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Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to University of Mumbai)

Master

End Sem 2014

T.E(M) Sem V

Total Marks: 50 Duration : 2 hours

Subject: Environmental Engineering and Management System Sem : V (Mechanical) TE(Mech)

Instructions: 1. Q (1) is compulsory
2. Attempt any two questions from the remaining
3. Figures to the right indicate full marks

Q. (1) a) What is ISO? What are its benefits for business, society and government? 06
b) Write a short note on Fabric Filters used for the separation of particulate matter. 06
c) Explain the steps involved in Tertiary treatment on sewage water. 06

Q. (2) a) Write the need and objectives of Environmental Legislation. 04
b) Write a note on water (Prevention and control of Pollution) Act. 04
c) What are the bad effects of different hazardous substances in E-waste? 04
d) Explain the Desert Ecosystem with its Producers, Consumers and Decomposers. 04

Q. (3) a) Explain the effects of Volcanic Eruption. 03
b) Explain different approaches of Watershed Management 03
c) What is Aerobic and Anaerobic Digestion? 03
d) What are the controls on Ecosystem function? 03
e) Explain suspended Film System of the Sewage Treatment. 04

Q. (4) a) What are the benefits of an effective EMS program? 04
b) Explain "Brine Treatment" used for industrial waste. 04
c) Explain "Ozone Hole" and "Global Dimming". 04
d) What are the advantaged and disadvantages of Artificial Recharge System. 04

T.E (Mech), Sem-V, Re-exam

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15/12/14

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SARDAR PATEL COLLEGE OF ENGINEERING
[An Autonomous Institution Affiliated to University of Mumbai]
RE-EXAMINATION, DEC- 2014

SEM / CLASS: SEM V/ T. E. (MECH. ENGG.) **TOTAL MARKS: 100**
SUB: Heat and Mass Transfer **TIME: 03 HR**

Master

- Use of Steam Table is allowed.
- Attempt any **Five questions** out of Seven questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Make suitable assumptions with proper explanations.
- Draw the suitable sketches wherever necessary.

Q.1. Solve any Four questions from following: **20**

a. What is conduction heat transfer? How does it differ from convective heat transfer?
b. What is shape factor? State its properties.
c. How are the heat exchangers classified ?
d. State and prove Kirchoff's law of radiation.
e. What are the advantages and limitations of the dimensional analysis?

Q.2. A. A furnace wall consists of 200 mm layer of refractory bricks, 6 mm layer of steel plate and a 100 mm layer of insulation bricks. The maximum temperature of the wall is 1150°C on the furnace side and minimum temperature is 40°C on the outermost side of the wall. An accurate energy balance over the furnace shows that the heat loss from the wall is 400 W/m². It is known that there is a thin layer of air between the layers of refractory bricks and steel plate. Thermal conductivity for the three layers is 1.52, 45 and 0.138 W/m °C respectively. Find: **10**

1. To how many mm of insulation brick is the air layer equivalent?
2. What is the temperature of the outer surface of the steel plate?

B. Show that the thermal conductance resistance offered by hollow sphere wall of uniform thermal conductivity is given by : $\frac{r_2 - r_1}{4\pi k\, r_1 r_2}$ **10**

Q.3. A. An egg with mean diameter of 40 mm and initially at 20°C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumer's taste. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at 5°C. **10**

Take the following properties for egg:
K = 10 W/m°C, ρ = 1200 Kg/m³, C = 2 KJ/Kg°C and h (heat transfer coefficient) = 100 W/m² °C. Use lump theory.

B. Explain Reynolds analogy with proper derivation. **10**

TE(Mech), Sem-II, Re-exam, Heat & mass transfer

15/12/19

Q.4 A. Water is heated while flowing through a 1.5 cm x 3.5 cm rectangular tube at a velocity of 1.2 m/s. The entering water temperature is 40°C and tube wall is maintained at 85°C. Determine the length of the tube required to raise the temperature of water by 35°C. **10**

Take the following properties of water:

$K = 0.653$ W/m°C, $\rho = 985.5$ Kg/m³, $Cp = 4.19$ KJ/Kg°C, $Pr = 3.27$,

$\nu = 0.517 \times 10^{-6}$ m²/s

Use co-relation: $Nu = 0.023\ (Re)^{0.8}\ (Pr)^{0.33}$

B. Explain and prove the Wien's displacement law: $\lambda_m T = 2.9$ mm.K **10**

Q. 5 A. A counter-flow heat exchanger is to heat air entering at 400°C with a flow rate of 6 kg/s by the exhaust gas entering at 800°C with a flow rate of 4 kg/s. The overall heat transfer coefficient is 100 W/m²°C and the outlet temperature of the air is 551.5°C. The specific heat at constant pressure for both air and exhaust gas can be taken as1.1 kJ/kg°C **10**

Calculate:

(i) The heat transfer area needed

(ii) The number of transfer units

B. (i) Explain the meaning and significance of Fouling Factor. **10**

(ii) Define Thermal Conductivity and briefly explain its significance in heat transfer.

Q. 6 A. For a hemisphere furnace, the flat floor is at 700 K and has an emissivity of 0.5. The hemispherical roof is at 1000 K and has emissivity of 0.25. Find the net radiative heat transfer from roof to floor. **10**

B. Derive the equation of LMTD for counter flow heat exchanger. **10**

Q. 7 **Solve any Four questions from following:** **20**

a. Industrial Applications of mass transfer

b. Differentiate between natural and forced convection

c. State and explain Fourier's law for one-dimensional conduction

d. Modes of Mass Transfer

e. Fick's law of diffusion

f. Differentiate between steady &unsteady state heat transfer

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BHARATIYA VIDYA BHAVAN'S
SARDAR PATEL COLLEGE OF ENGINEERING MASTER FILE
[An Autonomous Institution Affiliated to University of Mumbai]
T.E. (mech), Sem - IV
End SEM EXAMINATION, October 2014

SEM / CLASS: SEM V/ T. E. (MECH. ENGG.) **TOTAL MARKS: 100**
SUB: Heat and Mass Transfer **TIME: 03 HR**

