30 D18 (A)

Apr-25

SCHEME OF VALUATION

(Scoring Indicators)

Q-14

Revision : 2015 Course Code: 2021 [REV 15]

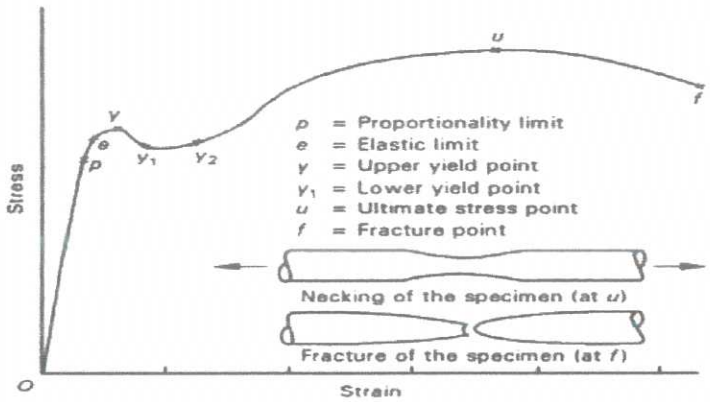
Course Title: BASIC MECHANICAL ENGINEERING

Qn. No.	Scoring Indicators	Split up Score	Sub Total	Total
	PART A			
I 1)	Liquid Penetrant Testing, Radiographic Test, Ultrasonic Test,Magnetic particle test	0.25 x 4	2	
2)	Safety valve, water level indicator,Fusible plug (any two)	0.5 x 2	2	
3)	**Classification of IC engines** 1)According to fuel used : Petrol engine, Diesel Engine, Compressed natural gas (CNG) engine 2)According to number of strokes per cycle: Four stroke engine –One power stroke is obtained in two complete revolution of crank shaft. Two stroke engine- One power stroke is obtained in one complete revolution of crank shaft. 3) According to working cycle: Otto cycle engine(combustion at constant volume) Diesel cycle engine (combustion at constant pressure) Dual cycle engine(combustion partly at constant volume and partly at constant pressure) 4) According to speed of engine: Low speed engine: upto 500 rpm Medium speed engine: 500-1000 rpm High speed engine: above 1000 rpm 5)According to method of ignition: Spark ignition engine Compression ignition engine.	0.25 x 4	2	10
4)	**Advantages** 1)Renewable energy 2) No moving parts 3) Absence of pollution 4) Excellent for remote areas not connected to electric grid (any two points)	0.5 x2	2	
5)	PLain carbon steels are usually classified on the basis of carbon content.They are a)Low carbon steels-(0.08- 0.3% carbon) b)Medium carbon steels-(0.3- 0.6% carbon) c)High carbon steels(0.6-1.5% carbon)		2	

II

1)

Stress strain curve for ductile material(Mild steel)



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2)

Comparison between Fire tube and Water tube boilers

Sl No.	Particulars	Fire tube boilers	Water tube boilers
1	Position of water and hot gases	Hot gases inside the tube and water outside the tubes.	Water inside the tube and hot gases outside the tubes.
2	Mode of firing	Internally fired	Externally fired
3	Rate of steam production	Lower (9000 kg/hr)	Higher(500000 kg/hr)
4	Construction	Difficult	Simple
5	Transportation	Difficult	Simple
6	Treatment of feed water	Not so necessary	Need to prevent scale formation
7	Operating pressure	Limited to 16 bar	High pressure as 100 bar
8	Floor area	More	Less
9	Shell diameter	Large for same power	Small for same power

