV/DEC2014)** BTL1 • Scenario Analysis • Failure modes and effects analysis • Fault free analysis • Event free analysis
10	**What is the use of knowledge of risk acceptance to engineers?** BTL2 Though past experience and historical data give better information about safety of products designing there are still inadequate .The reasons are

	• The information is not freely shared among industries. • There also new applications of old technologies that provides available data, which are less useful. • So, in order to access the risk of a product, the engineers must share their knowledge and information with others in a free manner.
11	**What are the positive uncertainties in determining risks?** BTL2 • Purpose of designing • Application of the product • Materials and the skill used for producing the product
12	**What is the Risk Transfer?** BTL2 It refers to the legal assignment of the cost of certain potential losses from one party to another. The most common way of affecting such transfer is by insurance.
13	**What are the steps involved in design for safety? ((MAY/JUNE 2014)** BTL2 • Define the problem • Generate alternate solutions • Analyses each solution • Test the solution • Select the best solution • Implement the chosen solution**.**
14	**State the industrial definition on safety .(MAY/JUNE 2014)** BTL1 • A ship in harbour is safe, but that is not what ships are built for – John A. Shedd • A thing is safe if its risks are judged to be acceptable,, - William W. Lawrence • We buy an ill-designed Iron box in a sale- Underestimating risk • We judge fluoride in water can kill lots of people - Overestimating risk • We hire a taxi, without thinking about its safety - Not estimating risk
15	**What is meant by Disaster? (MAY/JUNE 2014, NOV/DEC 2013)** BTL2 A DISASTER = A seriously disruptive event + A state of unpreparedness. E.g., Titanic collision with an iceberg, at night: Emergency Fewer lifeboats, inadequate training and warnings of icebergs unheeded ->Disaster
16	**What is informed consent? (MAY/JUNE 2011)(APR/MAY 2015)** BTL2 Informed consent is the process by which the treating health care provider discloses appropriate Information to a competent patient so that the patient may make a voluntary choice to accept or refuse treatment. It originates from the legal and ethical right the patient has to direct what happens to her body and from the ethical duty of the physician to involve the patient in her health care.

17	**What is the use of risk analysis?(APR/MAY 2015) (MAY/JUNE 2016) (APR/MAY 2017)**BTL2 Risk analysis is the process of defining and analyzing the dangers to individuals, businesses and government agencies posed by potential natural and human-caused adverse events.
18	**List the two types of authority given by Martin and Schinzinger.** **(May/June2011,NOV/DEC 2014),(APR/MAY2015)** BTL1 **Martin and Schinzinger define two types of authority** Institutional authority • Associated with administrative position Expert Authority • Accrues from specialized knowledge
19	**What are the elements of collegiality? (May/June 2010, NOV/DEC 2014)(Nov/Dec 2013) (MAY/JUNE 2014)** BTL2 • Respect • Commitment • Connectedness • Cooperation
20	**What do you mean by employee rights? And lists its categories. (Nov/Dec 2012)** BTL2 Employee rights are rights, moral or legal, that involve the status of being an employee. They include some professional rights that apply to the employer-employee relationship. Categories: • workplace safety • Civil rights • Family and medical leave • Workers compensation • Labor relations laws.
21	**What is the Basic Right of Professional Conscience? (MAY/JUNE 2011)** BTL2 The right to do what everyone agrees it is obligatory for the professional engineers to do the basic professional right is an entitlement giving one the moral authority to act without interference from others.
22	**What is Institutional authority? (NOV/DEC 2011)** BTL2 • Associated with administrative position.

	• Those with authority have the right to administer their duties and the freedom to actually achieve organizational goals by expending the resources available to them. This type of authority usually goes with the position: • Managers • Administrators • Project Engineers
23	**Define the term safety. How is it related to risk? (NOV-DEC 2018)** BTL2 Safety is a concept that includes all measures and practices taken to preserve the life, health, and bodily integrity of individuals. In the workplace, safety is measured through a series of metrics that track the rate of near misses, injuries, illnesses, and fatalities. In order to improve these metrics, employers and safety officials must also conduct investigations following any incident to ensure that all safety protocols and measures are being followed or to implement new ones if needed. **Safety relation with risk:** • Identifying a hazard • Collecting information and analyzing risk associated with it • Determining how to remove or reduce its effect by completely eliminating the process or equipment • Replacement with a better equipment or process • Using advanced technology or design and physically isolating processes or direct contact of user by the use of appropriate collective or personal protective equipment.
24	**Define term collective bargaining. (MAY/JUNE 2014)(NOV-DEC 2016) (APR/MAY 2017) (MAY/JUNE 2016)** BTL2 • There is a limit of one representative for each unit of employees • All representatives must promote the practice, and follow all procedures, of collective bargaining • Employers must bargain with the employees' representatives • Employees and their representatives have the right to discuss wage issues
25	**What do you mean by IPR? (APR/MAY 2017)** BTL2 Intellectual property rights are the rights given to persons over the creations of their minds. They usually give the creator an exclusive right over the use of his/her creation for a certain period of time.
26	**What is the difference between bribe and gifts? (Nov/Dec 2014)**BTL2 Gift: Something of value given without the expectation of return

