EXAM PREPARATION CLASS (EPC)

OME551 ENERGY CONSERVATION AND MANAGEMENT

(R 2017)

Class: III Year – Computer Science and Engineering & Information Technology

PART A (2 Marks)

UNIT – I - INTRODUCTION

1. Identify the types of the energy available on the earth.

   Primary energy sources take many forms, including nuclear energy, fossil energy -- like oil, coal and natural gas -- and renewable sources like wind, solar, geothermal and hydropower

2. Name the five states in India, where coal production is concentrated.
   Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Telangana

3. Illustrate the 'Final Energy Consumption'.

   Final energy consumption is the total energy consumed by end users, such as households, industry and agriculture. It is the energy which reaches the final consumer's door and excludes that which is used by the energy sector itself.

4. Describe the greenhouse gas effect.

   The greenhouse effect: some of the infrared radiation from the Sun passes through the atmosphere, but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

5. How Bureau of Energy Efficiency (BEE) facilitates energy efficiency programs in India?

   The mission of the Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy.

6. Differentiate between Energy Conservation and Energy Efficiency.

   Energy efficiency means to use less energy to perform the same task. Basically to eliminate energy waste. Energy conservation is to not use energy. For example, turning lights off in an unused room is energy conservation while switching to more energy efficient lights such as LEDs is energy efficiency.

7. Estimate at least three effects of acid rain.

Dead or dying trees are a common sight in areas effected by acid rain. Acid rain leaches aluminum from the soil. That aluminum may be harmful to plants as well as animals. Acid rain also removes minerals and nutrients from the soil that trees need to grow.

8. Explain the major sources of pollutants in Air.

There are four main types of air pollution sources: mobile sources – such as cars, buses, planes, trucks, and trains. Stationary sources – such as power plants, oil refineries, industrial facilities, and factories. Area sources – such as agricultural areas, cities, and wood burning fireplaces

9. List out the instruments for energy auditing.

- Flue Gas Analysers. Used for optimizing the combustion efficiency by measuring/monitoring the oxygen and CO levels in flue gas of boilers, furnaces etc.
- Temperature Indicators. ...
- Infrared Thermometers. ...
- Thermal Insulation scanner. ...
- Steam Trap Monitor. ...
- Conductivity Meter. ...
- pH meter. ...
- Thermo-hygrometer.

10. Examine the need for energy auditing.

An energy audit will identify energy-saving opportunities. It will help you understand your energy usage and ways to use energy better. An energy audit can identify safety concerns with electrical systems, wiring, and ventilation, thus making your home or business safer. It will increase a home's resale value.

11. Explain the types of energy audits.

Two types of energy audits are available: a preliminary energy audit and a detailed energy audit.

12. Differentiate primary energy and secondary energy.

Primary energy consists of unconverted or original fuels. Secondary energy includes resources that have been converted or stored. For example, primary energy sources include petroleum, natural gas, coal, biomass, flowing water, wind, and solar radiation.

13. Define the term Ton of Oil Equivalent (TOE) related with any country energy consumption.

Tonne(s) of oil equivalent, abbreviated as toe, is a normalized unit of energy. By convention it is equivalent to the approximate amount of energy that can be extracted from one tonne of crude oil.

14. What does the CO2 equivalent mean?

A carbon dioxide equivalent or CO_2 equivalent, abbreviated as CO_2-eq is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming.

15. A portable machine requires a force of 180 N to move it. How much work is done if the machine is moved 20 m and what average power is utilized if the movement takes 20s?

Work = Force X Distance

∴ Work = 200 N X 20 m = 4000 J

We also know that, $Power = \frac{work}{time}$

∴ Power = $\frac{4000}{25}$ = 160 W

UNIT – II – ELECTRICAL SYSTEMS

1. Define harmonics.

A harmonic is a wave or signal whose frequency is an integral (whole number) multiple of the frequency of the same reference signal or wave.

2. Define power factor.

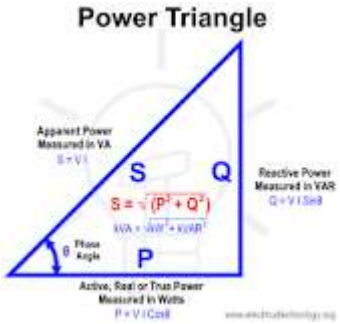
Power factor (PF) is the ratio of working power, measured in kilowatts (kW), to apparent power, measured in kilovolt amperes (kVA). Apparent power, also known as demand, is the measure of the amount of power used to run machinery and equipment during a certain period.