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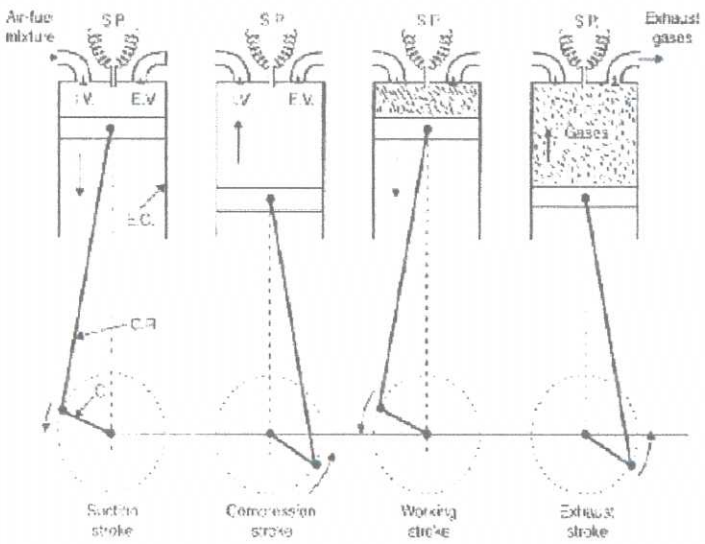
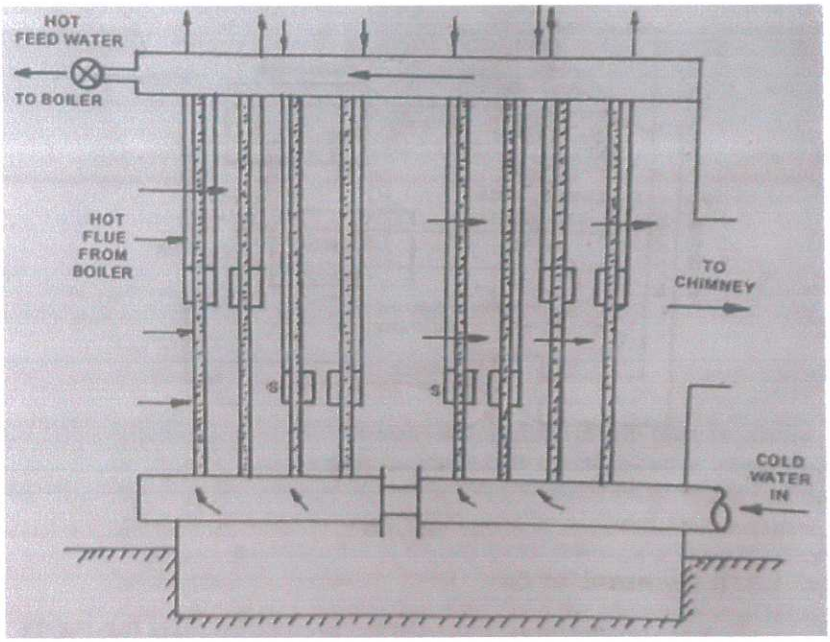
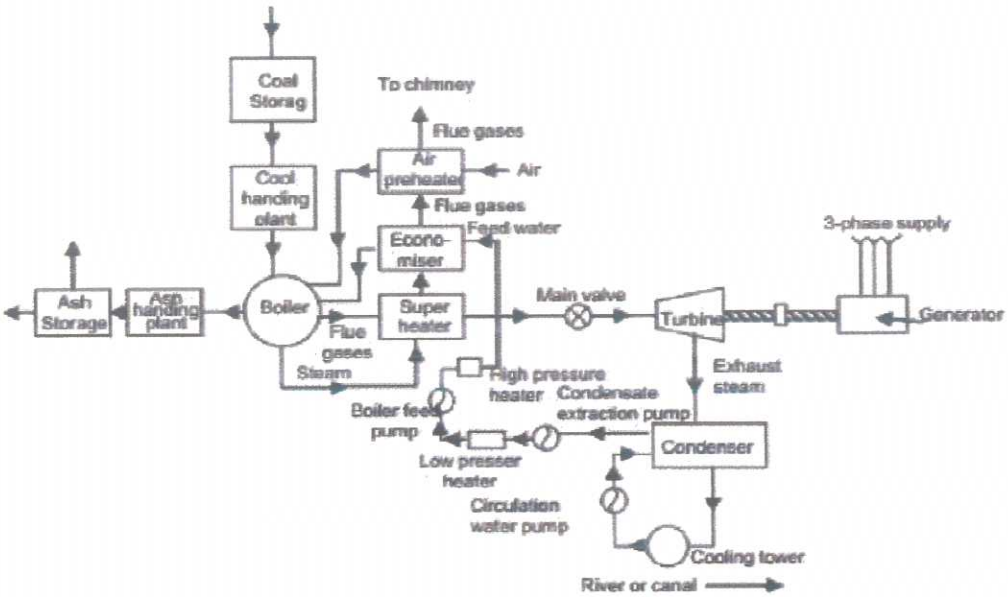
3)	 I.V. = Inlet valve, E.V. = Exhaust valve, E.C. = Engine cylinder, C.R. = Connecting rod C = Crank, S.P. = Spark plug Working of 4 stroke petrol engine Working of 4 stroke petrol engine comprises of 4 strokes,namely a)Suction stroke b)Compression stroke c) Power stroke d) Exhaust stroke	(fig.3+ explanation 3)	6	
4)	***It is a device used to heat feed water by utilizing heat of exhaust flue gas*** • Feed water from feed pump enters the bottom header • From there water passes through vertical tubes and reaches upper header • From upper header water enters the boiler • Water while flowing inside vertical tubes gain heat from flue gases which passes over vertical tubes • Soot deposited over vertical tube are cleaned by scrapes moving up and down • Soot collected in soot chamber are removed periodically • Stop valves are provided on bottom and top headers to control feed water entering and leaving economizer • Safety valve is provided to secure pipe from excessive pressure of flowing water	(explanation 4 + fig. 2)	6	



