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T.Y.B.Tech, Sem V Mech.
Heat & Mass Transfer.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.
End Semester Exam, **November 2015**

Max. Marks: **100** Duration: **3 Hrs.**
Class: **T. Y. B. Tech.** Semester: **V** Program: **Mechanical Engineering**
Name of the Course: **Heat and Mass Transfer** Course Code : **ME 301**

Instructions:

1. **Question No 1 is compulsory.**
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary
5. **Data Book Photocopies are allowed**

Master file.

Q1. **Answer the following questions (Any Five)** **20**

(A). What is shape factor (Configuration factor)? State its properties.

(B). How are the heat exchangers classified?

(C). Explain the meaning and significance of Fouling Factor.

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

(E). What is meant by transient heat conduction? What are the assumptions for lumped capacity analysis?

(F). Prove that emissivity is numerically equal to absorptivity.

(G). What are the advantages and limitations of the dimensional analysis?

Q2 (A). A 100 mm diameter pipe carrying a hot chemical at 250°C is covered with two layers of insulation, each 50 mm thick. The length of the pipe is 5 m. The outer surface temperature of the composite is 35°C. The rate of heat loss through the pipe is 270 W. If the thickness of the outer insulation is increased by 25%, the heat loss is reduced to 260 W. Calculate the thermal conductivities of the two insulating materials. **10**

(B). Derive Fourier's differential equation in the Cartesian co-ordinate. **10**
What are the assumptions to be made to get the following equation from the above?

$$\nabla^2 t = \frac{1}{\alpha}\frac{\partial t}{\partial \tau}$$

Q3 (A). A counter flow heat exchanger is used to heat water from 20°C to 80°C at a rate of 1.2 kg/s. The heating is obtained by using geothermal water available at 160°C at a mass flow rate of 2 kg/s. **10**
The inner tube is thin walled and has a diameter of 1.5 cm. If the overall heat transfer coefficient is 640 W/m^{2}K. Calculate the length of the heat exchanger required to achieve the desire heating by using effectiveness – NTU method.
Take specific heat of geothermal water as 4.31 kJ/kgK and that of ground water as 4.18 kJ/kgK.

(B). A steam pipe 50 mm diameter and 2.5 m long has been placed horizontally and exposed to still air at 25°C. If the pipe wall temperature is 295°C, determine the rate of heat loss. **10**
At the mean temperature of 160°C, the thermo-physical properties of air are:
K = 3.64 x 10^{-2} W/mK, ν = 30.09 x 10^{-6} m^2/s Pr = 0.682
Use the correlation: **Nu = 0.53 (Gr. Pr)$^{0.25}$**

(1)

(1)

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Q4 (A). A refrigerated truck is moving at a speed of 90 km/hr where the ambient temperature is 60°C. The body of the truck is of rectangular shape of size 10m x 4m x 3m. Assume the boundry layer is turbulent and the wall surface temperature is at 15°C. Neglect heat transfer from vertical front and backside of truck and flow of air is parallel to 10 m long side, calculate the heat loss from the four surfaces. **10**

For turbulent flow over flat surfaces: $\mathbf{Nu = 0.036\ (Re)^{0.8}\ (Pr)^{0.33}}$

Average properties of air at 37.5°C:

$\rho = 1.165$ kg/m^3, Cp = 1.005 kJ / kg.K, $\nu = 16 \times 10^{-6}$ m^2/s, Pr = 0.701,

K = 0.02673 W/m.k

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

Q5 (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 m^3 of rubber at 1 bar. If the gas constant for hydrogen is 4160 J/kgK 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). An aluminium sphere weighing 6 kg and initially at temperature of 360°C is suddenly immersed in a fluid at 30°C with convection heat transfer coefficient of 60 W/m^{2}K. Estimate the time required to cool the sphere to 100°C. **10**

Take thermo-physical properties of sphere as:

K = 205 W/mK, $\rho = 2700$ kg/m^3 and Cp = 900 J/kgK

Q6 (A). Two large parallel plates at temperature 1000 K and 600 K have emissivity of 0.5 and 0.8 respectively. A radiation shield having emissivity 0.1 on one side and 0.05 on the other side is placed between the plates. calculate the heat transfer rate by radiation per square meter with and without radiation shield. **10**

(B). A heat exchanger is required to cool 55,000 kg/hr of alcohol from 66°C to 40°C using 40,000 kg/hr of water entering at 5°C. **10**

Calculate: (a) exit temperature of water, (b) heat transfer rate, (c) surface area required for (i) parallel flow type, (ii) counter flow type of heat exchanger.