	Bribe: Something of value given with the hope of a future influence or benefit
	PART * B
1	**What is risk benefit analysis? Explain the procedure in Risk Benefit Analysis. Discuss its roles in reducing risks. (13M) (Nov/Dec 2010, May/June2011) (NOV/DEC 2014) (APR/MAY 2017) (NOV-DEC 2016) (NOV/DEC 2018) (APRIL/MAY 2018) (NOV/DEC 2019)** BTL2 **Answer: Page 128 - Mike W. Martin** **Introduction:(2 M)** A risk-benefit analysis is a comparison between the risks of a situation and its benefits. The goal is to figure out whether the risk or benefit is most significant. • Uncertainties in design • Personal risk • Public risk and public acceptance **Various procedure in adopting risk benefit analysis: (8M)** • Identify the risks early on in your project. • Communicate about risks • Consider opportunities as well as threats when assessing risks. • Prioritize the risks • Fully understand the reason and impact of the risks. • Develop responses to the risks • Develop the preventative measure tasks for each risk. • Develop the contingency plan for each risk. • Record and register project risks. • Track risks and their associated tasks. **Role in reducing risks: (3 M)** • Application of inherent safety concept in design. • Use of redundancy principle in the instrument protection • Regular inspection • Training and operating personnel • Conducting regular safety audits • Development of well-designed emergency evacuation plan and regular rehearsal.
2	**Define the term risk and safety. Explain how an engineer assesses the risk? (13M) (NOV/DEC 2014) (Nov/Dec 2013) (NOV-DEC 2016)** BTL2 **Answer: Page 121 - Mike W. Martin (2 M)**

	Define risk: "Potential for the realization of unwanted consequences from impending events." **Define safety:** "A thing is safe if its risks are judged to be acceptable." **(2 M)** **Definition** **(2 M)** A safety risk assessment is a systematic procedure for identifying and managing hazards. It encompasses thorough examination of the entire work environment, processes and equipment to determine any hazard to the health of the employees in the short or long term and implementing remedies. **Risk assessment:** **(3 M)** ▪ Risk assessments are recorded retained for significant hazards. ▪ Risk assessments are suitable, sufficient. ▪ Staffs are aware of, understand relevant risk assessments. ▪ Risk assessments are reviewed periodically **Risk assessment process:** **(4 M)** • Identify the hazards associated with a procedure • Consider who may be exposed and what is the maximum possible exposure • Include storage waste, disposal and cleaning, if appropriate. • List existing control measures. • Consider emergency procedures. • If further control measures required, list and set actions
3	**Describe the concept of Occupational crime with examples. (13M) (Nov/Dec 2013)(Apr/May 2015) (Nov/Dec 2015)** BTL2 **Answer: Page 128 M - Mike W. Martin** **Block and Geis (Man, Crime and Society, 1970: 307) have classified occupational offenders into five groups on the basis of the nature of victim involved: (4 M)** • Persons acting as individuals against other individuals (e.g., fraudulent lawyers, doctors), • Those committing crimes against business concerns that employ them (embezzlers), • Those in policy-making positions who commit crimes for their organizations (anti-trust violators), • Agents of an organisation who victimize the general public (advertising fraud), and • Merchants victimizing their customers (short-weighing). • This method is simple. The victim could be employer, employee, public concern, government organisation, and so forth. **Types of occupation crime:** **(9 M)** • Price fixing • Endangering lives • Industrial espionage
4	**Write brief notes on** (i) **Whistle blowing (ii) Discrimination (13M) (APRIL/ MAY 2015)** BTL3

Answer: Page 172-173 - Mike W. Martin

Whistle blowing **(6 M)**

- A whistleblower is a person who exposes any kind of information
- Exposes activity that is deemed illegal, unethical.
- Exposes, which is not correct within an organization that is either private or public. Types of whistle blowing:
- Internal Whistle Blowing
- External Whistle Blowing
- Open Whistle Blowing
- Anonymous Whistle Blowing

Discrimination **(7 M)**

Definition

It is referred to prejudice resulting from denial of an opportunity, unfair treatment in the job selection, promotion and transfer is called discrimination.

Types of Discrimination

- Direct discrimination
- Indirect discrimination
- Pregnancy and maternity discrimination
- Absence from work because of gender reassignment
- Discrimination connected to your disability
- Duty to make reasonable adjustments for disabled people
- Sexual harassment
- Victimization

5 **Explain the types and advantages of Intellectual property rights. (13M) (Nov/Dec 2015) (APRIL/ MAY 2013,NOV/DEC 2013) (NOV/DEC 2014) (MAY/JUNE 2016) (APRIL/ MAY 2015)** BTL2

Answer: Refer Notes

Intellectual property rights: **(2 M)**

Intellectual property rights are the rights given to persons over the creations of their minds. They usually give the creator an exclusive right over the use of his/her creation for a certain period of time.

Types of Intellectual Property Rights: **(8 M)**

Intellectual Property Rights can be further classified into the following categories −

	• Copyright • Patent • Trade mark • Trade Secrets, etc. **Advantages of Intellectual Property Rights (3 M)** • Provides exclusive rights to the creators or inventors. • Encourages individuals to distribute and share information and data instead of keeping it confidential. • Provides legal defence and offers the creators the incentive of their work. • Helps in social and financial development.
6	**Explain the concept of Confidentiality in detail. (13M) (NOV/DEC 2011)** BTL2 **Answer: Page 146 -Mike W. Martin** **Introduction: (2 M)** • Any information that is desirable to keep secret. Usually has some exploitable value for business purposes **Types of information (8 M)** – Public (available to anyone) – Private (restricted/conditional availability) • Confidential • Privileged • Proprietary • Trade secrets (and ~patents) How companies might handle you changing jobs when confidentiality is at risk: **(3 M)** • Employee sign employment contracts that place constraints on future employment • Company give positive benefits to those leaving such as special pension considerations, the opportunity to do consulting etc. • Company works with employees to show the damage that can be done if information is passed on.
7	**Explain a detailed note about collective bargaining. (13M) (APRIL/ MAY 2010), (NOV/DEC 2013) (NOV/DEC 2014) (APRIL/ MAY 2015)** BTL2 **Answer: Page: -5.8 - V.Jayakumar** **collective bargaining: (3 M)** • There is a limit of one representative for each unit of employees