3. What do you understand by load factor? and give example.

A load factor is the ratio of the average electric load to the peak load over a period of time. The load factor is the actual kilowatt-hours delivered on a system in a given period of time, as opposed to the total possible kilowatt-hours that could be delivered in a given period of time.

4. Describe the ‘Reactive power’ and ‘Active power’

Reactive Power. Definition. The True or Real or Actual Power dissipated in the circuit is known as Active Power which is actually utilized or consumed. (Also known as useful or watt-full power). A Power which continuously bounces back and forth between source and load is known as Reactive Power.



5. Describe the HT and LT supply system.

   A low tension line simply means low voltage and a high tension line simply means high voltage. If you have a three-phase connection you receive an LT supply of 400 volts. For a single connection, you will receive 230 volts. If you require bulk power to run your system you will be needing High tension or HT supply.

6. Describe the transformer loss.

   There are different kinds of losses that will be occurred in the transformer such as copper, hysteresis, eddy, iron, stray & dielectric. The copper loss commonly occurs due to the resistance in the transformer winding whereas hysteresis losses will be occurred due to the magnetization change within the core.

7. Evaluate the advantages of PF improvement by capacitor addition.

   Benefits of Improving Power Factor with Capacitors
   - Reduced electrical power bills.
   - Reduces I2R losses in electrical conductors.
   - Reduces loading on transformers by releasing system capacity.
   - Improves voltage on the electrical distribution system thereby allowing motors to run more efficiently and cooler.

8. Differentiate between ‘contract demand’ and ‘maximum demand’

   Contract Demand means the maximum demand in kiloWatt (kW) or kilo-Volt Ampere (kVA) (within a consumer's sanctioned load) agreed to be supplied by the electricity provider or utility in the agreement executed between the users and the utility or electricity provider. Maximum demand is the highest level of electrical demand monitored in a particular period usually for a month period.

9. Describe the motor efficiency.

Most electric motors are designed to run at 50% to 100% of rated load. Maximum efficiency is usually near 75% of rated load. Thus, a 10-horsepower (hp) motor has an acceptable load range of 5 to 10 hp; peak efficiency is at 7.5 hp. A motor's efficiency tends to decrease dramatically below about 50% load.

10. Define the term: the Lux and Lumens.

    A lumen defines the light energy emitted by a light source. LUX on the other hand defines the "light density" over a surface area and is effected by the structure of the light fixture. For example, a parabolic reflector concentrates the light emission of a light bulb and therefore increases the LUX output of the bulb.

11. Discuss the guidelines for energy efficiency in lighting.

    Energy efficient lighting helps lower electricity bills and carbon dioxide emissions, all without reducing the quality of light in our homes. If you replace all the bulbs in your home with LED lights, you could reduce your carbon dioxide emissions by up to 40kg a year.

12. Mention types of transformers with diagram.

    The different types of transformer are Step up and Step down Transformer, Power Transformer, Distribution Transformer, Instrument transformer comprising current and Potential Transformer, Single phase and Three phase transformer, Auto transformer, etc.

13. List the types of electric motor.

    Motor types for industrial electric drives

    - DC Series Motor.
    - DC Shunt Motor.
    - Cumulative Compound Motor.
    - Three phase Synchronous Motor.
    - Squirrel Cage Induction Motor.
    - Double Squirrel Cage Motor.
    - Slip ring Induction Motor.
    - Single phase Synchronous Motor.

14. List the losses in Induction Motor and how to minimize it?

    There are three main types losses in induction motor: Copper losses. Iron losses. Friction and windage losses.
    Losses in induction motor can be minimized through optimization of different variables, e.g. optimal slip, rotor flux

1. Define Stoichiometry.

   A branch of chemistry that deals with the application of the laws of definite proportions and of the conservation of mass and energy to chemical activity.

2. Write the expression for boiler efficiency.

   To calculate boiler efficiency: we divide the total energy output of a boiler by total energy input given to the boiler, multiplied by hundred.
   Boiler Efficiency = ((Energy output)/(Energy input)) X 100.