1.2 kg/s. The heating is obtained by using geothermal water available at 160°C at a mass flow rate of 2 kg/s.

Take overall heat transfer coefficient as 580 W/m^2.K

Cp (alcohol) and Cp (water) as 3760 and 4180 J/kg.K respectively.

Q7 Answer the following questions (Any Five) **20**

(A) State and explain Kirchhoff's law of radiation

(B) How is the utility of extended surfaces? List the assumptions made while analyzing the heat flow from a finned surface.

(C) What do you mean by critical radius of insulation? Explain its concept with the help of material and surface resistances.

(D) State and Explain Fick's law of diffusion and compare it with Fourier law of conduction.

(E) Explain the difference between convective heat transfer coefficient and overall heat transfer coefficient. Explain significance of Prandtl number and Reynolds number.

(F) What is thermal resistance? What is Newton's law of cooling?

(G) Differentiate between steady & unsteady state heat transfer with proper applications.

T.Y.B. Tech - Sem V
Theory of Machines - II

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End Semester Exam

November 2015

Max. Marks: 100 Duration: 03 Hours

Class: T. Y. B. Tech Semester: V Program: Mechanical Engineering

Name of the Course: Theory of Machines II Course Code : ME 302

Instructions:

1. Question No 1 is compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

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Question No		Maximum Marks
Q1(a)	Explain 1. Internal Expanding Shoe Brake 2. Uniform Pressure Theory	05
(b)	Explain 1. Reverted Gear Train 2. Gyroscopic effect on rolling of Ship	05
(c)	Explain 1. Pickering of Governor 2. Stability of an automobile while moving from a curved path	05
(d)	Explain 1. Balancing of single revolving mass 2. Centrifugal clutch	05
Q2(a)	A cone clutch with semi cone angle is 12.5 degree transmits 15 KW at 500 rpm. The width of the friction surface is 40 % of mean diameter. If the normal pressure between the surface in contact is not to exceed 120 KN/m^2, determine (i) The inner and outer radii of the cone (ii) The axial force required to engage the clutch.	12
(b)	100 KW is transmitted at 3000 rpm by a multiplate disc friction clutch. The plates in oil has a friction surface of steel and phosphor bronze alternatively, μ= 0.07 and the axial intensity of pressure not to exceed 1.5 bar. External radius is 1.25 times the internal radius, and the external radius is 12.5 cm. Determine number of plates needed to transmit the required torque. Assume uniform wear.	08 μ=0.07
Q3(a)	A car moving on a rough inclined plane is having the following data : Angle of inclination of the plane = 15 degree Wheel base of the car = 2m Height of centre of gravity of car above inclined plane = 1 m Perpendicular distance of CG from rear axle = 0.9 m Speed of car = 54 Km/hr Co efficient of friction between tyre and road = 0.6 Brakes are applied to all four wheels. Determine : 1. Distance travelled by the car before coming to rest 2. Time taken in doing so if	15