- Use of Steam Table is allowed.
- Attempt **any Five questions** out of Seven questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Make suitable assumptions with proper explanations.
- Draw the suitable sketches wherever necessary

Q.1. (A) A steam pipe 10 cm outside diameter is covered with two layers of insulation, each having a thickness of 2.5 cm. The average thermal conductivity of one material is 3 times that of other and the surface temperatures of the insulated steam pipe are fixed. Examine the position of better insulating layer relative to the steam pipe if heat dissipation from steam is to be minimum. What percentage saving in heat dissipation results from that arrangement? **(10)**

(B) Two rods of A and B of the same length and diameter protrude from a surface at 120°C and are exposed to air at 25°C. The temperatures measured at the end of the rods are 50°C and 75°C. If thermal conductivity of material A is 20 W/mK, calculate the thermal conductivity of material B. Consider a fin is insulated at the tip. **(10)**

Q.2. (A) Derive the equation for temperature distribution (unsteady state heat conduction) in the body for Newtonian heating and cooling. Mention some of the situations where transient conduction occurs. **(10)**

(B) Air at 2 bar and 40°C is heated as it flows through a 30 mm diameter tube at a velocity of 10 m/s. If the wall temperature is maintained at 100°C all along the length of tube, make calculations for the heat transfer per unit length of the tube. Proceed to calculate the increase in bulk temperature over one meter length of the tube. **(10)**

Use the following correlation:

$Nu = 0.023\ (Re)^{0.8}\ (Pr)^{0.4}$

Thermo-physical properties of air at 70°C and 2 bar:

$\rho = 2.226\ kg/m^3$, $\mu = 20.6 \times 10^{-6}\ Ns/m^2$ $Cp = 1.009\ kJ/kgK$, $K = 0.0297\ W/m.K$, $Pr = 0.694$

Q.3. (A) Explain thermal boundary layer and velocity boundary layer with neat sketches. What is the importance of these boundary layers in heat transfer? **(10)**

(B) Calculate the heat transfer rate per unit area by radiation between the surfaces of two long cylinders having radii 100 mm and 50 mm respectively. The smaller cylinder is placed in the larger cylinder. The axes of the cylinders are parallel to each other and separated by a distance of 20 mm. the surfaces of inner and outer cylinders are maintained at 400 K and

300 K respectively. The emissivity of both the surfaces is 0.5. Assume the medium between the two cylinders is non-absorbing. **(10)**

Q.4. (A) What is dimensional analysis? What are the uses of dimensional analysis? State at least any five dimensional numbers with their physical significance. **(10)**

(B) Estimate the heat transfer from a 40 W incandescent bulb at 125°C to 25°C in quiescent air. Approximate the bulb as a 50 mm diameter sphere. What percent of the power is lost by free convection? Assume that the characteristic length is the diameter of the sphere.

Using equation:

$$Nu = 0.6\{(Gr.\ Pr)^{0.25}\}$$

Take properties of air at bulk mean temperature 75°C:

$k = 0.03$ W/mK, $\nu = 20.55 \times 10^{-6}$ m^2/s, Pr = 0.693 **(10)**

Q. 5. (A) A counter-flow concentric tube heat exchanger is used to cool the lubricating oil of a large industrial gas turbine engine. The oil flows through the tube at 0.19 kg/sec (Cp = 2.18 kJ/kgK) , and the coolant water flows in the annulus in the opposite direction at a rate of 0.15 kg/sec (Cp = 4.18 kJ/kgK). The oil enters the coolant at 425 K and leaves at 345 K while the coolant enters at 285 K. How long must the tube be made to perform this duty if the heat transfer coefficient from oil to tube surface is 2250 W/m^{2}K and from tube surface to water is 5650 W/m^{2}K? The tube has a mean diameter of 12.5 mm and its wall presents negligible resistance to heat transfer. **(10)**

(B) Starting from basic show that for a heat exchanger when one fluid is condensing,

Effectiveness = $1 - e^{(-NTU)}$ **(10)**

Q.6. (A) Calculate the shape (configuration) factor like $F_{1\text{-}2}$ of hemispherical object which is covered by a circular plate on top side of bowl. Consider bowl as surface 1 and a circular plate as surface 2. **(05)**

(B) Calculate the shape (configuration) factor like $F_{1\text{-}2}$, $F_{1\text{-}3}$ and $F_{2\text{-}3}$ for the flat plate of a tube of an equilateral triangle. **(05)**

(C) State Kirchoff's law of radiation and show the emissivity is numerically equal to absorptivity. **(05)**

(D) Prove that emissive power of a black body is equal to π times the intensity of radiation of black body. **(05)**

Q.7. (A) Hydrogen gas at 25°C and 2.5 bar pressure flows through a rubber tubing of 12 mm inside radius and 24 mm outside radius. The binary diffusion coefficient of hydrogen is 2.1×10^{-8} m^2/s and the solubility of hydrogen is 0.055 m^3 of hydrogen per m3 of rubber at 1 bar. If the gas constant for hydrogen is 4160 J/kg.K and the concentration of hydrogen at the outer surface of tubing is negligible, calculate the diffusion flux rate of hydrogen per meter length of rubber tubing. **(10)**

(B) State the examples of mass transfer in day-to-day life and industrial applications. **(05)**

(C) What are the important modes of mass transfer? And Give at least one example of each. **(05)**

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Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

End Semester Examination, November 2014

Total Marks: 100 | Duration: 3 Hour

TE (Mechanical), SEM- V | **HYDRAULIC MACHINERY**

MASTER FILE

- Question no. 1is **compulsory.**
- Answer any four out of remaining six questions.
- Figures to the right indicate full marks.
- Make suitable assumption if necessary with proper reasoning

1. a) State the merits and demerits of a hydroelectric power plant (2 points each) **4**

   b) Compare impulse and reaction turbines based on the following points **4**
      i. Working principle
      ii. Specific speed
      iii. Need for air-tight casing
      iv. Installation of the turbine with respect to tail race level

   c) Define volumetric efficiency, head efficiency, hydraulic efficiency and mechanical efficiency for a pelton turbine. **4**

   d) Explain the need for a foot valve and a strainer in a centrifugal pump system. **4**

   e) Discuss the role of surge tank and draft tube in a reaction turbine system. **4**