5)



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6) Working of tidal power plant

(fig.3 + explanation 3)

- During high tide, water flows from sea to basin through the sluice way and operate the turbine.
- Turbine is directly coupled to a generator and produce electricity.
- During low tide, water flows back from basin to sea through the sluice valve and operate the turbine
- Electricity is produced while filling and emptying the basin
- A reversible hydraulic turbine is used for this purpose

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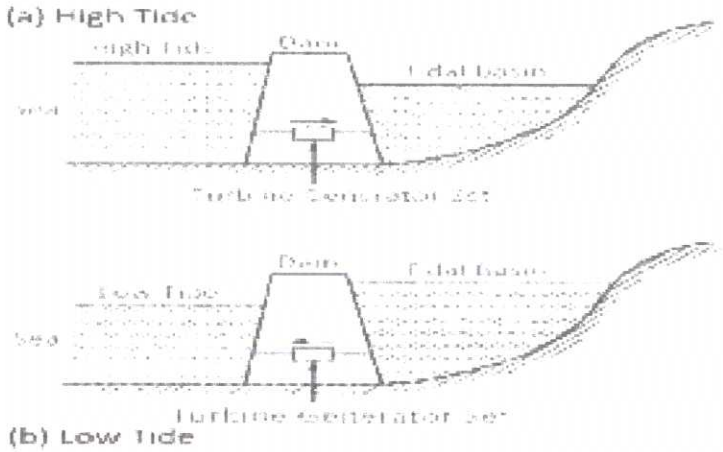
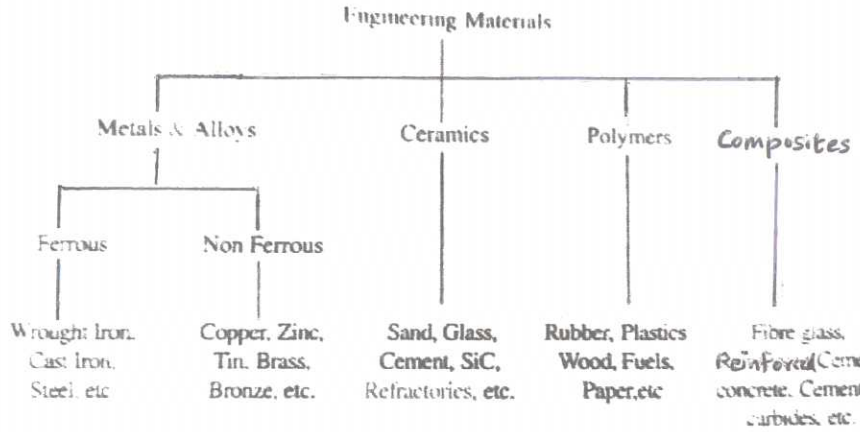
7)