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	1. The car is moving up the plane 2. The car is moving down the plane.	
(b)	Explain 1. Prony Brake Dynamometer 2. Rope and Brake Dynamometer	05
Q4(a)	In a Porter Governor the links and arms are each 300 mm long. Each ball weights 2.5 kg and the central load is 250 N. For the highest and the lowest position of the sleeve , the arms are inclined at 40 degree and 30 degree respectively to the vertical. The friction at the governor and the mechanism connected to the valve is equivalent to a force of 25 N at the sleeve. Assuming that the links and arms intersect on the axis, find : 1. The travel of the sleeve 2. Minimum ascending speed 3. Maximum descending speed 4. Range of speed of the governor.	16
(b)	Difference between Porter and Proell governor.	02
(c)	Define the following terms relating to governors : 1. Sensitiveness 2. Isochronism	02
Q5	A ship is propelled by a turbine rotor having a mass of 6000 kg and speed of 2400 rpm. The direction of rotation of rotor is anticlockwise when viewed from the bow end. The radius of gyration of rotor is 450 mm. Determine the gyroscopic effect when : 1. Ship is steering to the left in a curve of 60 m radius at a speed of 18 knots (1 knot = 1860 m/hr). 2. Ship is pitching in SHM with bow descending (falling) with maximum velocity. The time period of pitching is 18 seconds and the ship pitches 7.5 degree above and 7.5 degree below the normal position. 3. Ship is rolling and at the instant, its angular velocity is 0.035 rad / sec counter clockwise when viewed from stern 4. Also find the maximum angular acceleration during pitching.	20
Q6(a)	Two parallel shafts are to be connected by spur gearing. The approximate distance between the shafts is 600 mm. If one shafts runs at 120 rpm and the other at 360 rpm, find the number of teeth on each wheel if the module is 8 mm. Also determine the exact distance apart of shafts.	10
(b)	Draw a neat sketch of compound gear train involving six gears and calculate the reduction ratio assuming suitable number of teeth.	04
(c)	In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed makes 300 rpm in the clockwise direction, What will be the speed of gear B ?	06
Q7(a)	Three masses M1, M2 and M3 which rotate in transverse planes 1 ,2,and 3 are to be balanced by the addition of two rotating masses mA in plane A and mB in plane B at a radius of 250 mm each. Given that M1 = 4.0 kg, M2 = 6.4 kg and M3 = 2.0 kg. The location of centre of gravity of masses M1, M2 and M3 are 150 mm, 100mm and 225 mm respectively, from the rotor axis. Also, the angular location of masses M1, M2 and M3 from x axis are 30 degree, 300 degree and 135 degrees respectively as shown in figure	15

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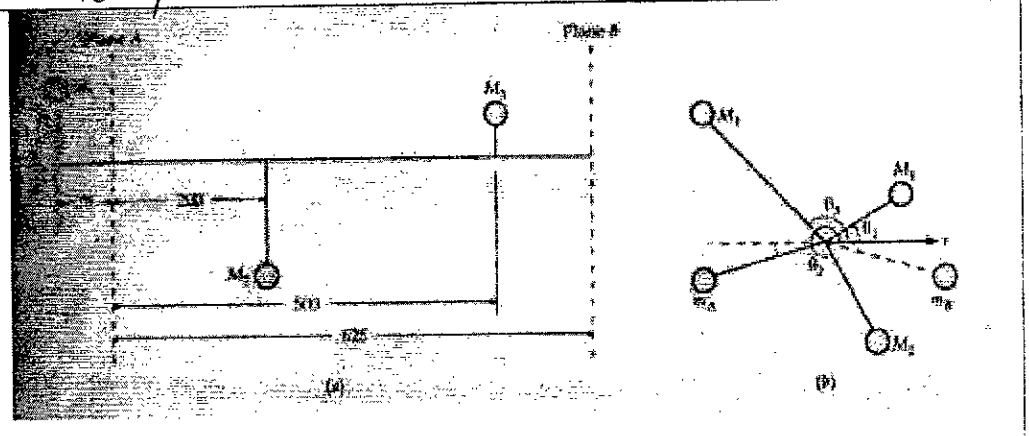
Theory of Machines - II Dt. 18/11/15.

	 The distance of transverse planes of masses M1. M2, M3 and planes B from the reference transverse plane A, are 75 mm, 200mm, 500 mm and 625 mm respectively. Determine mA and mB and show their angular positions for static balance of motor.	
(b)	Explain Balancing of 1. In Line Engine 2. V Engine	05

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T.Y. Tech. (Mech) Sem VI
Mechatronics.