	• All representatives promote practice, and follow all procedures, of collective bargaining • Employers must bargain with the employees' representatives • Employees and their representatives have the right to discuss wage issues **Collective Bargaining Process** Preparation : **(10 M)** Choosing a negotiation team and representatives of both the union and employer. Discussion: Parties meet to set ground rules for collective bargaining negotiation process. Proposal: Representatives make opening statements, outlining options, possible solutions to issue at hand. Bargaining: Following proposals, parties discuss potential compromises, bargaining to create an agreement that is acceptable to both parties. A "draft" agreement, which is not legally binding, but a stepping stone to coming to a final collective bargaining agreement. Final Agreement: Once an agreement is made between the parties, it must be put in writing, signed by the parties, and put into effect.
8	**Discuss on Respect for authority and Conflict of interest. (13M) (MAY/JUNE 2014) (NOV/DEC 2014)** BTL2 **Answer: page 150 - Mike W. Martin** **Respect for authority: (2 M)** • Authority is the "potential and resources" to accomplish tasks. • Power is the capability to do so • Authority gives the right to control decisions affecting the company's interests • Engineers must respect the authority of their employers **Martin and Schinzinger define two types of authority (5 M)** • Institutional authority Associated with administrative position • Expert Authority Accrues from specialized knowledge • Morally Justified Authority Institutions can try to direct engineers to do things that are not "morally justified"

	• Obliged to respect legitimate authority Does not give right to ignore legitimate directives Respecting authority comes second when: Lives are threatened Financial corruption is involved Grave economic loss may result **Conflict of interest: (2 M)** • "Professional conflicts of interest are situations where professionals have an interest which, if pursued, might keep them from meeting their obligations to their employers or clients."(M&S) • Three types of conflict of interest (Harris, Pritchard and Rabins, 2000) **(4 M)** • Actual • Potential • Apparent
9	**Explain the concept of Human rights and employee rights. And its role in organisation (13M) (MAY/JUNE 2014) (Nov/Dec 2013) (NOV/DEC 2014) (APRIL/ MAY 2015) (APR/MAY 2017)** BTL2 **Answer: Refer notes.** **Human rights: (3 M)** • Based on the principle of respect for the individual. • Each person morally, rationally treated who deserves to be treated with dignity. • Rights to which everyone is entitled—no matter who they are, where they live—simply because they are alive. **Employee rights. (2 M)** • An employee right can be any right, moral or legal, that involves status of being an employee. • They involve some professional rights also, such as the right to be paid according to the salary mentioned in one's contract. • Privacy and equal opportunity can be considered essential rights too. **Employee rights (4 M)** All employees have basic rights in the workplace -- including • The right to privacy • Fair compensation • Freedom from discrimination. • Equal Opportunity – Non-discrimination • Equal opportunity – Affirmative Action

Rights of an Employee: (4 M)

An employee is, at the very least, entitled to the following rights at his workplace −

- No discrimination at work, especially on the basis of gender, nationality, religion, medical condition, and political affiliation.
- Healthy work-life balance, which means no long hours at work. Employees can also report if their employer makes unnecessary delays in delegating work.
- Protection of job for people with disabilities and medical conditions.
- Complete protection against sexual harassment of any kind and immunity from being forced to exchange favors for benefits.
- Freedom to discuss the terms and conditions of the employment with other employees and negotiating wages to suit lifestyle as per changing times.
- Right to ask for safe working conditions and reservation to answering questions on age, religion, nationality, and medical condition.
- Demanding certain changes and modifications regarding the working conditions to accommodate situations that might crop up due to their prevailing medical conditions.
- Right to form or participate a union that aims to improve the wages, lifestyle, working environment, and emphasizes on employee rights at the workplaces.

10

Discuss professional rights in an engineer field.(13M) (APRIL/ MAY 2015) (MAY/JUNE 2014) (NOV/DEC 2014) (Nov/Dec 2013) BTL2

Answer: Page 163 - Mike W. Martin

Professional Rights (3 M)

The rights that engineers have as professionals are called Professional Rights. These professional rights include :

- The basic right of professional conscience.
- The right of conscientious refusal.
- The right of professional recognition

Professional rights set by professional societies (10 M)

- Guided in all their relations by the highest standards of honesty and integrity.
- Engineers shall at all times strive to serve the public interest.
- Engineers shall avoid all conduct or practice that deceives the public.
- Not disclose, without consent, confidential information concerning business affairs.

	• Engineers shall not influence in their professional duties by conflicting interests. • Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly. • Guilty of unethical, illegal practice shall present information to proper authority for action. • Credit for engineering work to those to whom credit is due, recognize proprietary interests of others.
11	**Discuss the 'faithful agent argument' and 'public service argument' of collective with suitable examples. (13M) (NOV-DEC 2018) (NOV/DEC 2019)** BTL2 **Answer: Refer notes** Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest or the appearance of conflicts of interest. (7 M) a. Engineers shall avoid all known conflicts of interest with their employers which could influence their judgment or the quality of their services. b. Engineers shall not undertake any assignments which would knowingly create a potential conflict of interest between themselves and their clients or their employers. c. Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project. d. Engineers shall not solicit or accept financial or other valuable considerations, for specifying products without disclosure to their clients or employers. e. Engineers shall not solicit or accept gratuities, directly or indirectly, from contractors, their agents, or employers in connection with work for which they are responsible. f. Engineers shall not participate in considerations or actions with respect to services provided by them or their organization(s) in private or product engineering practice. g. Engineers shall not solicit an engineering contract from a governmental body or other entity on which a principal, officer. h. Engineers shall exercise careful judgment in their determinations to ensure a balanced viewpoint, and avoid a conflict of interest. i. When, as a result of their studies, Engineers believe a project(s) will not be successful, they shall so advise their employer or client. j. Engineers shall treat information coming to them in the course of their assignments as confidential, and shall not use such information as a means of making personal profit. (1) They will not disclose confidential information concerning the business

affairs or technical processes

(2) Not reveal confidential information or finding of any commission or board of which they are members unless required by law or court order.