Power generation during low & high tide





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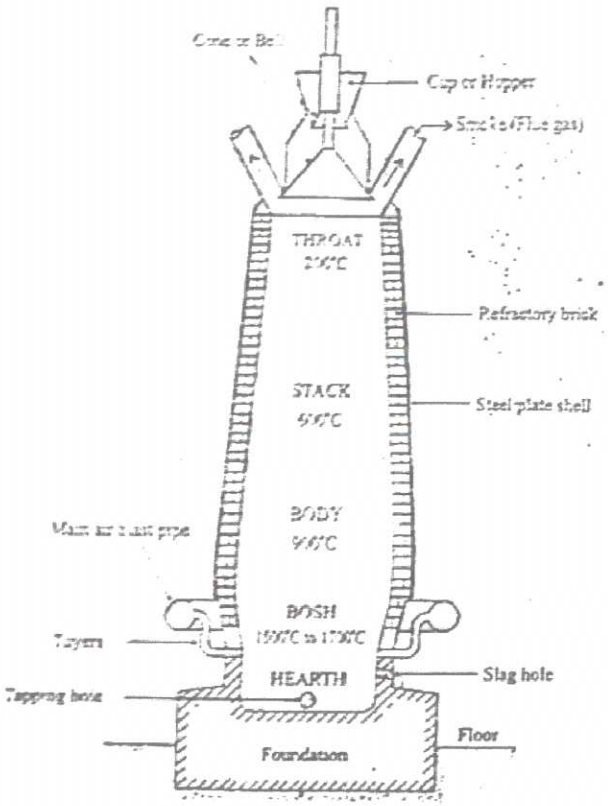
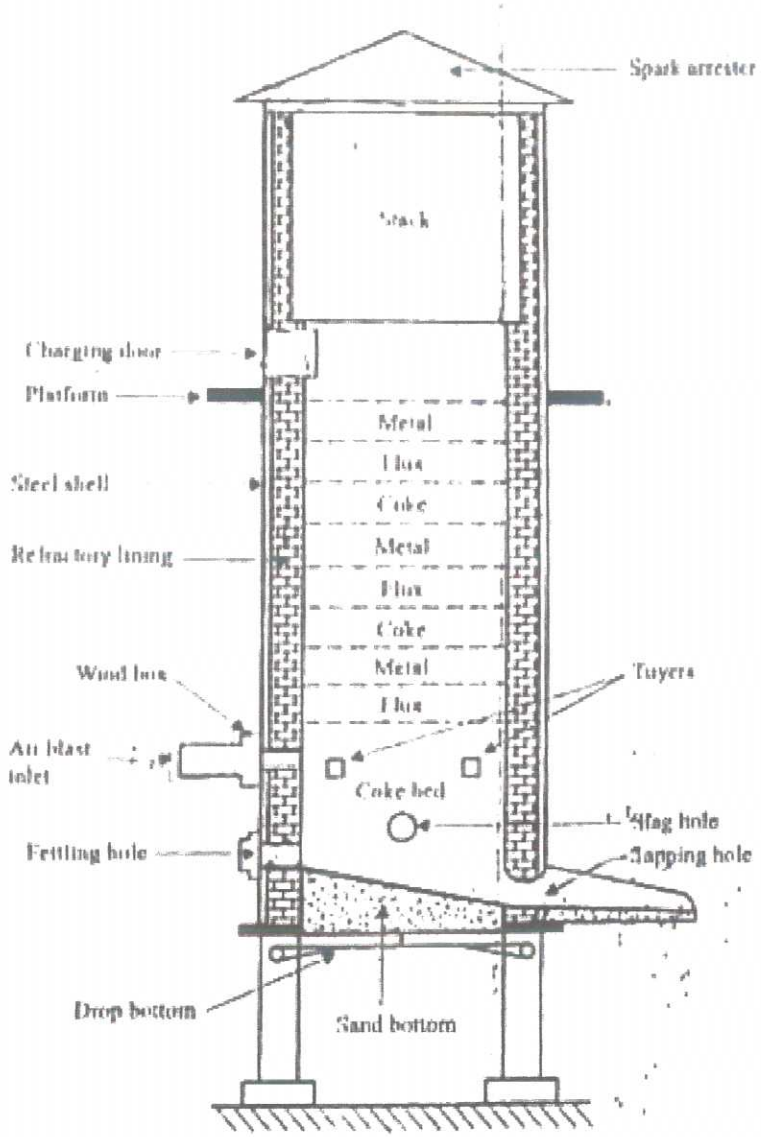
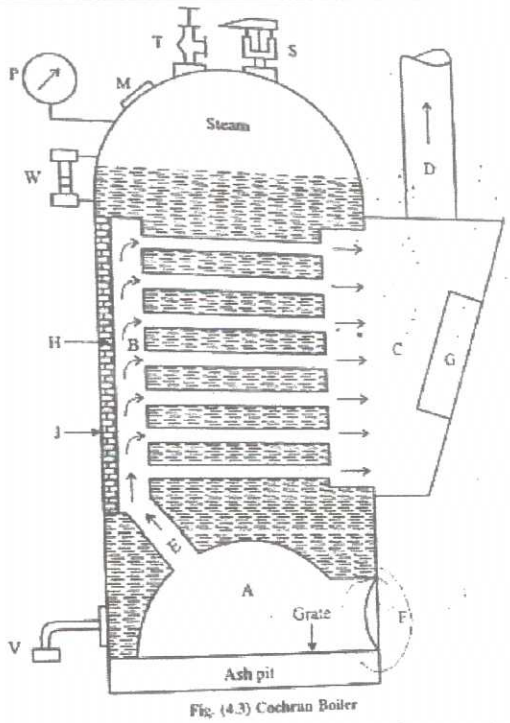
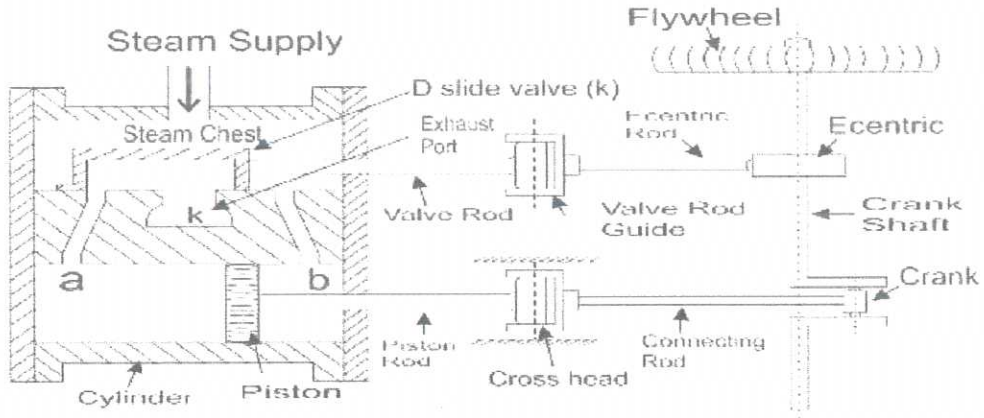
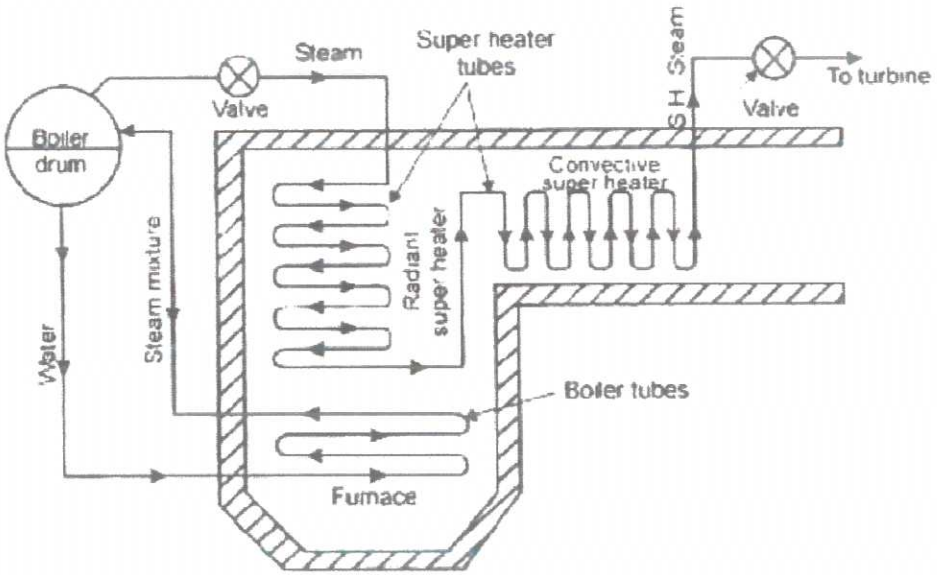
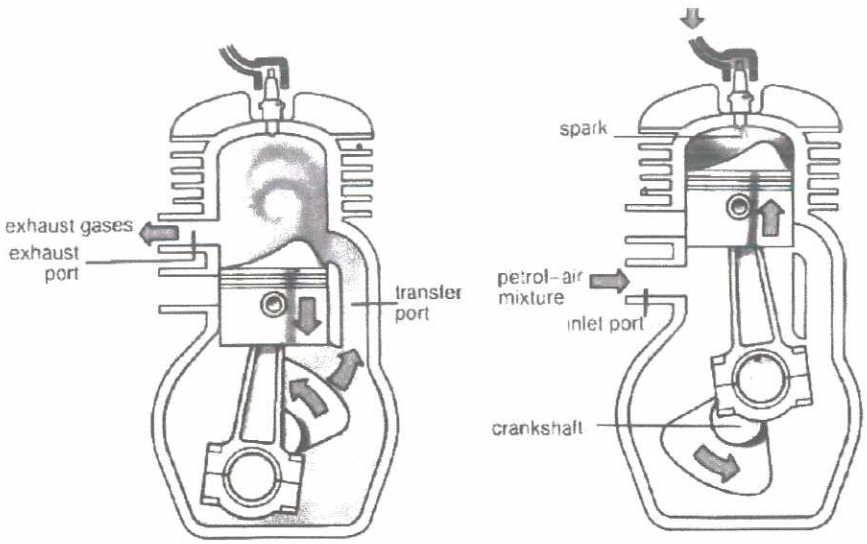
III a)	 Blast furnace is used for manufacture of pig iron from iron ore.	(Fig.4 + explanation 4)	8	
b)	**Liquid(Dye) penetrant test** • Detects flaws that are open to surface eg.cracks,laps,porosity etc. • Used for the inspection of ferrous & non ferrous metals,ceramics,plastiscs and glass • Surface of the material is properly cleaned • Spray colour penetrant on the surface • After allowing sufficient penetration time, excess penetrant is removed • Developer(absorbent powder) is then applied to revel the flaws by absorbing penetrant from these flaws • If fluorescent penetrant is used, surface must be examined under ultra violet light to see the presence of defects **Radiography** • Use of X-rays and γ- rays to check internal defects like blow holes, slag inclusion, gas porosity etc. in welding, forging and casting **Principle** • X-rays or γ- rays are passed through metals being examined and a picture is obtained in a photographic film • Intensity of rays coming out of object depends on density of object • Presence of internal defects will change the intensity of radiation and the defect will appears as either light or dark areas in the film	2 x 4	7 8	60