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End Semester Exam
November 2015

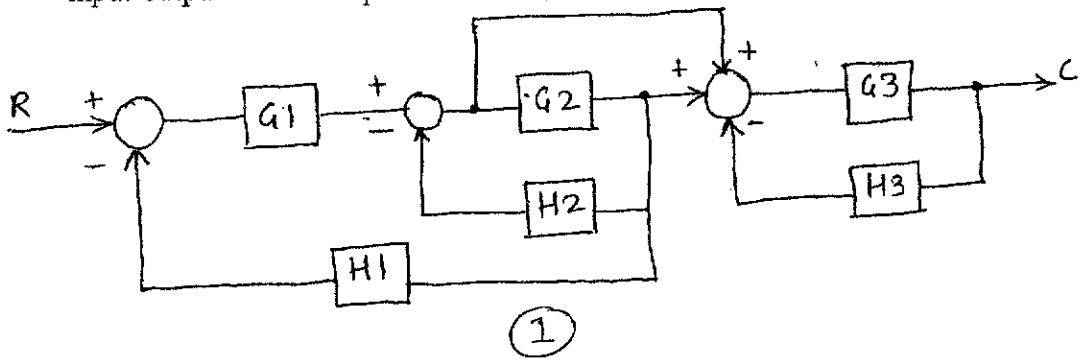
Class: T Y. Tech. (Mechanical) Semester: VI
Program: B. Tech. (Mechanical Engineering) Name of the Course: Mechatronics
Course Code: ME303 Duration: 3 Hrs
Maximum Marks: 100

Instructions:

Master file.

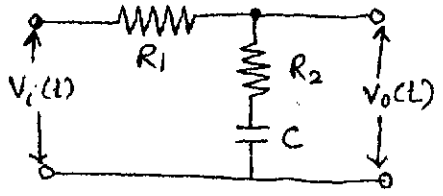
1. **Attempt any five questions out of Seven**
2. **Draw neat diagrams**
3. **Assume suitable data if necessary**

Q.1	a	Explain the applications of Mechatronics in Office,Home and Industry also discuss the objectives of Mechatronics	10
	b	Explain Mechatronics Design Process in detail	05
	c	Develop a Functional Block diagram of Bottle filling Plant	05
Q.2	a	Explain interfacing of Stepper motor and LCD	10
	b	Explain Memory Organization of 8051	05
	c	Describe different component of 8085	05
Q.3	a	Explain different PLC Programming Methods	10
	b	Develop A+B+ A-B-	05
	c	Develop Time Delay Circuits	05
Q.4	a	Using block diagram reducing technique for the system shown in fig. Find the input-output relationship	10



T.Y.Tech (Mech) Sem ~~V~~ VI
Mechatronics - Dt. 20/11/15

Q.4 b Determine the Transfer Function of the phase lag network shown in fig 05



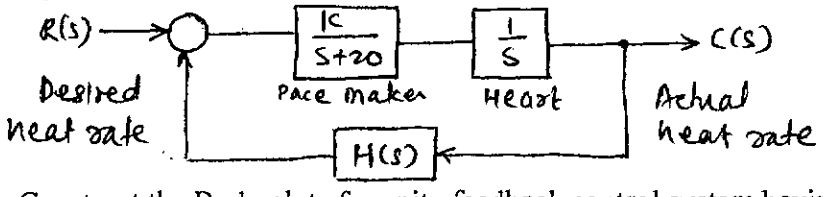
c Explain the Time response specifications 05

Q.5 a Predict the Root Locus for the system having 10

$$G(s)H(s) = \frac{1}{S(S+2S+2)}$$

b Evaluate stability using Routh Criteria $S^8+5S^6+2S^4+3S^2+1=0$ 5

c The block diagram of an electronic pace maker for controlling the rate of heart beats is shown in fig.Asuming unity feedback and K=400,calculate a)the output c(t) for unit step input, b)steady state error for unit ramp input,c)determine K if the error to a ramp input is 0.02 5



Q.6 a Construct the Bode plots for unity feedback control system having 10

$$G(s) = \frac{2000}{S(S+1)(S+100)}$$

From the plots determine,
a) Gain crossover frequency b)Phase crossover frequency c)Gain margine d) Phase margine . Comment on Stability of the system