(3) Designs supplied to Engineers by clients shall not be duplicated by the Engineers for others without the express permission of the client(s).

k. Engineers shall act with fairness and justice to all parties when administering a construction (or other) contract.

l. Before undertaking work for others in which Engineers may make improvements, plans, designs, inventions, Engineers shall enter into positive agreements regarding the rights of respective parties.

m. Engineers shall admit their own errors when proven wrong and refrain from distorting or altering the facts to justify their mistakes or decisions.

n. Engineers shall not accept professional employment or assignments outside of their regular work without the knowledge of their employers.

o. Engineers shall not attempt to attract an employee from other employers or from the marketplace by false or misleading representations.

'PUBLIC SERVICE ARGUMENT' (6 M)

Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.

a. Engineers shall recognize that the lives, safety, health and welfare of the general public are dependent upon engineering judgments.

b. Engineers shall not approve nor seal plans and/or specifications that do not conform with accepted engineering standards.

c. Should the Engineers' professional judgment be over ruled under circumstances where the safety, health, and welfare of the public are endangered.

(c.1) Engineers shall do whatever possible to provide published standards, test codes and quality control procedures that will enable the public to understand the degree of safety.

(c.2) Engineers will conduct reviews of the safety and reliability of the design, products or systems for which they are responsible before giving their approval to the plans for the design. (c.3) Should Engineers observe conditions, which they believe, will endanger public safety or Health.

d. Should Engineers have knowledge or reason to believe that another person or firm may be in violation of any of the provisions of the Guidelines?

(d.1) They shall advise proper authority if an adequate review of the safety and reliability of the

	Products or a system has not been made. (d.2) They shall withhold approval of products of systems when changes or modifications are made which would adversely affect its performance insofar as safety and reliability are concerned. e. Engineers should seek opportunities to be of constructive service in civic affairs and work for the advancement of the safety, health and well being of their communities. f. Engineers should be committed to improving the environment to enhance the quality of life.
12	**Explain the factors that affect Risk Acceptability? And the knowledge required to assess the risk by engineer.(13M) (MAY- JUN 2016) (Nov/Dec 2013)** BTL2 **Answer: Page 153 - Mike W. Martin** **The Factors That Affect Risk Acceptability (6 M)** • Voluntarism and control • Effect of information on risk assessment • Job related pressures • Magnitude and proximity of the people facing risk **The knowledge required to assess the risk by engineer (7M)** • Data in design • Uncertainties in design • Testing for safety • Analytical testing • Risk-benefit analysis
	PART * C
1	**Discuss the significance of intellectual property rights. Also Explain the legislations covering intellectual property rights in India. (15M) (NOV/DEC 2013) (MAY-JUN 2016) (MAY/JUNE 2014) (NOV/DEC2014)** BTL2 **Answer: Refer notes.** **SIGNIFICANCE: (4 M)** • Clear identification of the IP. • Unambiguous title to the asset. • Qualitative and quantitative characteristics of the IP. • Earnings capacity and profitability relating to the IP. • Market share supported by, or as a result of, the IP. • Legal rights restrictions, competition, barriers to entry, risks associated with the IP. • Product life cycles and positioning.

	• Historical growth and prospects for the future. **Firms of all sizes and purpose are motivated by similar goals in the creation of such programs:** • To identify what constitutes a risk sensitive intangible asset; **(4 M)** • To address new and emerging threats to IP; • To properly allocate available risk resources given limited funds; and • To achieve compliance within the legal and regulatory environment in which they operate. The TRIPS Agreement came into effect on 1st January 1995, is considered till date most complete multilateral agreement on intellectual property. The areas of intellectual property, it covers are as following: **(7 M)** • Trademarks which include service marks as well. • Industrial designs. • Copyright and related rights (i.e. producers of broadcasting organization, the rights of performers) • Geographical indications which include appellations of origin. • The lay-out designs (topographies) of assimilated circuits. • The information which are not closed which includes test data and trade secrets. • Patents which include protection of new varieties of plants.
2	**(i) Discuss the significance of loyalty and collegiality in team work.(15M)(MAY-JUN 2014) (NOV/DEC2014) (APRIL/ MAY 2015)** **(ii) Explain the different types of collective bargaining.(APRIL/ MAY 2015)** BTL2 **Answer: Page 150 - Mike W. Martin.** • **Loyalty** **(4 M)** Loyalty is the faithful adherence to an organization, employer. **Loyalty to an employer can be either of the two types:** • **Agency-loyalty:** Acting to fulfill one's contractual duties to an employer. • **Attitude-loyalty :** A lot to do with attitudes, emotions A sense of personal identity as it does with actions. **Collegiality** **(3 M)** • To improve the respect in work place • To help to maintain the better relation in the organisation • To increase the value of relationship