3. What means “Blowdown” in boiler?

   Boiler blowdown is the removal of water from a boiler. Its purpose is to control boiler water parameters within prescribed limits to minimize scale, corrosion, carryover, and other specific problems. Blowdown is also used to remove suspended solids present in the system.

4. Write the stoichiometric equation for furnace oil.

   The stoichiometry of a balanced chemical equation identifies the maximum amount of product that can be obtained.
   A liquid and gas fuel burner achieve this desired balance in most scenarios by operating at 105% to 120% of the optimal theoretical air. For natural gas-fired burners, the stoichiometric air required is 9.4-11 $ft.^3$ / 1.0 ft. of natural gas or approximately an air-to-gas ratio of approximately 10:1.

5. Describe the factors affecting the furnace efficiency.

   There are many factors affecting furnace performance such as capacity utilization of furnaces, excess air ratio, final heating temperature etc. It is the key for assessing current level of performances and find- ing the scope for improvements and productivity.

6. Illustrate the advantages of Thermic Fluid Heaters.

   5 Advantages of a Thermal Fluid Heater

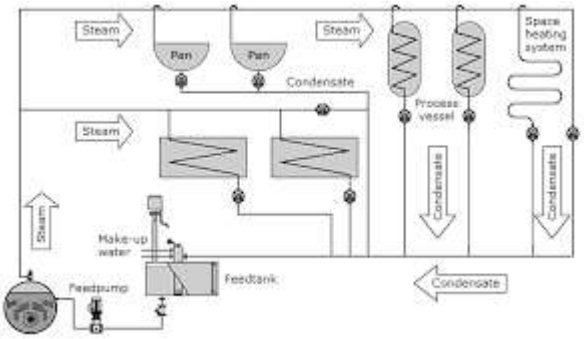
   - Achieve High Temperature at a Low Pressure. ...
   - Install Heating Equipment Outdoors. ...
   - Minimize Maintenance. ...

- Operate Without Stationary Attendant. ...
- Central Plant Heating.

7. Identify the duty of steam traps.

   The duty of a steam trap is to discharge condensate, air and other incondensable gases from a steam system while not permitting the escape of live steam.

8. Draw the schematic diagram of steam distribution.



9. Define Flash Steam.

   Flash steam is a name given to the steam formed from hot condensate when the pressure is reduced. Flash steam is no different from normal steam, it is just a convenient name used to explain how the steam is formed.

10. Generalize the properties of refractory.

    Important properties of refractories include chemical composition, bulk density, apparent porosity, apparent specific gravity.

11. Describe the different types of refractories.

    The typical refractory materials include fireclay refractories, high alumina refractories, silica brick, Magnesite refractories, Chromite refractories, Zirconia refractories, Insulating materials and Monolithic refractory.

12. Define critical thickness of insulation. Write its equation for a cylindrical pipe carrying steam.

    The thickness up to which heat flow increases and after which heat flow decreases is termed as Critical thickness. $(r_{cr})_{thickness} = r_{cr} - r$. The critical radius is 30 mm.

13. State the advantages of condensate recovery in a process plant

Benefits of Condensate Recovery

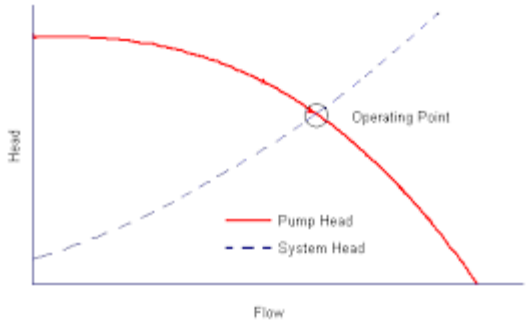
- Condensate is an excellent source of feed water as it is relatively pure (compared to most water supplies) being condensed water vapor.
- Boiler water cycles of concentration can be increased and blow down amounts can be reduced with its use.
- Improves energy efficiency.

UNIT – IV –ENERGY CONSERVATION IN MAJOR UTILITIES

1. List the different types of pumps.

   There are three basic types of pumps: positive-displacement, centrifugal and axial-flow pumps.

2. Estimate the head – flow curve of pumping system



3. Discuss the factors affecting pump performance

   Important factors affecting pump performance are surface roughness; internal clearances; mechanical losses, such as those related to bearings, lip seals, mechanical seals, and packing; high suction specific speed; impeller trim; and the viscosity of the fluid pumped.