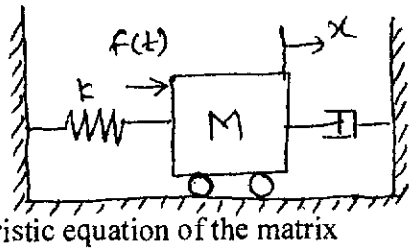
b The open loop transfer function of a unity feedback system is 05

$$G(s) = \frac{4}{S(S+1)}$$

Determine the nature of response of the closed-loop system for a unit-step input.Also determine the rise time,peak time, peak overshoot and settling time.

c Derive the equation of steady state error 05

Q.7 a Obtain the state model for the mechanical system given in fig. 10



b Obtain characteristic equation of the matrix 05

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

c A system is represented by the following dynamic equations : 05

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \qquad y = \begin{bmatrix} 1 & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Determine the transfer function (2)

T.E. (Mech) Sem V
Thermal Systems.

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End Semester Exam
November 2015

Max. Marks: 100 Duration: 3 Hours
Class: T.E.(Mechanical) Semester: V Program: B. Tech
Name of the Course: Thermal Systems Course Code : ME304

Instructions:

1. Question No 1 is compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary
5. Use of steam table and Mollier chart is permitted.

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Question No		Maximum Marks
Q1(a)	Show that the cylinder clearance does not affect the theoretical work required to compress and deliver 1 kg of air, provided that the suction and delivery pressure remain same and indices of compression and expansion have the same value.	05
(b)	Dry saturated steam is passed at 7 bar through a convergent-divergent nozzle. The throat cross-sectional area is 4.5 cm^2. Find the mass of steam passing through the nozzle per minute	05
(c)	On which ideal cycle steam power plants work? Draw schematic and T-s diagram.	05
(d)	Discuss advantages and disadvantages of gas turbine over internal combustion engines.	05
Q2(a)	Prove that for nozzle the condition of pressure ratio for maximum discharge is given by: $$\frac{P_2}{P_1} = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$$	08
(b)	A two-stage double acting air compressor, operating at 200 RPM takes in air at 1.013 bar and 27°C. The size of L.P. cylinder is 350 x 380 mm; the stroke of H.P. cylinder is same as that of L.P. cylinder and the clearance of both the cylinders is 4 % of respective stroke. The L.P. cylinder discharges the air at a pressure of 4.052 bar. The air passes through the inter-cooler so that it enters the H.P. cylinder at 27°C and 3.850 bar, finally it is discharged from the compressor at 15.4 bar. The value of n in both cylinders is 1.3. C_p = 1.0035 kJ/kgK and R = 0.287 kJ/kg-K. Calculate (i) the heat rejected in the inter-cooler, (ii) the diameter of H.P. cylinder and (iii) the power required to drive H.P. cylinder.	12
Q3(a)	Discuss methods adopted for increasing isothermal efficiency of compressor. Also explain what is multi-staging of compressors.	10

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(b)	Prove that optimum blade speed ratio (ρ) for single stage impulse turbine for maximum efficiency is given by: $\rho = (\cos \alpha)/2$ where α is nozzle angle.	10
Q4(a)	Draw a neat diagram of Cochran boiler and explain its working.	10
(b)	Explain what are boiler mountings and accessories. Explain with neat sketch spring loaded safety valve.	10
Q5(a)	Explain the phenomenon of surging and chocking in centrifugal compressors.	10
(b)	Draw a neat sketch of non-mixing type surface condenser and explain its working.	10
Q6(a)	Explain the methods of reducing wheel or rotor speed of steam turbines.	08
(b)	The mean diameter of the blades of an impulse turbine with a single row wheel is 105 cm and the speed is 3000 RPM. The nozzle angle is 18° and ratio of blade speed to steam speed is 0.42. Also the ratio of relative velocity at the outlet from the blades to that of the inlet is 0.84. The outlet angle of the blade is 3° less than the inlet angle of the blade. The steam flow is 8 kg/sec. Determine (i) Resultant thrust on the blades (ii) Power developed in the blades (iii) Blade efficiency.	12
Q7(a)	Explain regenerative type open cycle gas turbine with neat sketch.	04
(b)	A 2000 kW open cycle stationary plant is to have one inter-cooler, one reheater and a regenerator. On one shaft, the high pressure turbine drives the low pressure compressor. On another shaft, the low pressure turbine drives the high pressure compressor and the load. The following data may be assumed: (Neglect mass of fuel) Ambient pressure = 1.00 bar Ambient temperature = 300 K Maximum cycle temperature = 1000 K Pressure ratio of each stage of compression = 2.5 Turbine and compressor efficiencies = 82 % Pressure drop in each heater and each side of regenerator = 3 %. Regenerator effectiveness = 75 %. Assume intercooling to ambient temperature and reheating to maximum cycle temperature. Sketch the flow diagram, index all state points. Calculate these state points and the necessary ideal states. Calculate the thermal efficiency and air rate. Find the power of each turbine and compressor. If the fuel used has 43000 kJ/kg heating value and that the combustion efficiency is 97 % calculate the fuel used per hour at rated load and specific fuel consumption.	16