	• To maximise the method of communication • Motivates unity in the workplace. • Offers differing perspectives and feedback • Improved efficiency and productivity • Provides great learning opportunities • Promotes workplace synergy **Definiton:** Collective Bargaining. **(2 M)** The Collective Bargaining is the process wherein the unions (representatives of employees or workers), and the employer meet to discuss the issues related to wage, the number of working hours, work environment and the other terms of the employment **Types of collective bargaining:** **(6 M)** • Conjunctive or Distributive Bargaining • Co-operative or Integrative Bargaining • Productivity Bargaining • Composite Bargaining
3	**Discuss the features of whistle blowing. (15M) (NOV/DEC2014) (15M)** BTL2 **Answer : Page 177 - Mike W. Martin** **The features of whistle blowing (15M)** • Evidence A whistleblower must have evidence that someone, usually a corporation or government contractor • Documentation The whistleblower needs to have more than just suspicions; he or she needs to collect concrete and legitimate documentation of the wrongdoing • Information Gathering Names and contact information of the parties involved in the wrongdoing, laws that he or she believes are being violated by said parties • Confidentiality The whistleblower should keep the information and the case absolutely confidential and avoid discussing it with anyone. • Settle in for the Long Haul Since cases like these often take a long time to settle, the whistleblower should prepare for a long process • Prepare for Backlash It's not uncommon for a whistleblower to be accused of being privy to the wrongdoing or even

	participating in it. • Look for New Employment Whistleblowers can get a bad reputation, which can affect finding a new job, so getting a new one before that happens is important • Be a Model Citizen Being a model citizen and not doing anything that can be used against them is important for whistleblowers. • Get Support In addition to finding an attorney for legal help, whistleblowers should look into resources like the National Whistleblowers Canter
4.	**Safety in a commodity comes with a price' – Explain. And discuss how the knowledge of risk is always better for safety with suitable examples. (15M) (NOV-DEC 2018) (APRIL/MAY 2018)** BTL2 **Answer: Refer notes** **Safety in a commodity comes with a price' (8 M)** • Absolute safety is never possible to attain and safety can be improved in an engineering product only with an increase in cost. • On the other hand, unsafe products incur secondary costs to the producer beyond the primary (production) costs, like warranty costs loss of goodwill, loss of customers, litigation costs, downtime costs in manufacturing, etc. • Figure indicates that P-Primary costs are high for a highly safe (low risk) product and S- Secondary costs are high for a highly risky (low safe) product. • If we draw a curve T=P+S as shown, there is a point at which costs are minimum below which the cost cannot be reduced. If the risk at Minimum Total Cost Point is not acceptable, then the producer has to choose a lower acceptable risk value in which case the total cost will be higher than M and the product designed accordingly. • It should now be clear that safety comes with a price only. **"Knowledge of risk for better safety".(7 M)** • Robert Stephenson writes that all the accidents, the harms caused and the means used to repair the damage should be recorded for the benefit of the younger Members of Profession. • A faithful account of those accidents and the damage containment was really more valuable than the description of successful work. • Hence it is imperative that knowledge of risks will definitely help to attain better safety.

	But it should be borne in mind, that still gaps remain, because i) There are some industries where information is not freely shared ii) There are always new applications of old technology that render the available information less useful.

	UNIT V GLOBAL ISSUES
	Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

	PART * A
1	**State the term called embezzlement. (APRIL/ MAY 2011)** BTL2 Embezzlement is a form of white-collar crime wherein a person or entity misappropriates the assets entrusted to him or her. In this type of fraud the assets are attained lawfully and the embezzler has the right to possess them, but the assets are then used for unintended purposes. Embezzlement is a breach of the fiduciary responsibilities placed upon a person.
2	**What is technology transfer? (APRIL/ MAY 2010)** BTL2 Technology transfer is a process of changing the technology to a new setting and implementing it. Technology includes hardware such as machines and installations as well as techniques such as technical, organizational and managerial skills and procedures**.**
3	**Write a note on moral leadership. APRIL/MAY2010) (NOV/DEC 2014)** BTL2 Whenever the goals of a leader become permissible and also morally valuable, it is known as moral leadership. Moral leadership also means that employing morally acceptable ways to motivate the groups to move towards morally desirable ways. The ways are depending on the situations.
4	**State the most important ethical mistake made by the multinational corporation which caused Bhopal gas plant disaster. (NOV/DEC 2010)** BTL1 • The tanks used to store Methyl Iso-cyanate were overloaded to a tune of 75%. • The emergency plant was also filled with a large amount of chemicals. • The entire refrigeration unit had been shut down as a measure to reduce the cost and this Led to increase of temperatures to a higher level. • One of the disappointed workers unscrewed a pressure gauge on a tank and inserted a hosepipe into it, knowing that it would cause damage, but not to this extent. • Scrubber has also been shut down. • Flare tower was also not in an operating condition. • Unfortunately there were no emergency drills or evacuation plants available.
5	**Define Conflict resolution. (APRIL/ MAY 2010)** BTL2 Conflict resolution means a process of resolving dispute or disagreement. It mainly aims at reconciling opposing arguments in a manner that promotes and protects the human rights of all parties concerned.