2. a) Develop a generalized Euler equation for calculating power for a turbine. Decompose it into dynamic, centrifugal and accelerating components using velocity triangles. **10**

   b) A centrifugal pump is required to discharge 600L/s of water and develops a manometric head of 15m when the impeller rotates at 750rpm. The manometric efficiency is 0.8. The total loss of head in the impeller and casing is $0.027V^2$ where V is the absolute velocity with which water leaves the impeller. Water enters the impeller without shock and whirl. The velocity of flow is constant and is 3.2m/s. Determine the (a) impeller diameter, (b) blade angle at outlet, and (c) outlet area. **10**

3. a) What is an air vessel? State its functions. Show that percentage of work saved in pipe friction by fitting of air vessels for a single acting pump is 84.8% and that for a double acting reciprocating pump is 39.2%. **10**

   b) A Francis turbine has a runner diameter of 1m at the entrance and 0.5m at exit. The blade angle is 90^0 and guide vane angle is 15^0 at entrance. The water at exit leaves the blades without any whirl. The net head for the turbine operation is 30m and velocity of flow is constant throughout. The hydraulic efficiency is 0.95. Sketch the velocity triangles. What is the (a) speed of the runner in rpm, (b) blade angle at exit and (c) absolute and relative velocities of water at inlet and exit? Is the calculated speed synchronous with 50Hz frequency? If not, what speed would you recommend to directly couple the turbine with an alternator of 50Hz? **10**

4. a) Explain the phenomenon of cavitation in context to hydraulic machinery. Which parameters affect it? How does cavitation effect system's performance, and suggest any two methods to avoid them. **10**

   b) A single acting reciprocating pump handles a fluid of specific gravity 1.5. The bore and stroke of the unit are 20cm and 30cm. The sump is 3m below the pump while the discharge tank is 10m above the pump. The suction pipe diameter is 12cm and **10**

T.E. Mech - Sem V
Hydraulic Machinery.

length is 8m. The delivery pipe diameter is 12cm and length is 24m. Darchy friction factor (4f) = 0.02. The speed of operation is 32rpm. The atmospheric pressure is 10.3m of water. Estimate

i. Absolute pressure head on the piston at start, middle and end of suction and delivery stroke and show it on an indicator diagram.
ii. Power required by the pump.
iii. The maximum speed for its safe operation if absolute vapour pressure is 2.7m of water.

5. a) A pelton turbine installed at Nainital power house develops a power of 200kW at a speed of 600rpm when working under a head of 300m. If the coefficient of velocity, speed ratio and overall efficiency are 0.98, 0.45 and 0.75 respectively, determine the discharge, least jet diameter, mean runner diameter, jet ratio and minimum number of buckets. **10**

b) Explain system characteristics of a pump and its variation with discharge. What is its significance? **10**

A pump used to transfer water from a sump to an overhead reservoir has the following H-Q characteristic: $H = 23 + 11Q - 110Q^2$. The overhead reservoir is 15m above the sump. The frictional resistance to the flow in the suction and delivery pipes varies with discharge as $20Q^2$ and $55Q^2$ respectively. The total resistance to flow in various fittings and bends varies with discharge as $15Q^2$. In these equations H is in meters and Q is in m^3/s. Determine the system characteristics equation and the operating point of the pump. What is the shut-off head of the pump? Discuss whether the pump will be able to deliver a discharge of 400L/s.

If an identical pump is connected in parallel with the first pump, calculate the new operating point.

6. a) Explain briefly the various energy losses in a centrifugal pump. **5**

b) Classify hydraulic turbines on five major parameters. **5**

c) Explain the meaning of NPSHA and NPSHR with suitable illustration. **5**
Does NPSHA > NPSHR always ensure a cavitation free operation? Comment.

d) The head and discharge through a Kaplan turbine is to be 20m and $130m^3/s$ respectively. Its tip diameter and hub diameter are designed to be 4.5m and 2m respectively. The whirl component of velocity is to be zero at outlet. The hydraulic efficiency of the turbine may be assumed to be 95%. If the turbine runner is to rotate at 150rpm, justify the need for a continuous twist in blade from hub to tip. **5**

7. a) A centrifugal pump with impeller of 0.25m diameter and backward curved blades with blade angle 35^0 at outlet; is running in the reverse direction at 1500rpm. The flow velocity at outlet is 15% of the outlet peripheral velocity. Estimate the theoretical total head (Euler's head) and absolute velocity at impeller exit. **5**

b) The discharge from a single acting reciprocating pump with piston diameter 30cm and stroke length 40cm is 25L/s. The crank is rotating at 50rpm. Calculate the slip, percentage slip and coefficient of discharge. What would be the cause for slip being negative? **5**

c) A total discharge of $0.09m^3/s$ against a net head of 15m is desired. Estimate the number of double suction pumps required if the specific speed of the pumps is to be 20. The impeller is rotating at 1500rpm. **5**

d) A turbine has an exit velocity of 10m/s and is provided with a straight conical draft tube. The velocity head at the exit of the draft tube is 1.0m and loss of head in the draft tube is 1.5m. To avoid cavitation, the minimum pressure head in the turbine is set at 2.0m (abs). Taking atmospheric pressure as 10.3m of water, estimate the maximum height of setting of the turbine above the tailwater level. **5**

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T.E.(Mech)-sem V – Re-exam-Dec 2014.

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

RE-EXAMINATION, DECEMBER 2014

Total Marks: 100 Duration: 3 Hours

TE (MECHANICAL) SEM: V **Hydraulic Machinery**

MASTER FILE.

- Attempt any **FIVE** questions out of seven questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Make suitable assumption if needed with proper reasoning.