IV a)	**Ductility**: Under go deformation under tensile load without rupture. This property enables wire drawing. Most ductile material is Gold. **Malleability**: Under go deformation under compressive load with out rupture• This property is useful in rolling of thin sheets . **Hardness:** Resistance to indentation(penetration),abrasion or scratching• Desirable property for dies,punches,cutting tool. **Elasticity:** Ability of a material to regain its originalshape and size after removal of load Eg:Steel,rubber		8	
b)		(fig.4 + exp.3)	7	

V a)	 Fig. (4.3) Cochran Boiler A - Furnace B - Combustion Chamber C - Smoke box D - Chimney E - Short pipe F - Fire door G - Smoke box door H - Fire brick lining J - Boiler shell M - Man hole P - Pressure gauge S - Safety valve T - Steam stop valve V - Blow-off cock W - Water level indicator	(Fig. 4 + exp.4)	8	
b)	Single cylinder double acting steam engine  **Single cylinder double acting steam engine- Working** • Super heated steam from the boiler is supplied to steam chest • Steam enters steam port A or B depending on the position of D slide valve • When D slide valve opens steam port A for steam entry (cover end) and steam port B for steam exhaust (cylinder end): - • *Steam rushes to left side of piston and forces it to right* • *Steam from right side of piston is exhausted through steam port B and exhaust port E* • At the end this stroke position of D slide valve changes	(fig.4 + exp.3)	7	

	• Steam enters steam port B while used steam escape from steam port A and exhaust port E • Steam rushes to right side of piston and forces it to left. Operations are repeated			
VI a)	**Super heater** Increases temperature of saturated steam without raising its pressure.This is done by passing steam generated from boiler through a set of tubes placed in the path of flue gas  	(fig 4 + exp.4)	8	
b)	**Classification of boilers** • **Position of axis** a)Horizontal boiler: Axis of boiler is horizontal. Example:- Lancashire boiler, Locomotive boiler, Babcock and wilcox. b) Vertical boiler: Axis of boiler is vertical. Example:-Simple vertical, Cochran boiler,LaMount, Benson. • **Tube content** a) Fire tube boilers:- Hot gases produced by combustion of fuel pass through tubes which are surrounded by water. Example: Simple vertical, Cochran, Lancashire, Locomotive, Cornish b) Water tube boiler:- Water passes through the tubes and hot gases surrounding the tubes. Example:- Babcock and Wilcox boiler, La Mont boiler,Stiriling boiler,Yarrow,Loeffler. • **Position of furnace** a) Externally fired boilers:- Furnace is placed outside the boiler shell. Generally water tube boilers are externally fired. Example:- Babcock and Wilcox boiler. b) Internally fired boilers:- Furnace is placed inside the boiler shell. Generally fire tube boilers are internally fired. Example:- Lancashire, Cochran boiler.		7	