6	**What is contextualizing? (APRIL/MAY 2010)** BTL2 In accordance to Gilligan women try hard to preserve personal relationship with all people. This context-oriented emphasis on maintaining personal relationship is called as ethics of care.
7	**Give a short note on ethical pluralism and ethical relativism. (APRIL/MAY 2010)** BTL2 Ethical pluralism: According to this view there may be alternative moral perspectives that are reasonable, but no one of which must be accepted completely by all rational and morally concerned persons. Ethical relativism: Actions are morally right when they are approved by law or custom they are wrong when they violate laws or customers.
8	**What should an ethical expert witness, even though hired by a company, expected to do? (APRIL/MAY 2010)** BTL2 Engineers should not become the hired-guns to their clients, but instead remain as objective as humanly possible in their investigations and the conclusions they reach .They should avoid biases resulting from money ego, and sympathy.
9	**List down the international rights listed by Donaldson. (NOV/DEC 2014)** BTL2 Thomas Donaldson in his book _The ethics of International Business,, has listed the following as the International rights: • The right to freedom of physical movement • The right to ownership of property • The right to freedom from torture • The right to a fair trial • The right to non discriminatory treatment • The right to physical security • The right to freedom of speech and association • The right to minimal education • The right to political participation • The right to subsistence.
10	**Define appropriate technology. (Nov 2008)** BTL2 Appropriate technology refers to the identification, transfer and implementation of the most suitable technology for a new set of conditions.
11	**List out four examples for Multinational Corporation.(Nov 2010) (NOV/DEC 2018)** BTL1 Large corporations having investment and business in number of countries are known as Multinational or Transnational corporation. Some of them are : Hindustan Lever, Ford, Toyota, Sony, LG, Smith Kline Beecham, ITC, Ponds etc.

12	**Define computer ethics. (DEC/NOV2010) (NOV/DEC 2016)** BTL2 Ethics is a set of moral principles that govern the behaviour of a group or individual. Therefore, computer ethics is set of moral principles that regulate the use of computers. Some common issues of computer ethics include intellectual property rights (such as copyrighted electronic content), privacy concerns, and how computers affect society.
13	**Write a short note on globalization. (MAY/JUN2016)**BTL2 Our lives are increasingly dependent upon the goods/services produced over the world and are influenced by the business from around all the corners of the world. In general world has become a global village and have a global economy. The increasing international flow of capital, technology, trade, and people have had the effects of changing the nature of local organizations governments and people of countries and have led to social changes and developments.
14	**List the three senses of relative values. (DEC/ NOV 2012)** BTL2 • Ethical Relativism The theory that holds that morality is relative to the norms of one's culture. • Descriptive Relativism The existence of moral disagreements between cultures or individuals. • Moral Relativism More easily understood in comparison to moral absolutism. Absolutism claims that morality relies on universal principles (natural law, conscience).
15	**What are the normal issues arise in Multinational Corporation?(MAY/JUNE 2014)** BTL2 Ethical dilemmas faced by certain companies may be specific to their industry or company; other types of ethical issues are common to all types of companies. Handling ethical decisions with wisdom is especially important for small businesses, given the potentially devastating effects these companies may face if such issues aren't handled correctly**.**
16	**Differentiate the Eye witness and expert witness in the legal system. (MAY/JUNE 2014)** BTL4 An eyewitness is one who testifies what they perceived through his or her senses (e.g. Seeing, hearing, smelling, touching). That perception might be either with the unaided human sense or with the aid of an instrument, e.g., microscope or stethoscope, or by other scientific means, e.g. a chemical reagent which changes color in the presence of a particular substance An expert witness is one who allegedly has specialized knowledge relevant to the matter of interest, which knowledge purportedly helps to either make sense of other evidence, including other testimony, documentary evidence or physical evidence (e.g., a fingerprint)

17	**What is meant by Moral Leadership? (NOV/DEC 2013) (MAY/JUN 2016) (APRIL/ MAY2015) (NOV–DEC 2014)** BTL2 Moral Leadership is a very different kind of leadership. Rather than aspiring to being followed, Moral Leaders aim to serve. Instead of showcasing their own skills, Moral Leaders tend to develop the capacities of others.
18	**Define the term honesty and moral leadership.** BTL2 Honesty :A facet of moral character that connotes positive and virtuous attributes such as Integrity, truthfulness, and straightforwardness, along with the absence of lying, cheating, or theft "Moral Leadership": A process of social influence in which one person enlists the aid and support of others in accomplishing a common task.
19	**Write a note on business ethics. (APRIL/ MAY2015)** BTL2 Business ethics (also corporate ethics) is a form of applied ethics or professional ethics that Examines ethical principles and moral or ethical problems that arise in a business environment. It applies to all aspects of business conduct and is relevant to the conduct of individuals and entire organizations**.**
20	**What is meant by hired guns? (APRIL/ MAY 2011)** BTL2 Engineers are hired by attorneys to help them to establish the facts in away favourable to their clients. The hired guns violate the standards of honesty and also due care in conducting investigations.
21	**What is meant by corporate social responsibility?(NOV-DEC 2018)(APR-MAY 2017)** BTL2 Corporate social responsibility (CSR) is how companies manage their business processes to produce an overall positive impact on society. It covers sustainability, social impact and ethics, and done correctly should be about core business - how companies make their money - not just add-on extras such as philanthropy.
22	**What are demerits of MNC'S to host country? (NOV-DEC 2018)** BTL2 (i) Danger for Domestic Industries (ii) Repatriation of Profits (iii) No Benefit to Poor People (iv) Danger to Independence (v) Disregard of the National Interests of the Host Country (vi) Misuse of Mighty Status (vii) Careless Exploitation of Natural Resources
	PART * B
	Explain the philosophical view of nature in environmental ethics. Discuss the approaches to resolve environmental problems.(APRIL/ MAY2011) (APRIL/ MAY2015) (MAY– JUN 2014) (NOV–DEC 2013) (NOV–DEC 2014) (13M) BTL2