1 a) Classify hydroelectric power station on any two important base of classification. Draw a schematic diagram of a low head hydro power plant and explain its working Briefly discuss the function of each component shown in the diagram. **8**

b) Explain constructional features of a Francis Turbine? Draw inlet velocity triangle for (a) low, (b) medium and (c) high specific speed Francis runner. Calculate specific speed of a runner generating 50 MW power under a head of 500 m. The speed chosen is 600 rpm. Indicate what type of turbine is suitable. **12**

2. a) Develop Euler equation for a hydro turbine and separate out its dynamic, centrifugal and accelerating components of work output. **8**

b) A Pelton wheel of two jet working under head 762m is required to drive a generator to develop 20MW. Assuming electric generator efficiency 95%, wheel efficiency 87%, nozzle velocity coefficient 0.97, speed ratio 0.46, outlet angle of the bucket 15° and friction of bucket reduces the relative velocity by 15%. Find **12**

(a) Diameter of the jet, b) Flow rate through turbine and c) The force exerted by jet on the buckets

If the ratio of mean bucket circle diameter to the jet diameter is not to be less than 10, find the best synchronous speed for generation at 50 cycles per second and the corresponding mean diameter of the runner.

3 a) Explain all essential features of a pumping system. How does it work? With the help of appropriate sketch, explain the working of a centrifugal compressor. **8**

b) A Francis turbine developing 16120 kW under a head of 260 m runs at 600 rpm. The runner outside diameter is 1500 mm and the width is 135 mm. The flow rate is 7 m^3/s. The exit velocity at the draft tube outlet is 16 m/s. Assuming zero whirl velocity at exit and neglecting blade thickness determine the overall and hydraulic efficiency and rotor blade angle at inlet. Also find the guide vane outlet angle. **12**

4 a) Derive an expression for optimum speed ratio and maximum hydraulic efficiency of a Pelton wheel. Sate the assumption made. **8**

b) Differentiate between Kaplan and Propeller turbine. **12**
A Kaplan turbine delivers 10 MW under a head of 25 m. The hub and tip diameters are 1.2 m and 3 m. Hydraulic and overall efficiencies are 0.90 and 0.85. If both velocity triangles are right angled triangles, determine
(a) RPM and specific speed,
(b) Guide blade outlet angle,

T.E. (Mechanical) Sem V
Hydraulic Machinery. 19/12/14.

(c) Blade outlet angle, 1
(d) Speed and flow ratio.

5 a) What is draft tube? Derive an expression for draft tube efficiency. 8
b) What do you understand by system characteristic curve? Explain. 12
Two centrifugal pumps A and B are available for use in a pipe flow system with following test data-

PUMP -A	
Discharge (m^3/s)	Head, m
0	40
0.1	38
0.2	29
0.25	23
0.30	16

PUMP -B	
Discharge (m^3/s)	Head, m
0	45
0.1	43
0.2	38
0.3	28
0.4	14

Plot and determine head–capacity curve for these pumps when both pumps are connected in (i) parallel and (ii) series.
If system curve is represented by $H=k_1+k_2Q^2$, where $k_1=18$ and $k_2=20$, find the operation point in parallel and series operation by representing on graph paper.

6 a) Explain the function of air vessel. Show that in a double acting pump the work saved by fitting air vessels is about 39.2%. 8
b) A single acting reciprocating of pump handles water. The bore and stroke of the unit are 20 cm and 30 cm. The suction pipe diameter is 12 cm and length is 8 m. The delivery pipe diameter is 12 cm and length is 24 m. f = 0.02. The speed of operation is 32 rpm. Determine the friction power with and without air vessels. 12

7 (a) Draw indicator diagram of a reciprocating pump considering the effect of acceleration and friction on delivery side and acceleration on suction side. 8
(b) The dimensionless specific speed of a centrifugal pump is 0.06. Static head is 30 m. Flow rate is 50 l/s. The suction and delivery pipes are each of 15 cm diameter. The friction factor is 0.02. Total length is 55 m other losses equal 4 times the velocity head in the pipe. The vanes are forward curved at 120°. The width is one tenth of the diameter. There is a 6% reduction in flow area due to the blade thickness. The manometric efficiency is 80%. Determine the impeller diameter. Inlet is radial. 12

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SARDAR PATEL COLLEGE OF ENGINEERING

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Total marks : 100 T.E (Mech), Sem-V October , 2014

CLASS/SEM : TE (Mech) / SEM- V SUBJECT: Mechatronics

- Assume suitable Data whenever necessary
- Figures to the right indicate full marks
- Use your judgment for any unspecified data
- Draw **neat & clean** diagrams
- Solve any **FIVE** out of SEVEN questions

Master

Q.1 a) Explain basic components of Mechatronics Systems & Mechatronics Design Process with functional block diagram **10**

b) Explain any five sensors and actuators with suitable diagrams and applications **10**

Q.2 a) Draw and explain organization of Internal RAM & SFR in detail **10**

b) Explain features of 8085 & 8051 **10**

Q.3 a) Draw and explain Time delay circuit & Pressure Reducing circuit **10**

b) Enlist & explain different programming devices use for PLC and what are different programming methods use for it with suitable example **10**

Q.4 a) What is Steady State Error , derive expression for Steady State Error ,obtain effect of inputs on steady state error **10**

b) State whether $S^8+5S^6+2S^4+3S^2+1=0$ is stable or not with justification **05**

c) For G(s)H(s)= K/s(s+2) obtain nature of roots **05**

Q.5 a) Draw root locus of a system with **10**

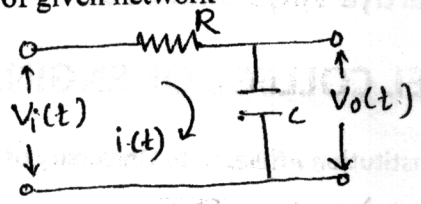
$$G(s) = \frac{K}{S(S^2 + 2S + 2)}$$

Comment on Stability

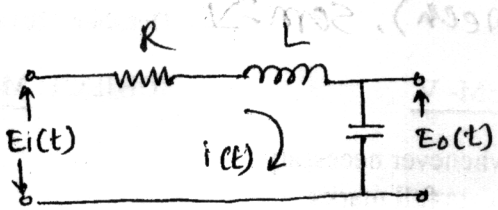
b) Explain Hurwitz's criterion & Routh's Stability Criterion with suitable example also discuss special cases **10**

