



SUMMER- 14 EXAMINATION

Subject Code: **17413**

Model Answer

Important Instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. 1 a) Classification of steam turbines on basis of (**01 mark for each**)

- i) Action of steam
Impulse, Reaction, combined impulse and reaction turbine
- ii) Direction of steam flow
Axial flow, radial flow, tangential flow, single flow or double flow

q. 1 b) Boiler efficiency : It is defined as the ratio of heat actually utilized in generation of steam to the heat supplied by the fuel in the same period.(**02 marks**)

Q. 1 c) Why starting motor is required in I.C.Engines? (**02 marks for suitable answer**)

To start I. C. Engines, initial motion is required to be given to the piston through crank shaft and connecting rod. This is known as cranking. In small engines, this can be done manually by handles or by foot operated kick as used in starting bikes and scooters. But the bigger engines require more torque which can not be provided manually. It is difficult and inconvenient to start these engines manually. Hence, starting motors are used which are coupled to the crank shaft of the engine and they provide the necessary initial torque to start the i.c. engines.

Q.1 d) (**01 mark for each**)

i) Compression ratio : It is defined as the ratio of volume of air before compression to the volume of air after compression.

$$r_c = (\text{swept volume} + \text{clearance volume}) / (\text{clearance volume})$$

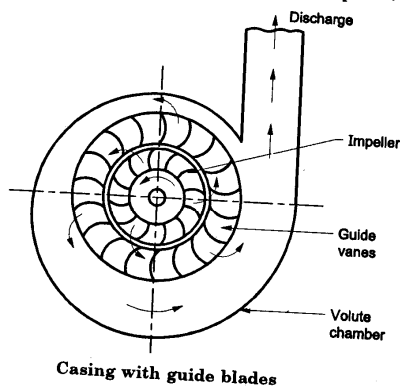
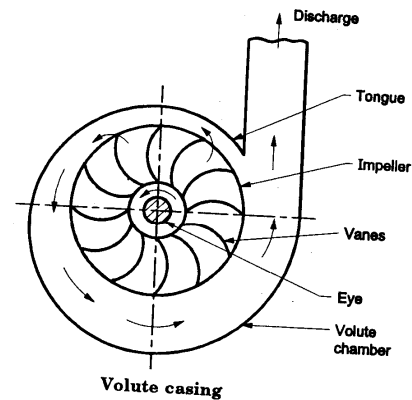
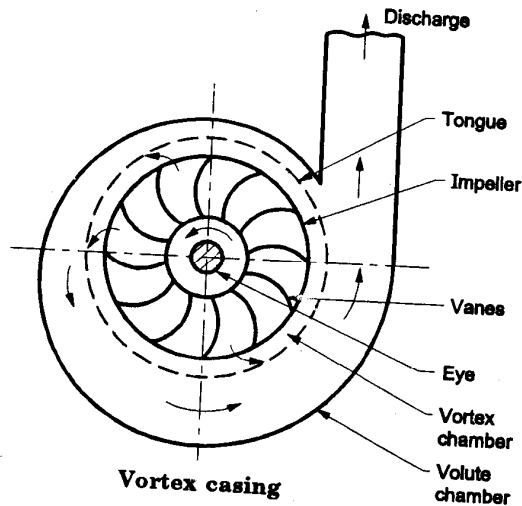
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ii) Free air delivered : It is the volume of air delivered under the condition of temperature & pressure existing at the compressor intake. Generally the condition is 1.01325 bar and 15⁰C.

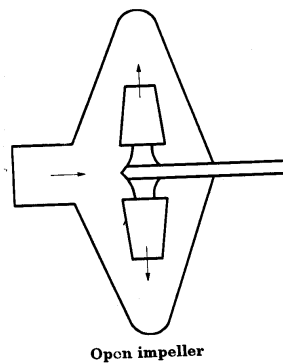
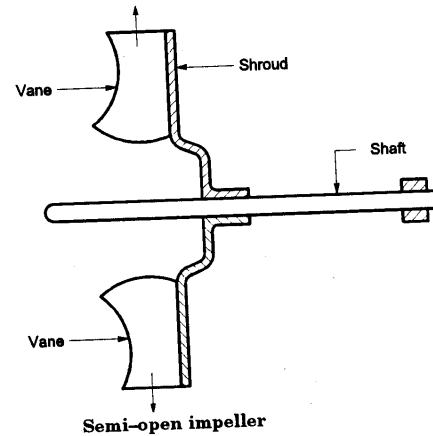
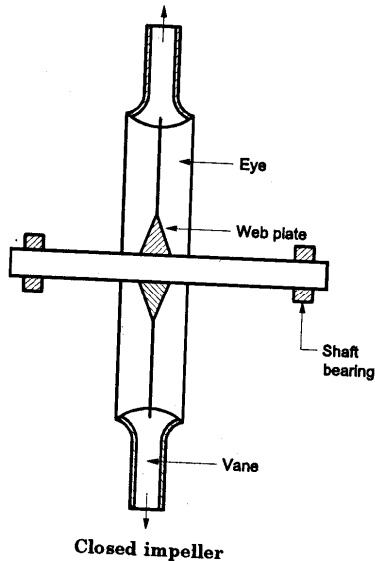
Q.1 e) Draw labeled sketch of casing and impeller of centrifugal pump. (Any one casing & impeller from below should be drawn.)(01 mark each for casing & impeller)