1	**Answer: Refer Notes** **The philosophical view of nature: (8 M)** • Sentient – centered ethics • Bio-centric- Ethics • Eco-centric – ethics • Human - centered environmental ethics **The approaches to resolve environmental problems: (5 M)** • Cost oblivious approach • Cost benefit analysis
2	**Describe the Bhopal Gas Tragedy and its effects.(APRIL/MAY 11) (NOV/DEC 2018) (13M)** BTL2 **Answer: Page 245- Mike W. Martin** **Introduction (5 M)** Bhopal disaster, also referred to as the Bhopal gas tragedy, was a gas leak incident on the night of 2–3 December 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh, India. It was considered as of 2010 to be the world's worst industrial disaster **Explanation (8 M)** • Liquid MIC storage • Earlier leaks • Acute effects • Gas cloud composition • Immediate aftermath • Subsequent legal action • Post-settlement activity
3	**Explain the different code of ethics of professional engineering societies. (NOV/DEC 2012) (13M)** BTL2 **Answer: Refer Notes** **Code of ethics Meaning:(2 M)** To provide basic framework for ethical judgment for a professional. **Code of ethics of professional engineering societies.(11M**

	▪ American society of mechanical engineers ▪ American society of civil engineers ▪ Institute of electrical and electronics engineers ▪ The institution of engineers ▪ National society of professional engineers ▪ American institute of chemical engineers ▪ Association of computer machinery ▪ Computer society of India
4	**Write briefly on Engineer used as expert witness and advisers. (13 M) (APR-MAY2017) (MAY/JUNE 2013) (MAY/JUNE 2014) (NOV–DEC 2018) (NOV–DEC 2015) (MAY/JUN 2016) (NOV–DEC 2014) (NOV/DEC 2019)** BTL3 **Answer: Refer Notes** **Engineer used as expert witness. (2 M)** "An expert witness is a witness who has knowledge beyond that of the ordinary lay person enabling him/her to give testimony regarding an issue that requires expertise to understand." USLEGAL goes on to explain, "Experts are allowed to give opinion testimony which a non- expert witness may be prohibited from testifying to. In court, the party offering the expert must lay a foundation for the expert's testimony. Laying the foundation involves testifying about the expert's credentials and experience that qualifies him/her as an expert. Sometimes the opposing party will stipulate (agree to) to the expert's qualifications in the interests of judicial economy." **Abuses of engineers as expert witness: (5 M)** • Hired guns • Financial biases • Ego biases • Sympathy biases **Engineers as expert advisers: (6 M)** **Normative model of advisers:** • Hired guns • Value neutral analysts • Value guided advocates
5	**Discuss the roles and responsibilities of engineers and managers. (13 M) (MAY/JUNE 2014) (NOV–DEC 2014) (APRIL/MAY 2018) (APRIL/MAY 2019)** BTL2 **Answer : Refer Notes** **Roles of managers: (7 M)** • Interpersonal • Informational • Decisional **Responsibilities of engineers and managers: (6 M)** • Promoting ethical climate

	• Resolving the conflicts • Principles of conflict resolution
6	**Explain the engineers as consultants. (13 M) (MAY/JUNE 2014) (APR-MAY 2017 (NOV- DEC 2018) (NOV–DEC 2015) (NOV/DEC 2019)** BTL2 **Answer : Refer notes** **Introduction: (2M)** Engineers in consulting engineering companies come from virtually every discipline and specialty. These engineers are often referred to as consulting engineers and they participate in project teams to help the consulting engineering firm deliver services to its clients. **The responsibilities of consulting engineers: (11 M)** • Advertising • Competitive bidding • Contingency fees • Safety and client needs • Provision for resolution of disputes
7	**Discuss in detail about Computer Ethics. (13M)(NOV/DEC2013) (NOV–DEC 2015) (APR-MAY 2017)(MAY/JUNE 2014) (NOV–DEC 2014)**BTL2 **Answer : Page 254 - Mike W. Martin** **Computer Ethics: (2 M)** Computer ethics deals with the procedures, values and practices that govern the process of consuming computing technology and its related disciplines without damaging or violating the moral values and beliefs of any individual, organization or entity. In 1991 the Computer Ethics Institute held its first National Computer Ethics Conference in Washington, D.C. The Ten Commandments of Computer Ethics were first presented in Dr. Ramon C. Barquin's paper prepared for the conference, "In Pursuit of a 'Ten Commandments' for Computer Ethics." **The Computer Ethics Institute published them as follows in 1992: (5 M)** • Not use a computer to harm other people. • Shall not interfere with other people's computer work. • Thou shall not snoop around in other people's computer files. • Not use a Computer to steal. • Should not use a computer to bear false witness. • Shall not copy or use proprietary software for which you have not paid. • Do not use other people's computer resources without authorization or proper

	compensation. • Not appropriate other people's intellectual output. • Do think about social consequences of program you are writing or system you are designing. • Shall always use a computer in ways, insure consideration and respect for your fellow humans. • ethics codes of conduct and resources **Important unethical act under this categories: (6M)** • Bank robbery • Privacy • Hacking • Computer viruses
8	**Explain the characteristics of moral leader in detail**. **(13 M) (NOV/DEC2013) (MAY/JUNE 2014) (APR/MAY 2015) (NOV/DEC 2014)** BTL2 **Answer : Page 39 - Mike W. Martin** **Moral Leadership (2 M)** Moral Leadership is a very different kind of leadership. Rather than aspiring to being followed, Moral Leaders aim to serve. Instead of showcasing their own skills, Moral Leaders tend to develop the capacities of others. **CHARACTERISTICS OF MORAL LEADER(11M)** o Justice o Respect others o Honesty o Humane o Focus on teambuilding o Value driven decision-making o Encourages initiative o Leadership by example o Values awareness o No tolerance for ethical violations
9	**Discuss the corporate social responsibility in detail. (MAY/JUNE 2014) (NOV/DEC 2016) (13M)**BTL2 **Answer : Refer notes** **CORPORATE SOCIAL RESPONSIBILITY: (2 M)**