	• **Method of water circulation** a) Natural circulation boilers:- Water flow take place naturally, by density difference of water (natural convection). Example:- Lancashire, Babcock and Wilcox boiler. b) Forced circulation boilers:- Water flow takes place by a pump. Example:- Benson boiler, LaMont boiler, Velox boiler. • Pressure rating a) High pressure boiler:-Produce steam above 80 bar pressure. Example:- Babcock and Wilcox boiler b)Low pressure boiler:- Produce steam below 80 bar pressure. Example:- Cochran and Cornish boiler. • Use and application a) Stationary boiler:- These are used in power generation or process heating in industries. b) Mobile boiler:- These are used in marine and locomotive engines • Numbers of tubes in the boiler • a) Single tube boiler:- Only one fire or water tube. Example:- Cornish boiler. • b) Multi-tube boiler:- Two or more fire or water tubes. Example:- Locomotive, Cochran, Lancashire, Babcock and Wilcox boiler.			
VII a)	In a two stroke petrol engine,one power stroke is obtained for every revolution of the crank shaft. It involves 2 strokes: an upward stroke and a down ward stroke.  		8	

b) **Comparison of SI engine with CI engine**

SI Engine	CI Engine
1) Working based on Otto cycle	Working based on Diesel cycle.
2)Air-fuel mixture is taken during suction stroke	Only fresh air is taken during suction stroke.
3)Fuel used is petrol or gasoline (highly volatile)	Fuel used is diesel (non-volatile).
4)Spark plug is used	Fuel injector is used.
5) Lower engine efficiency	Higher engine efficiency
6) Higher fuel consumption	Lower fuel consumption
7)Lower vibration and engine noise	Higher vibration and engine noise
8)Low initial cost	High initial cost
9)High running cost	Low running cost
10) Light duty application	Heavy duty application
11) High speed engine	Low speed engine
12)Quantity governing(Throttle controls the quantity of air fuel mixture to regulate the load)	Quality governing(quality of fuel is regulated to control the load

(any 7 points)

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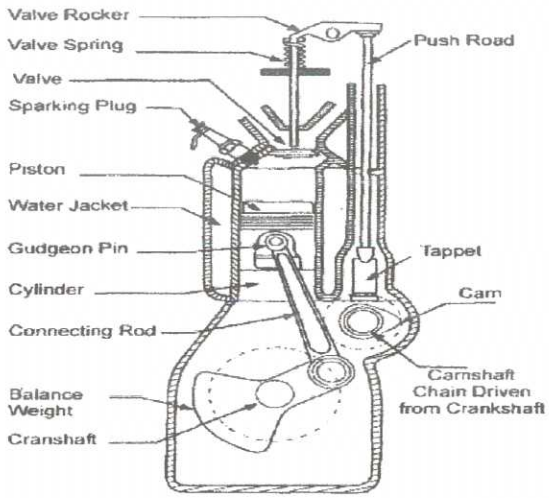
VIII

a)



Internal combustion engine mechanism.

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b)

Internal combustion engines: Combustion of fuel takes place inside the engine cylinder and movement of piston produces power – eg. automobile engines(Petrol and diesel engines)

External combustion engines: Combustion of fuel takes place outside the engines .Heat energy produced during external combustion is used for producing useful work– eg. steam engine, steam turbine, gas turbine.

Advantages of IC engines over EC engine

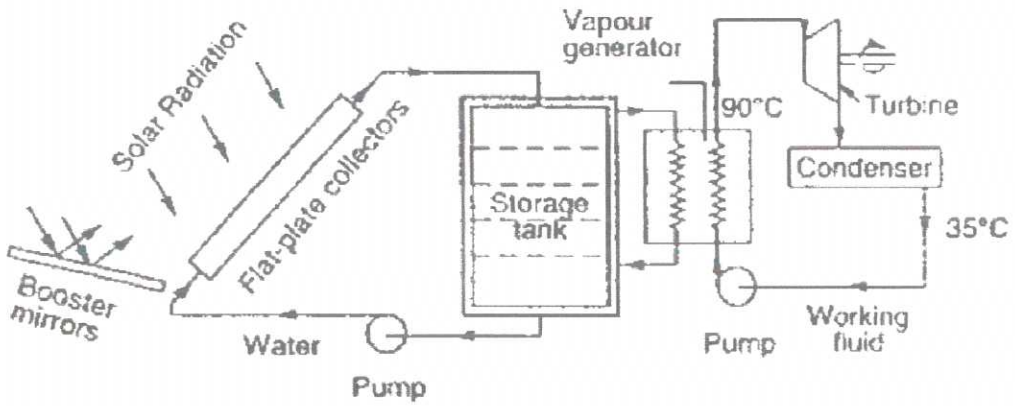
1. Simple design
2. Compact,require less space
3. Low initial cost
4. Overall efficiency is high
5. Power to weight ratio is higher
6. Quick starting