Q.6 a) Find out the TF of given network **10**

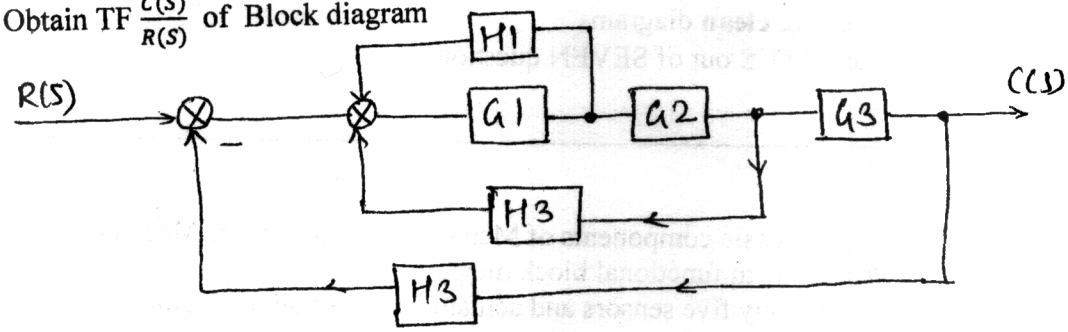
i)



ii)



b) Obtain TF $\frac{C(S)}{R(S)}$ of Block diagram **10**

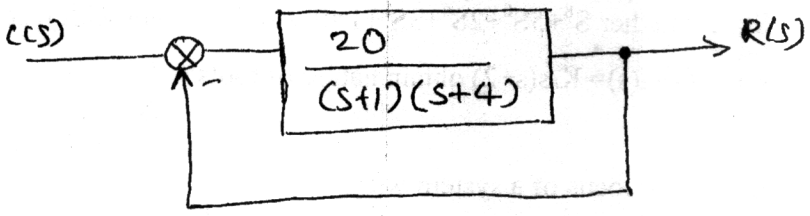


Q.7 a) For unity feedback control system has **10**

$$G(s) = \frac{80}{s(s+2)(s+20)}$$

Draw Bode plots determine ,
a) Gain crossover frequency b) Phase crossover frequency c) Gain margin
d)Phase margin Comment on stability of the system

b) Explain the Transient Response specifications with suitable diagram i.Delay Time ii. Rise time iii.Peak time iv.Peak Overshoot v. settling time also solve for the system shown in the figure obtain the closed loop TF damping ratio natural frequency and expression for the output response if subjected to unit step input. **10**



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Bhartiya Vidya Bhavan's Estd. 1962

Sardar Patel College of Engineering

(Government Aided Autonomous Institute)

T.E. (Mech), Sem - II

Second Half 2014

Total Marks: 100 Duration : 3 Hours

CLASS/SEM : T.E.(MECH). V Sem. SUBJECT : THEORY OF MACHINES II

Master

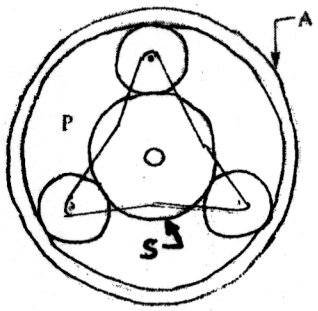
- Attempt any **FIVE** question out of **SEVEN** questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data wherever necessary.

Q.1 Attempt any **four** :

(A) Explain effort and power of governor..
(B) Explain working of internal expanding shoe brake.
(C) Explain differential gear box with simple example.
(D) Derive an expression for gyroscopic couple from first principle.
(E) Differentiate between theory of uniform pressure and theory of uniform wear in case of Clutch.

(20)

Q.2 An epicyclic gear train for an electric motor is shown in figure. The wheel S has 15 teeth and is fixed to the Motor shaft rotating at 1450 r.p.m. The planet P has 45 teeth, gears with fixed annulus A and rotates on a spindle carried by an arm which is fixed to the output shaft. The planet P also gears with the sun wheel S. Find the speed of the output shaft. If the motor is transmitting 1.5 KW, find the torque required to fix the annulus A.



(20)

Q.3(A) A,B,C and D are four masses carried by a rotating shaft at radii 100 mm, 150 mm, 150 mm and 200 mm respectively. The planes in which the masses rotate are spaced at 500 mm apart and the magnitude of the masses B, C, and D are 9 kg, 5kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.

(15)

(B) Explain balancing of V engines with suitable sketch.

(05)

Q.4 (A) A Porter governor has all four arms 200 mm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to a sleeve at a distance of 25 mm from the axis. Each ball has a mass of 2 kg and the mass of the load on the sleeve is 20 kg. If the radius of rotation of the balls at a speed of 250 r.p.m is 100 mm, find the speed of the governor after the sleeve has lifted 50 mm. Also determine the effort and power of the governor.

(15)

(B) Explain Hartnell governor.

(05)

Q.5 A racing car weighs 20 KN. It has a wheel base of 2 m, track width 1 m and height of C.G. 300 mm above the ground level and lies midway between the front and rear axle. The engine flywheel rotates at 3000 r.p.m clockwise when viewed from the front. The moment of inertia of the flywheel is 4 Kg-m^2 and moment of inertia of each wheel is 3 Kg-m^2. Find the reaction between the wheels and the ground when the car takes a curve of 15 m

radius towards right at 30 km/h, taking into consideration the gyroscopic and the centrifugal effects. Each wheel radius is 400 mm.

(20)

Q.6 (A) In a band and block brake , the band is lined with 14 blocks, each of which subtends an angle of 20° at the drum centre. One end of the band is attached to the fulcrum of the brake lever and the other to a pin 150 mm from the fulcrum . Find the force required at the end of the lever 1 m long from the fulcrum to give a torque of 4 KN-m. The diameter of the brake drum is 1 m and the coefficient of friction between the blocks and the drum is 0.25.

(15)

(B) Explain self energizing and self locking brakes.