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f) (02 marks for suitable answer, diagram preferred , but not essential))

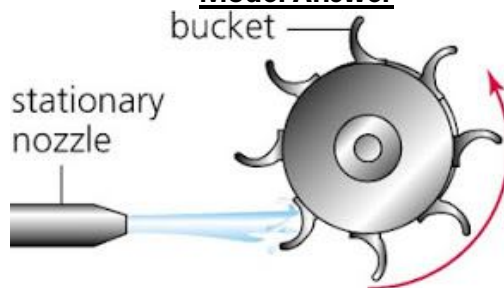
Principle of impulse turbine : If a jet of steam is discharged from a fixed nozzle at a high speed over a flat stationary plate, a steady force will be exerted over this plate. This force is nothing but an impulse. No work is done as the plate is fixed. But, if a number of such plates are fixed on the rim of a wheel, the wheel may be rotated due to the impulse of steam. Curved plates are used instead of flat plates to utilize greater amount of energy.

In the impulse turbine, steam is expanded in the fixed nozzle only. In the nozzle the velocity of steam increases with decrease of pressure. As the steam passes over the blades, the pressure remains constant with a decrease of velocity.

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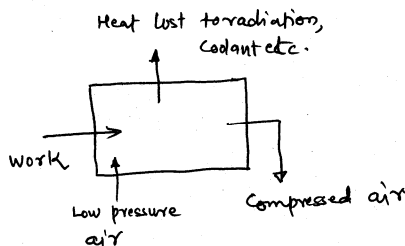
g) losses in turbine(any four, ½ mark each)

- Admission losses
- Leakage losses
- Friction losses
- Exhaust loss
- Radiation and convection losses
- Losses due to moisture
- Carry over losses

Q. 1 h) (02 Marks)

Principle : Air compressor takes in atmospheric air, compresses it and delivers it to high pressure storage vessel from where it is conveyed to the application. Since air compression process requires work to be done on it , compressor is power driven machine. Out of work supplied to compressor from prime mover, some is lost in friction, heat radiation, coolant heating and rest will be held in high pressure air. The energy contained by high pressure air is utilized for different applications such as pneumatic tools , spray painting etc.

In reciprocating compressor, atmospheric air is admitted into the cylinder through suction valve which is operated by pressure difference and then compressed to the desired pressure by a reciprocating piston driven by the prime mover. High pressure air is then delivered through delivery valve.





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- i) (01 mark for equation, 01 mark for meaning of terms)

Power required by reciprocating pump :

$$P = (\text{Work done per second})/1000$$

$$= 2 \cdot \rho \cdot g \cdot A \cdot L \cdot N \cdot (h_s + h_d) / 60 \cdot 1000$$

Where ρ = density of fluid

g = gravitational constant

A = cross sectional area of piston or cylinder

L = Length of stroke ($2r$)

N = rpm of crank

h_s = height of axis of cylinder from water surface in sump(suction head)

h_d = height of delivery outlet above the cylinder axis (delivery head)

- j) **What is the basic difference between compressor & pump?**
(02 marks for suitable answer)

The compressor is used to increase the pressure of air or gas whereas the pump is used to increase the pressure of liquid like water or oil.