4. Tabulate the comparison of different compressors

	Reciprocating Compressor	Centrifugal Compressor
1.vibration problems	Greater	Less
2.Mechanical efficiency	Lower	Higher
3. Installation Cost	Higher	Lower
4. Pressure ratio per stage	About 5:8	About 3:4.5

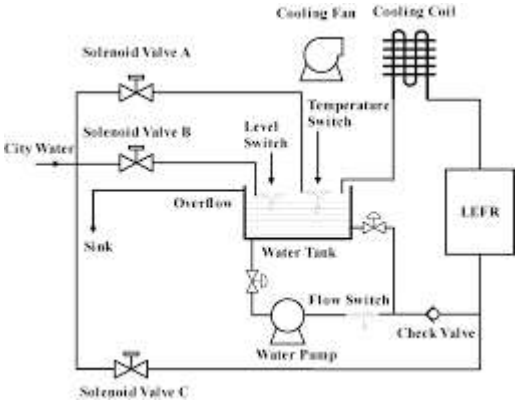
5. Differences between Fans, Blower and Compressor

A fan moves large amount of gas with a low increase in pressure: you will find these in your home.
A blower is a machine used for moving gas with a moderate increase of pressure: a more powerful fan, if you will. By changing the angle of the blades, a blower will be able to push air in any direction you want it.
A compressor is a machine for raising gas to a higher level of pressure, actually making the sir denser by cramming air into a small space.

6. Define the energy efficiency ratio

   The Energy Efficiency Ratio (EER) of an HVAC cooling device is the ratio of output cooling energy (in BTU) to input electrical energy (in watts) at a given operating point.

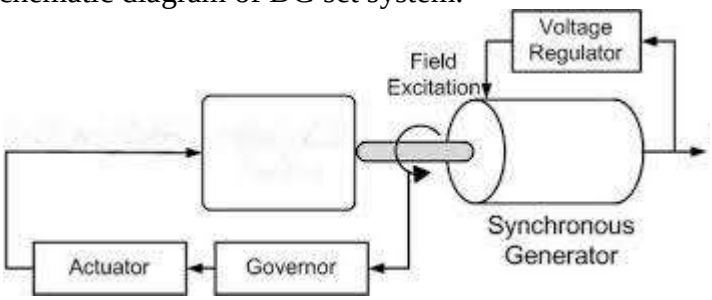
7. Draw the schematic diagram of the cooling water system



8. What is the function of fill media in a cooling tower?

   Heat exchange between air and water is influenced by surface area of heat exchange, time of heat exchange (interaction) and turbulence in water effecting thoroughness of intermixing. Fill media in a cooling tower is responsible to achieve all of above.

9. Draw the schematic diagram of DG set system.



10. Summarize the load characteristics of DG set system

The load on a diesel generator is the power being consumed from the unit. In a household application the load would be the items in your house, such as lights, heating, AC units, fridges, cookers, phone chargers or televisions.

11. Write the steps involved in estimating compressed air leak test.

The leak test is performed by immersing a part, usually a sandwich composite structure, in a hot water tank. The temperature of the water induces the expansion of air in the structure, and if a crack or a delamination is present, gas bubbles escape the structure and are immediately detected by visual inspection.

12. Define COP.

The coefficient of performance (COP) calculated as the ratio of cooling capacity provided to electrical power consumed

13. Mention the types of refrigeration and what are the factors affecting performance of refrigeration plants?

4 Types of Refrigeration Systems

- Evaporative Cooling. Evaporative cooling units are also referred to as swamp coolers. ...
- Mechanical-Compression Refrigeration Systems. Mechanical compression is used in commercial and industrial refrigeration, as well as air conditioning. ...
- Absorption. ...
- Thermoelectric.

The major factors that affect the efficiency of a refrigeration system are: The evaporating temperature. The condensing temperature. The type of refrigerant used.

14. Name the 2 most important parameters to be considered in the selection of a pump.

Essential Variables For Pump Selection

- Process Liquid Properties. What type of liquid is the pump intended for? ...
- Materials of Construction. ...
- Is the Pump Critical to Plant Operation? ...
- Pump Inlet Conditions. ...
- Pump Environment. ...
- Power Source Availability. ...
- Flow Rate and Pressure.