(05)

Q.7 (A) A single plate clutch consist of a pair of contacting surfaces. The inner and outer diameters of the friction disk are 125 and 250 mm respectively. The coefficient of friction is 0.25 and total axial force is 15 KN. Calculate the power transmitting capacity of the clutch at 500 rpm using :

(i) Uniform wear theory
(ii) Uniform pressure theory.

(10)

(B) Explain:

(i) Proneybrake dynamometer
(ii) Belt transmission dynamometer

(10)

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Bhartiya Vidya Bhavan's Estd. 1962

Sardar Patel College of Engineering

(Government Aided Autonomous Institute)

TE (Mech), Sem-V, Re-exam. First Half 2014

Total Marks: 100 Duration : 3 Hours

CLASS/SEM : T.E.(MECH). V Sem. SUBJECT : THEORY OF MACHINES II

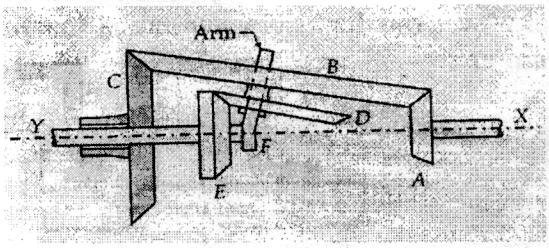
Master

- Attempt any **FIVE** question out of **SEVEN** questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data wherever necessary.

Q1. Explain any four : (20)

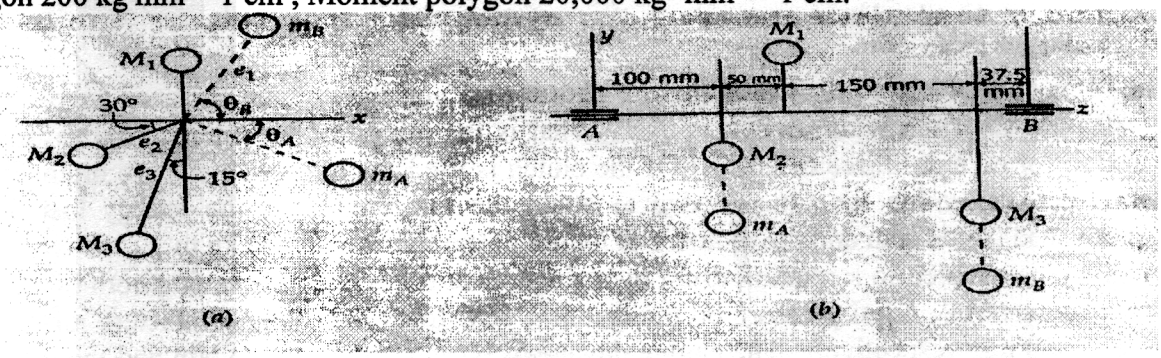
1. Centrifugal Clutch
2. Differential Gear of an automobile
3. Balancing of a four cylinder four stroke inline engine
4. Pickering Governor
5. Gyroscopic effect on a naval ship

Q2. A shaft Y is driven by a co- axial shaft X by means of the epicyclic gear train as shown in figure. The wheel A is keyed to X and E to Y.The wheels B and D are compounded and carried on an arm F which can turn freely on the common axis of X and Y. The wheel C is fixed. If the numbers of teeth on A, B, C,D and E are 20, 64,80, 30and 50 respectively and the shaft X makes 600 rpm. Determine the speed in rpm and direction of rotation of shaft Y.



(20)

Q3. In the figure a shaft is rotating at 120 rpm with three unbalanced masses have been illustrated. It is proposed to attach masses in plane of M_2 and M_3 at a radius of 50 mm, so as to balance the system. Find out the masses to be attached and their angular positions with respect to the axis as shown in figure.
M_1 = 9kg, M_2 = 10.5 kg, M_3= 4 kg, r_1 =125mm, r_2 = 75mm, r_3 = 150 mm. Recommended scale force polygon 200 kg mm = 1 cm , Moment polygon 20,000 kg- mm^2 = 1 cm.



(20)

Q4 (A). In a hartnell governor, the lengths of ball and sleeve arms of a bell crank lever are 120 mm and 100 mm repectively. The distance of fulcrum of bell crank lever from the governor axis is 140 mm. Each governor ball has a mass of 4 kg. The governor runs at a mean speed of 300 rpm with the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4 % the sleeve moves 10 mm upwards, Neglecting friction, Find

1. The minimum equilibrium speed of the total sleeve movement is limited to 20 mm.

TE(Mech), Sem-V, Re-exam, Theory of machines

16/12/14

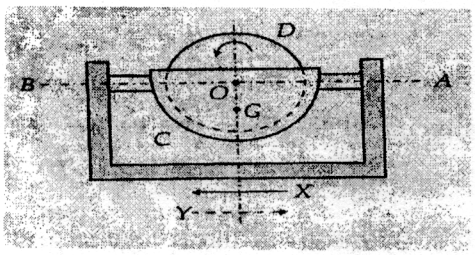
2. Sensitiveness of the governor. (10)

Q4 (B). In the proell governor as shown in figure, the mass of each ball is 3 kg and the central load on the sleeve is 25 kg. The arms are of 20 cm length and pivoted about the axis displayed from the central axis of rotation by 37.5 mm, y=238mm, x=303.5 mm, CE = 85 mm, MD = 142.5 mm. Determine the equilibrium speed.

(10)

Q5 (A). A gyrowheel D of mass 0.5 kg with a radius of gyration of 20 mm is mounted in a pivoted frame C as shown in figure. The axis AB of the pivots passes through centre of rotation O of the wheel, but the centre of gravity G of the frame C is 10 mm below O. The frame has a mass of 0.30 kg and the speed of rotation of the wheel is 3000 rpm in the anticlockwise direction as shown.
The entire unit is mounted on a vehicle so that the axis AB is parallel to the direction of motion of the vehicle. If the vehicle travels at 15 m/sec in a curve of 50m radius , find the inclination of the gyrowheel from the vertical, when

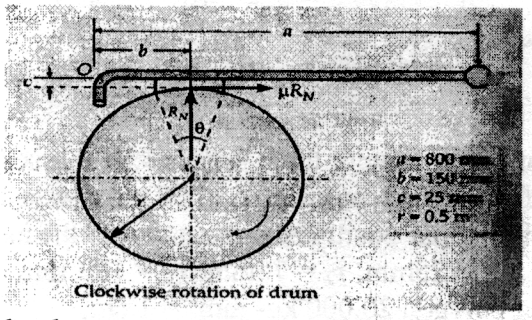
1. The vehicle moves in the direction of the arrow 'X' taking a left hand turn along the curve, and
2. The vehicle reverses at the same speed in the direction of arrow 'Y' along the same path.