- k) **The function of impeller in centrifugal pump :**

(02 marks for suitable answer)

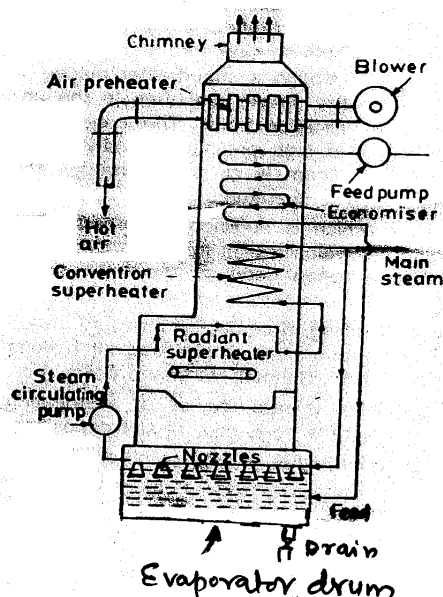
It converts the mechanical energy obtained from the external source into pressure and kinetic energy of water.

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Q. 2 a) Loeffler Boiler (**Four marks**)



Q. 2 b) State classification of I.C. Engines (any four, 01 mark each)

I.C. Engines can be classified by various ways .

1. According to ignition method
 - a. SI (spark ignition) engines
 - b. CI (Compression ignition) engines
2. According to working cycle of the engine
 - a. Two stroke cycle engine
 - b. Four stroke cycle engine
3. According to no. of cylinders
 - a. single cylinder engine
 - b. Multi cylinder engine
4. According to position and arrangement of cylinders
 - a. horizontal
 - b. vertical
 - c. Radial
 - d. V type
5. According to applications
 - a. stationary
 - b. portable
 - c. automobiles
 - d. marine
 - e. air crafts
6. According to speed of the engine
 - a. Low speed
 - b. Medium speed
 - c. high speed
7. According to method of cooling
 - a. Air cooled
 - b. Water cooled
8. According to method of governing

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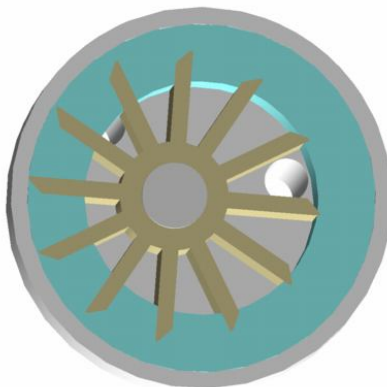
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a. Quality governed b. Quantity governed c. Hit & miss governed

Q. 2 c) Liquid ring vane compressor/pump(02 marks for sketch, 02marks for description)

It is rotating positive displacement pump.They are typically used as a vacuum pump but can also be used as a gas compressor.The function of a liquid ring pump is similar to a rotary vane pump with the difference being that the vanes are an integral part of the rotor and churn a rotating ring of liquid to form the compression chamber seal.They are an inherently low friction design, with the rotor being the only moving part. Sliding friction is limited to shaft seals. Liquid ing pumps are typiclaay powered by an induction motor.



d) Comparison of centrifugal pump & reciprocating pump (01 mark for each point)

	Centrifugal Pump	Reciprocating pump
Principle	Mechanical energy is converted into pressure energy by means of centrifugal force acting on the fluid	Mechanical energy is converted into pressure energy by means of sucking the liquid into the cylinder inwhich the piston is reciprocating . Piston exerts thrust on the liquid and increases pressure energy.
Construction	The main parts of pump are 1.impeller 2. casing, 3.suction and delivery 4.pipe , foot valve / strainer etc.	The main parts of pump are1. a cylinder with piston, piston rod, connecting rod and crank 2.Suction & delivery pipe 3.suction & delivery valves etc.



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Priming	Priming is necessary to remove air from various parts of pump.	Priming is not required to remove air from various parts of pump. Suction is sufficient to lift the fluid.
Applications	Used where high discharge is required. e.g. domestic use, agricultural water lifting, industrial use.	Used where high head is required e.g. auto service unit, high head lifting

Q. 2 e) Procedure for registration for new boiler as per IBR 1923 (**04 marks**)

Boilers are high pressure closed vessels. Steam generated in the boiler must be within the safe limit of pressure. To ensure safety, their regular up keep and maintenance is essential. The rules and regulations known as Indian Boiler Act 1923 monitors the registration and working of boiler.

Provisions for registration :

1. The owner can not use a boiler without registration with chief inspector of boiler.
2. The chief inspector will appoint the inspector for the inspection of the boiler.
3. The inspector will inspect the boiler thoroughly by conducting tests on the boiler and will determine the maximum working pressure. He will issue a certificate in the prescribed form to this effect. It will authorize the owner to run the boiler within given pressure limits.
4. The registration will have to be renewed after expiry date.
5. Also. It will have to be renewed in case of accident.
6. In case of accident, the owner has to inform to the inspector within 24 hours of accident.
7. IBR rules are governed and revised by Central Boiler Board.
8. Any owner violating law is liable for punishment.