15. List Encon opportunities available in a pumping system?

Energy Conservation Opportunities in Pumping Systems are as follows: Ensure adequate NPSH at the site of installation. Ensure availability of basic instruments in the pump like pressure gauges, flow meters. Operate pumps near best efficiency point.

16. List the types of Air Conditioners.

- Window Air Conditioners.
- Portable Air Conditioners.
- Wall Hung Split or Multi Head Split Air Conditioners.
- Ducted Air Conditioning.
- Air Conditioners For a Diverse Range of Situations.

UNIT – V – ECONOMICS

1. Describe the energy economics.

   Energy economics is the field that studies human utilization of energy resources and energy commodities and the consequences of that utilization. In physical science terminology, "energy" is the capacity for doing work, e.g., lifting, accelerating, or heating material.

2. Define energy tariff.
   An energy tariff is how an energy provider charges a customer for their gas and electricity use. The two main types of tariff are fixed rate and variable.

3. Illustrate the capacity factor.

   It basically measures how often a plant is running at maximum power. A plant with a capacity factor of 100% means it's producing power all of the time. Nuclear has the highest capacity factor of any other energy source—producing reliable, carbon-free power more than 92% of the time in 2021

4. Examine the energy discount rate.

   The discount rate is the interest rate that firms use to determine how much a future cash flow is worth in the present. The practice of using the discount rate to evaluate cash flows is called discounting
   Using the discount rate, the calculation finds the present value:
   Present value = Future Value After t Periods(1+r)tFuture Value After t Periods(1+r)t

   - tt = Period of time measured in years
   - rr = The discount rate (interest rate) expressed as a decimal
   - The future value after the whole period of time (tt)

5. Discuss the simple payback period and mention disadvantages.

Simple payback time is defined as the number of years when money saved after the renovation will cover the investment.Ignores the time value of money: The most serious disadvantage of the payback method is that it does not consider the time value of money. Cash flows received during the early years of a project get a higher weight than cash flows received in later years.

6. Estimate the net present value.

   Net present value (NPV) is used to calculate the current value of a future stream of payments from a company, project, or investment.

7. Describe the internal rate of return.

   The internal rate of return (IRR) is the annual rate of growth that an investment is expected to generate. IRR is calculated using the same concept as net present value (NPV), except it sets the NPV equal to zero.

8. Define the life cycle costing.

   Life cycle costing is a method of adding up all the costs associated with an asset starting from its initial cost to its end of life. It does not take into account the salvage value or residual value of the asset. Life cycle costing provides an estimate of the cost that an asset will incur in its lifetime.

9. Explain the Financing options for energy management.

   Generally there are two kinds of financing options; the initial investment as one or more installments, and the savings arising from the investment. This over simplifies the reality of energy manage- ment investment.

10. Define the energy service companies.

    Energy service companies (ESCOs) develop, design, build, and arrange financing for projects that save energy, reduce energy costs, and decrease operations and maintenance costs at their customers' facilities.

11. Compare the ROI with IRR method analysis.

    ROI indicates total growth, start to finish, of an investment, while IRR identifies the annual growth rate. While the two numbers will be roughly the same over the course of one year, they will not be the same for longer periods.

12. Describe the energy performance contracts.

    Energy performance contracting (EPC) uses cost savings from reduced energy consumption to repay the cost of installing energy conservation measures.

13. State two main functions of energy management information system.

Energy management systems (EMS) are automation systems that collect energy measurement data from the field and making it available to users through graphics, online monitoring tools, and energy quality analyzers, thus enabling the management of energy resources.

PART B (13 Marks & 15 Marks)

UNIT – I – INTRODUCTION

1. What is the need of energy audit and list out the various barriers for same?
2. What is energy audit? And explain its types in detail.
3. How energy consumption and "Acid rain & Ozone layer depletion" are related? And explain global warming and list the gases that cause it.
4. Explain the energy measuring instruments.
5. Explain in detail of Energy Crisis causes, effects and solution.

UNIT – II – ELECTRICAL SYSTEMS

1. List at least 8 options for energy conservation in transformers and illumination systems?
2. List 5 losses taking place in motor operation. Indicate the values of these losses in % and show by a sankey diagram. (Assume total loss = 100%)
3. Discuss in detail of the terms of Lux , Lumens and Explain the types of lighting.
4. Give short notes on
   (i) Types of Transformers
   (ii) Rating of Transformers
   (iii) Transformers Losses and Efficiency
5.