(15)

Q5 (B). Explain Stability of two wheel vehicle (05)

Q6 (A). The diameter of brake drum of a single block brake as shown in figure is 1 m. It sustains 250Nm of torque at 400 rpm. The coefficient of friction is 0.32. Determine the required force to be applied when the rotation of drum is : (a) Clockwise (b) Counterclockwise and the angle of contact is 100 degree. Given that a=800 mm, b=150 mm and c= 25 mm. Also find the new values of c for self locking of brake.



(15)

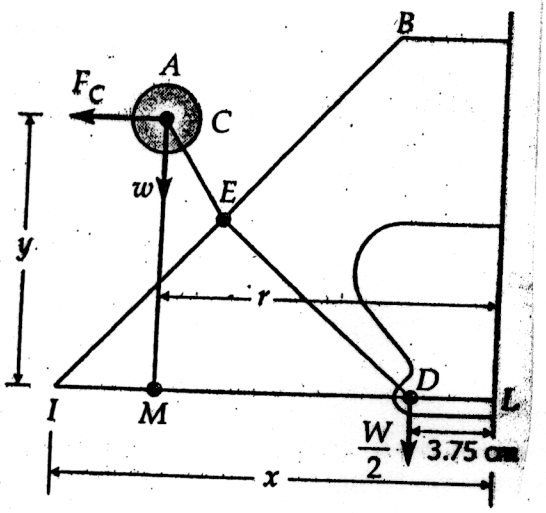
Q6 (B) Explain rope and brake dynamometer. (05)

Q7 (A). The semi cone angle of a cone clutch is 12.5 degree and the contact surfaces have a mean diameter of 80 mm. Coefficient of friction is 0.32. What is the minimum torque required to produce slipping of clutch for an axial force of 200 N ? If the clutch is used to connect an electric motor with a stationary flywheel, determine the time needed to attain the full speed and the energy lost during slipping. Motor speed is 900 rpm and the moment of inertia of the flywheel is 0.4 kg m^2. (10)

Q7 (B). An engine is coupled to a rotating drum by a single disc friction clutch having both of its sides lined with friction material. Axial pressure on the disc is 1 KN. Inner and outer diameters of the disc are 280 mm and 360 mm respectively. The engine develops constant torque of 36 Nm and the inertia of its rotating part is equivalent to that of a flywheel of 30 Kg mass and a radius of gyration of 280 mm. The mass and radius of gyration of the drum are 50 kg and 420 mm respectively and the torque to overcome the friction is 6 Nm. The clutch is engaged when the engine speed is 480 rpm and the drum is stationary. Assuming the coefficient of friction to be 0.3. Determine

1. Duration of slipping
2. Total time taken for the drum to reach a speed of 480 rpm. (10)

figure for Q4(B)



05/11/19

BHARTIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

[An Autonomous Institution Affiliated to University of Mumbai]

MUNSHI NAGAR, ANDHERI(WEST), MUMBAI-400 058

END SEMESTER

CLASS/SEM: **T.E. (Mechanical)/V** (T-EC Mech) Sem V

SUBJECT: **Thermal Systems (ME-304)**

TOTAL MARKS:**100**

DURATION: **3 HOUR**

1. Answer any **Five** questions out of **Seven** questions.
2. Figures to the right indicate full marks.
3. Assume suitable data and justify the same.
4. Use of steam table and Mollier chart is permitted.

master

Q.1. (a) Derive ideal intercooling pressure ratio with perfect intercooling of compressor for minimum work input. **[08]**

(b) A single-stage double-acting air compressor delivers air at 7 bar. The pressure and temperature at the end of suction stroke are 1 bar and 27° C. It delivers 2 m^3 of free air per minute when the compressor is running at 400 r.p.m. The clearance volume is 5% of the stroke volume. The pressure and temperature of ambient air are 1.03 bar and 20°C. Take index of compression 1.3 and index of re-expansion 1.35 and find followings.
(i) Volumetric efficiency of the compressor.
(ii) Indicated power of the compressor.
(iii) Diameter and stroke of the cylinder if both are equal. **[12]**

Q.2. (a) What are the methods of improving efficiency of open cycle gas turbine? Explain open cycle gas turbine with reheating. **[08]**

(b) In a gas turbine power plant the compressed air goes to combustion chamber through regenerator. This air is then expanded over the turbine and passed through regenerator. The following data is given:
Isentropic efficiency of compressor = 0.83, Isentropic efficiency of turbine = 0.85, Mechanical transmission efficiency = 0.99, Combustion efficiency = 0.98, Heat Exchanger effectiveness =0.80, Pressure ratio = 4.0, Maximum cycle temperature = 11000 K, Ambient conditions = 1 bar and 288 K. Calorific value of fuel = 42 000 kJ/kg. Calculate specific work output, specific fuel consumption and cycle efficiency. Neglect mass of fuel while calculating heat taken by gases. Take C_p = 1.005 kJ/ kg-K , γ = 1.4 during compression and C_p = 1.147 kJ/kg-K, γ = 1.33 during combustion and expansion. **[12]**

Q.3.(a) Dry saturated steam at a pressure of 8 bar absolute enters a convergent-divergent nozzle and leaves at 1.5 bars absolute. If the flow is isentropic and corresponding expansion index is 1.135 find the ratio of cross-sectional area at exit and throat for maximum discharge. **[08]**

(b) Derive equation for general relationship between area, velocity and pressure in a nozzle flow and explain when flow will be subsonic and supersonic for accelerated and decelerated flow. **[12]**