Q. 2 f) (**any two of the following, two mark each**)

Faults and remedied for less efficiency of I.C.Engine

Fault	Remedies
1. Piston ring may be worn out . So high pressure gases may leak to crank case.	1. Replace piston rings for proper sealing
2. Worn valve stem or valve guide . Gases may leak into cylinder head and less power will be developed.	2. Replace the set of valve & valve guide.
3. Fuel injection pump adjustment defective. So much fuel may be	3. Inspect fuel pressure regulator.



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unburnt.	
4. Pre ignition	4. Clean combustion chamber, use standard spark plug.
5. Lubricating oil burnt. Friction increases.	5. Clean piston, cylinder set with kerosene.
6. Damaged gasket	6. Check & replace
7. Valve timing not perfect	7. Tune up engine properly.
8. Exhaust manifold choked. So gases are not totally expanded.	8. Clean/replace the exhaust filter.

Q. 3 a) (01 mark each)

- i) cochran boiler : Fire tube
- ii) Babcock & Wilcox Boiler – water tube
- iii) La mont boiler- water tube
- iv) Loeffler boiler - water tube

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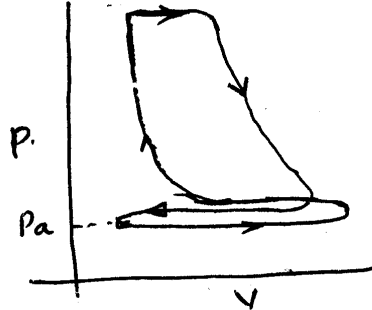
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Q. 3 b.

soln.

$$\text{Spring scale} = 1.3 \text{ bar/mm} \\ = 1.3 \times 10^5 \text{ Pa/mm}$$

-1 mark



$$P_{mi} = \frac{\text{Area}}{\text{length}} \times SS$$

$$= \frac{425}{65} \times 1.3 \times 10^5$$

$$= 85 \times 10^4 \text{ Pa} \quad -1 \text{ mark}$$

$$IP = P_{mi} \times l \times a \times \frac{N_s}{2} W$$

$$= 85 \times 10^4 \times \frac{152}{1000} \times \frac{\pi}{4} \times \left(\frac{100}{1000}\right)^2 \times \frac{500}{60 \times 2}$$

$$= 4228 \text{ W} \quad -1 \text{ mark}$$

$$BP = 2\pi \times N_s T$$

$$= 2\pi \times \frac{500}{60} \times (20 \times 9.81 - 35) \times \frac{634}{2 \times 1000}$$

$$= 2676 \text{ W} \quad -1 \text{ mark}$$

Q. 3 c) i) Low pressure of compressor – (any two, 02 marks)

Cause	Remedies
1. leak in piping	Check leaks
2. Restricted air intake	Clean/replace air filter
3. Worn out piston rings	Replace ring set



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4. loose/worn belt	Tighten belt/ replace belt
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ii) Compressor stopped working : (**any two, 02 marks**)

Cause	Remedies
1. No electric power	Turn on supply, see wiring
2. Low oil level	Check/ replace oil.
3 HP cut out short circuited	Check HP cut out.
4 Pressure in the tank below cut in pressure	Check pressure switch/replace it.

Q. 3 d) Select the pump in following cases (**01 mark each for correct selection**)

- Domestic water lifting : centrifugal pump o small capacity , small submersible pump.
- Borewells : Jet pump, small submersible pump.
- Service station of automobile : Reciprocating pump.
- Irrigation : Huge discharge capacity centrifugal pump

Q. 3 e) State the purpose of (**02 marks for each**)

i) **Priming in centrifugal pump** : To remove air from suction pipe , casing of pump and portion of delivery pipe and these parts are filled with water to be pumped.

ii) **Air vessel** :

- To obtain a continuous supply of liquid at uniform rate .
- To save considerable amount of work in overcoming the frictional resistance in the suction and delivery pipes.
- To run the pump at higher speed without separation.

Q. 3 f) Practical applications of compressed air : (**any four, 01 mark each**)

- To start I.C. Engines
- To operate pneumatic tools such as rock drills, pneumatic hammer, pneumatic grinder etc.
- To operate various pneumatic controls on machine tools and instruments.
- To inject the fuels in diesel engines



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5. To clean workshops and automobiles
6. To supercharge I.C .Engines
7. To spray paints
8. Filling air in automobile tyres.