Disadvantages of IC engines over EC engine

1. Very high temperatures (combustion occurs inside the engine cylinder) necessitates engine cooling arrangements.
2. High temperatures restrict IC engines to be single-acting (where as EC engines are usually
double-acting making every stroke a power stroke)
3. Fuels are relatively expensive.
5. Variety of fuels cannot be used. Only liquid and gaseous fuels with given specification can be used
4. Vibration produced by reciprocating components are high

(difference 3+ adv. and dis adv. 4) — 7

IX a)



Low temperature solar power plants

- Uses flat plate collectors to collect solar energy. Working temperature is limited to 100℃
- The solar energy absorbed by water is passed through a heat exchanger
- Heat of water is absorbed by a low working temperature fluid like butane(or refrigerant like ammonia,freon etc.) and get vaporised
- This vapour runs a turbine which is coupled to a generator and electricity is produced
- The exhaust vapour is then condensed in a condenser and the liquid is pumped back to the evaporator and the cycle is repeated

(Fig.4 + exp. 4) — 8

b)

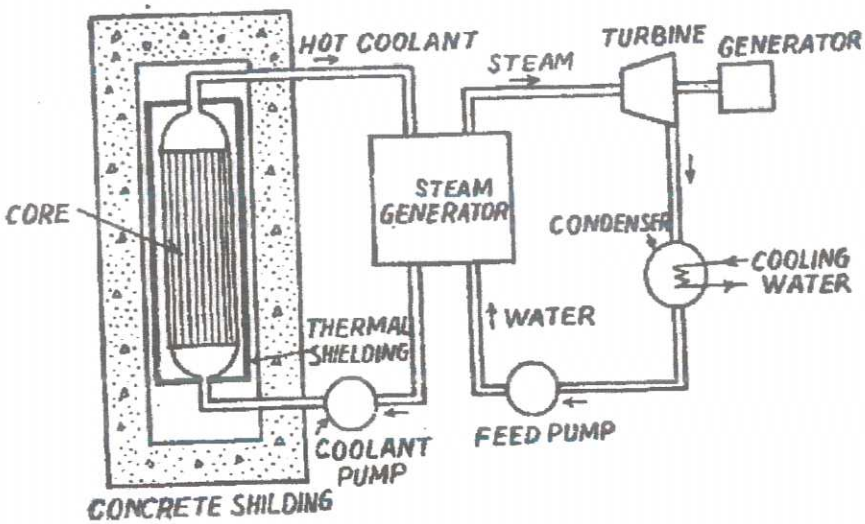
Advantages

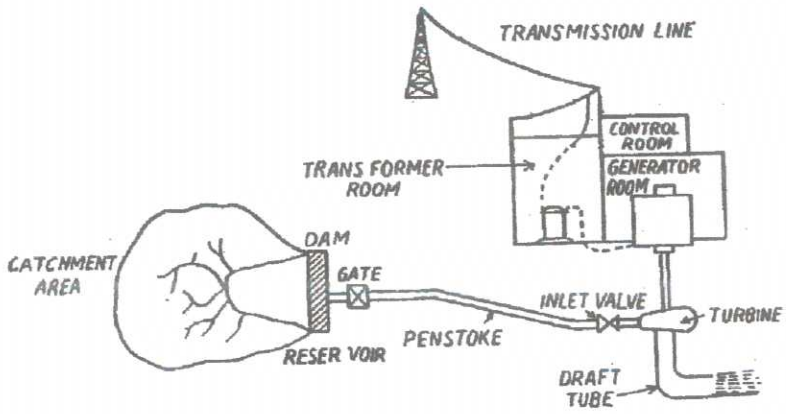
- Free from pollution. Does not create green house gases
- Clean, renewable source of energy.
- No fuel cost, no transportation
- Construction of plants require less time and simpler

Disadvantages

- Availability of wind is variable
- Noise pollution

7

	• Threat to birds • Require large open area • High initial cost • Requires back up storage when there is no wind			
X a)	**Working of Nuclear Power Plant** • Heat is liberated in the reactor as a result of nuclear fission of fuel (U^{235}, U^{238} , Pu^{239}) • This heat is taken up by the primary coolant circulating through the reactor core. • The primary coolant transfers this heat to secondary coolant (water) circulating through heat exchanger(steam generator) and gets converted to steam. • This steam is expanded in the turbine which turns the turbine shaft. • Mechanical energy is used to run an electric generator which is directly coupled to turbine shaft. • The expanded steam coming out of the turbine is condensed and is pumped back as feed water by the feed water pump into the reactor core.  	(Fig.4 + exp .4)	8	

b)	**Hydro electric power plant**  		7	