Q.4 (a) Prove that condition for maximum blade efficiency of a reaction turbine is given by relation:

$$\eta_b = \frac{2\cos^2\alpha}{1+\cos^2\alpha}$$ **[08]**

(b) Saturated steam at 10 bar is supplied to a single stage steam turbine through a convergent-divergent steam nozzle. The nozzle angle is 20° and the mean blade speed is 440 m/sec. The steam pressure leaving the nozzle is 1 bar. Find (i) the best angle if the blades are equiangular and (ii) the maximum power developed by the turbine if the numbers of nozzles used are 6 and area at the throat of each nozzle is 0.5 cm^2. Assume a nozzle efficiency of 90 % and blade friction coefficient of 0.85. **[12]**

Q.5. (a) Differentiate between fire tube and water tube boiler. **[08]**

(b) Explain why boiler accessories are used in the boiler and explain in detail function of economiser and air preheater with neat sketch. **[12]**

Q.6 (a) Explain evaporative condenser with neat sketch. **[10]**

(b) Explain advantages and limitations of rotary verses reciprocating compressors and axial verses centrifugal compressors. **[10]**

Q. 7 Write short notes on **[Any Four]** **[20]**
(a) Pressure and velocity compounding in steam turbine
(b) Classification of compressors on the basis of displacement
(c) Ideal cycle for steam power plant
(d) Methods adopted for increasing isothermal efficiency of reciprocating compressors.
(e) Blow off cock.

TE (Mech). Sem - V. Re- exam.

18/12/14

BHARTIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

[An Autonomous Institution Affiliated to University of Mumbai]

MUNSHI NAGAR, ANDHERI(WEST), MUMBAI-400 058

RE-EXAM- DECEMBER 2014

CLASS/SEM: **T.E. (Mechanical)/V** TOTAL MARKS:**100**

SUBJECT: **Thermal Systems (ME-304)** DURATION: **3 HOUR**

1. Answer any **Five** questions out of **Seven** questions.
2. Figures to the right indicate full marks.
3. Assume suitable data and justify the same.
4. Use of steam table and Mollier chart is permitted.

Master

Q.1 Answer the followings **[20]**

(a) Enumerate various applications of compressed air.

(b) Differentiate between high pressure and low pressure boilers.

(c) Explain multistaging in reciprocating air compressors.

(d) Differentiate between impulse and reaction turbine.

Q.2 (a) Differentiate between fire tube and water tube boiler. **[08]**

(b) A two stage double acting air compressor operating at 250 rpm takes air in at 1.013 bar and 27^0 C. The diameter and stroke of L.P cylinder are 37 cm and 40 cm respectively. The stroke of H.P cylinder is same as L.P. cylinder and clearance of both the cylinder is 5% of the stroke. The L.P. cylinder discharges air at a pressure of 4.052 bar. The air passes through the intercooler so that it enters the H.P. cylinder at 27^0 C and 3.85 bar. Finally, the air is discharged from the compressor at 15.4 bar. The compression and re-expansion in both the cylinder follows the same law $pv^{1.3}$ =Constant. Determine

(i) Brake power required to run the compressor if mechanical efficiency is 85 %

(ii) The diameter of H.P. cylinder

(iii) Heat rejected in intercooler.

Take C_p = 1 kJ/kg-K and R = 287 J/kg-K for air. **[12]**

Q.3 (a) Derive expression for optimum pressure ratio for maximum specific work output in actual simple gas turbine. **[08]**

(b) In a gas turbine installation, air is taken in L.P. compressor at 288K and 1.1 bar and after compression, it is passed through intercooler where its temperature is reduced to 295K. The cooled air is further compressed in H.P compressor and then passed in the combustion chamber where its temperature is increased to 950°C by burning the fuel. The combustion products expand in H.P. turbine which runs the compressor and further expansion is continued in L.P. turbine which runs the alternator. The gases coming out from L.P. turbine are used for heating

the incoming air from H.P. compressor and then exhausted to atmosphere. Taking the following data determine the power output, specific fuel consumption and thermal efficiency. Pressure ratio in each compressor = 2, Isentropic efficiency of each compressor stage = 85%, Isentropic efficiency of each turbine stage = 85 %, Effectiveness of heat exchanger = 0.75, Air flow = 15 Kg/Sec, C.V. of fuel = 45000 kJ/Kg. C_p (for air) = 1 kJ/kg-K, C_p (for gas) = 1.15 kJ/kg-K, γ = 1.4 (for air) and γ = 1.33 (for gas). Neglect the mechanical, pressure and heat losses of the system and fuel mass also. **[12]**

Q.4 (a) Derive equation for critical pressure ratio of a nozzle and prove that for maximum discharge pressure ratio is given by:

$$\frac{P_2}{P_1} = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$$ **[08]**

(b) A steam turbine develops 160 kW with a consumption of 19.4 kg/kWh. The pressure and temperature of the steam entering the nozzle are 12 bar and 220°C. The steam leaves the nozzles at 1.2 bar. If the diameter of the nozzle at throat is 7 mm, find the number of nozzles required. If 8 % of the total enthalpy drop is used up in frictional reheating in the diverging part of the nozzle, determine the diameter at the exit of nozzle and quality of steam leaving the nozzle. **[12]**

Q.5 (a) Explain different methods of compounding of steam turbine stages. **[10]**

(b) Steam at 300 m/s is supplied to a single stage impulse turbine through a nozzle. The nozzle angle is 25°. The mean diameter of the blade rotor is 100 cm and it has a speed of 2000 RPM. Find suitable blade angles if there is no axial thrust. If the blade velocity coefficient is 0.9 and steam flow rate is 10 kg/sec, find the power developed. **[10]**

Q.6 (a) Explain surface condenser with neat sketch. **[10]**

(b) What is the difference between rotary and reciprocating compressor? What do you mean by surging and chocking of compressor? **[10]**

Q.7 (a) Discuss with neat sketches different methods of improving thermal efficiency of simple open cycle gas turbines. **[10]**

(b) Why boiler mountings and accessories are used in the boiler? Explain with neat sketch Feed check valve and blow off cock used in boiler. **[10]**