	Corporate Social Responsibility is the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large. **TYPES OF CORPORATE SOCIAL RESPONSIBILITY: (5 M)** o Environmental Responsibility o Philanthropic Initiatives o Ethical Business Practices o Economic Responsibility **ADVANTAGES OF CSR: (6 M)** o The ability to have positive impact in the community o It supports public value outcomes: o It supports being an employer of choice: o It encourages both professional and personal development o It enhances relationships with clients
10	**Explain the problems of defence industry with examples. (13M) (MAY/JUNE 2014) (13M)**BTL2 **Answer: Refer Notes** **1.Large military build-ups (4M)** $2 billion cost overrun on the development of C5-A cargo plane reported to the public by Ernest Fitzgerald due to poor operating efficiencies in defence industry. He pointed out how large suppliers felt secure in not complying with cost-cutting plans but small contractors were willing.25% firms hold 50%of all defence contracts and 8 firms conduct 45% of defence research. **2. Technology creep (3M)** The arms are not only growing in size, it is also becoming better. The development of a new missile or one that can target more accurately, by one country, can upset or destabilize a diplomatic negotiation. Sometimes this fad for modernization leads to undesirably consequences. The F15 fighter planes were supposed to be fastest and most manoeuvrable of its kind but most were not available for service due to repairs, defects and lack of spares. Engineers should be bewaring of such pitfalls. **3. Impact of secrecy (3M)** Secrecy poses problems to engineers. Engineers should be aware of the answers to the following questions: Should discoveries of significance to military be informed to govt.? Can they be shared with other researchers, in other countries? Should they be withheld from the scientific and public community. **4. Effect on economy:** Every dollar spent on defence produces less jobs than what could be provided for by using the resource on other neglected sectors such as education and road development.

	PART * C
1	**Discuss the various features of multinational corporation. (15M) (APR/MAY2015) (NOV/DEC 2016)** BTL2 **Answer: Refer notes.** **MULTINATIONAL CORPORATION:** **Definition: (2 M)** A multinational company is a business that operates in many different countries at the same time. In other words, it's a company that has business activities in more than one country. **Example: (2 M)** The true definition of a multinational company isn't that it manufactures in other countries, however; the true meaning is that the business has operations in multiple countries. This can take form in many different ways besides manufacturing. Take McDonalds for example. They have almost 35,000 restaurants located in 119 countries around the world. This means that not only operate the physical restaurants, they also operate supply chains to deliver the beef and other products required to keep their locations working properly. **Features of Multinational Corporations (MNCs): (11 M)** **Following are the salient features of MNCs:** ▪ Huge Assets and Turnover ▪ International Operations Through a Network of Branches ▪ Unity of Control ▪ Mighty Economic Power ▪ Advanced and Sophisticated Technology ▪ Professional Management ▪ Aggressive Advertising and Marketing ▪ Better Quality of Products
2	**Discuss the ethical issues related to weapon development. (15M) (NOV/DEC2014) (MAY/JUNE 2014) (MAY/JUN 2016) (NOV – DEC 2018)** BTL2 **Answer: Refer notes.** **Introduction: (2 M)** • Military activities including world wars have stimulated growth of technology.

	• The growth of internet amply illustrates this fact. • The development of warfare and the involvement of engineers bring out many ethical issues concerned with engineers. **Role of Engineers in weapons development: (13 M)** • It gives one job with high salary. • One takes pride and honor in participating in the activities towards the defense of the nation. • Engineers are capable of innovating and developing new weapons. • Many of the rational engineers feel that they cannot work on designing weapons, which are ultimately used to kill human beings. Even though they are not ultimate users of those weapons, they find it morally unacceptable to work on such areas. • One believes the he fights a war on terrorism and thereby contribute to peace and stability of country. • Ironically, the wars have never won peace, only peace can win peace. • By research and development, engineer is reducing or eliminating risk from enemy weapons. • Savings ones country from disaster. • By building up arsenals, show of force, a country can force rough country, towards regulation. • Engineers can participate effectively in arms control negotiation for surrender or peace • Bombing of Nagasaki and Hiroshima led to surrender by the Japanese in 1945. • Many engineers had to fight and convince their personal conscience. • Engineers must have the potential judgments to serve in defense works that would jeopardize the human community.
3	**Explain the advantages and disadvantages of multinational corporation. (15M) (NOV/DEC 2016)**BTL2 **Answer: Page 155 - Mike W. Martin** **Advantages of MNCs :(8 M)** ▪ Employment Generation: ▪ Automatic Inflow of Foreign Capital: ▪ Proper Use of Idle Resources: ▪ Improvement in Balance of Payment Position: ▪ Technical Development: ▪ Managerial Development:

- End of Local Monopolies:
- Improvement in Standard of Living:
- Promotion of international brotherhood and culture:

Limitations of MNCs :(7 M)

- Danger for Domestic Industries:
- Repatriation of Profits:
- No Benefit to Poor People:
- Danger to Independence:
- Disregard of the National Interests of the Host Country:
- Misuse of Mighty Status:
- Careless Exploitation of Natural Resources:
- Selfish Promotion of Alien Culture:
- Exploitation of People, in a Systematic Manner