Motor Specifications

Rated power	=	34 kW/45 HP
Voltage	=	415 Volt
Current	=	57 Amps
Speed	=	1475 rpm
Insulation class	=	F
Frame	=	LD 200 L
Connection	=	Delta

No load test Data

Voltage, V	=	415 Volts
Current, I	=	16.1 Amps
Frequency, F	=	50 Hz
Stator phase resistance at 30°C	=	0.264 Ohms
No load power, P_o	=	1063.74 Watts

a) Calculate iron plus friction and windage losses

b) Calculate stator resistance at 120°C

$$R_2 = R_1 = \frac{235 + t_2}{235 + t_1}$$

c) Calculate stator copper losses at operating temperature of resistance at 120°C

d) Calculate full load slip(s) and rotor input assuming rotor losses are slip times rotor input.

e) Determine the motor input assuming that stray losses are 0.5 % of the motor rated power

f) Calculate motor full load efficiency and full load power factor

UNIT – III – THERMAL SYSTEMS

1. Explain the boiler types and any one of it.
2. Demonstrate the energy conservation opportunities in boiler system.
3. Explain the Thermic Fluid Heaters.
4. Explain the steam distribution systems and draw its schematic diagram.
5. Integrate the steam traps and also explain the types of steam traps.
6. Explain the process of condensate recovery and flash steam utilization.
7. Explain the properties and types of Refractories.
8. Water consumption and coal consumption were measured in a coal-fired boiler at hourly intervals. Weighed quantities of coal were fed to the boiler during the trial period. Simultaneously water level difference was noted to calculate steam generation during the trial period. Blow down was avoided during the test. The measured data is given below.

Type of boiler: Coal fired Boiler

Heat output data

Quantity of steam generated (output)	: 8 TPH
Steam pressure / temperature	: 10 kg/cm^2(g)/ 180°C
Enthalpy of steam(dry & Saturated) at 10 kg/cm^2(g) pressure	: 665 kCal/kg
Feed water temperature	: 85°C
Enthalpy of feed water	: 85 kCal/kg

Heat input data

Quantity of coal consumed (Input)	: 1.6 TPH
GCV of coal	: 4000 kCal/kg

UNIT – IV – ENERGY CONSERVATION IN MAJOR UTILITIES

1. Explain in brief the energy conservation opportunities in pumping systems.
2. A chemical plant operates a cooling water pump for process cooling and refrigeration applications. During the performance testing the following operating parameters were measured;
   Measured Data:
   Pump flow, Q= 0.40 m^3/ s
   Power absorbed, P= 325 kW
   Suction head (Tower basin level), h_1 = +1 m
   Delivery head, h_2= 55 m
   Height of cooling tower= 5 m
   Motor efficiency= 88 %
   Type of drive =Direct coupled
   Density of water =996 kg/ m^3
   Determine the Hydraulic Power, Pump Efficiency.
3. Evaluate the energy conservation opportunities in a fans and blowers.
4. Discuss the energy saving opportunities in cooling towers.

5. Explain the checklist for energy efficiency in compressed air system.
6. Explain the energy savings measures for DG sets.

UNIT – V – ECONOMICS

1. What is the role of ESCO (Energy Saving Company) in the implementation of ENCON schemes in an industry?
2. Integrate a case study of energy efficiency in building through ESCOs
3. Define depreciation. The capital cost of a road laying machine is Rs 30lakhs. Its salvage value after 5 years is Rs 50,000. The length of the road that the machine can lay its lifetime is 75,000 km. The length of the road during third year of operation is 3000km. Find the depreciation of the equipment for the third year?
4. Three mutually exclusive projects A, B & C have been proposed. Each project requires an investment worth Rs 2,00,000 and have an estimated 5 years, 4 years & 3 years respectively. After its life cycle, the salvage value of the projects is to be zilch. The company's required rate of return is 10%. The anticipated cash flows after taxes (CFAT) for the three projects are follows

Year	**CFAT for Projects**		
	A	**B**	**C**
I	50,000	80,000	1,00,000
II	50,000	80,000	1,00,000
III	50,000	80,000	10,000
IV	50,000	30,000	----
V	1,90,000	---	----

Rank each project applying the methods of SPB, ARR, NPV & IRR

5. Discuss the following terms:
   a. ESCO concept
   b. Life Cycle Costing
   c. Discount rate
   d. Net Present Value