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T.Y.B.Tech (Mech) sem V
Hydraulic Machinery.

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End Semester Exam

November 2015

Maximum Marks: 100 **Duration: 3 Hrs**

Class: **T.Y. B. Tech. (Mechanical)** Semester: **V**

Program: **B. Tech. (Mechanical Engineering)**

Name of the Course: **Hydranlic Machinery**

Course Code: **ME305**

Instructions:

1. **Question No 1 is compulsory.**
2. **Attempt any four questions out of remaining six.**
3. **Draw neat diagrams**
4. **Assume suitable data if necessary**

Master file.

Question No.		Max. Marks
1. (a)	Match the followings (Hydraulic Machineries with its working principle/characteristic feature) Centrifugal Pump — Impulse turbine Gear Pump — Axial flow reaction turbine Pelton Turbine — Medium specific speed reaction turbine Francis Turbine — Positive displacement Pump Kaplan Turbine — Rotodynamic Pump	(05)
(b)	What is negative slip in reciprocating pump? Explain the same with the help of indicator diagram.	(05)
(c)	Explain cavitation in turbines? Suggest methods to avoid cavitation in turbine	(05)
(d)	Draw rough nature of Head-Discharge (Hm Vs Q) characteristics of forward faced, radial, and backward faced impeller outlet vane angle of centrifugal pump. Explain why generally centrifugal pump impeller with backward faced outlet vane angle is preferred in design?	(05)
2. (a)	Manometric head discharge characteristics of a centrifugal pump is given by the equation: $Hm=20+15Q-600Q^2$ Where Hm is in m and Q is in m^3/s. System curve for a typical installation is estimated as $10+900Q^2$ (Q is in m^3/s), where 10 is static head in m. If the NPSHR characteristics of the pump is given by equation: $NPSHR=20Q+60Q^2$ where Q is in m^3/s, evaluate how high the pump can be safely installed above the	(10)

	sump if suction pipe diameter is 15 cm, pipe length on suction side is 1.5 times static suction lift and 'f' for the pipe is 0.016. Evaluate the cavitation parameter 'σ' if pump runs at 1440 rpm and operates at duty point. Calculate the specific speed and suction specific speed.	
(b)	A single jet Pelton turbine is required to drive a generator to develop 10000 KW. The available head at the nozzle is 760 m. Assuming electric generation efficiency 95%, Pelton wheel efficiency 87%, coefficient of velocity for nozzle 0.97, mean bucket velocity 0.46 of jet velocity, outlet angle of bucket 15^0 and the relative velocity of the water leaving the buckets 0.85 of that relative velocity at inlet, find: (i) The flow in m^3/s; (ii) The diameter of jet, (iii) The force exerted by the jet on the buckets, and (iv) The best synchronous speed for generation at 50Hz and the corresponding mean diameter if the ratio of the mean bucket circle diameter to the jet diameter is not to be less than 10.	**(10)**
3 (a)	Show that the hydraulic efficiency for a Francis turbine having velocity of flow through runner as constant, is given by the relation: $$\eta_h = \frac{1}{1+\frac{0.5\tan^2\alpha}{\left(1-\frac{\tan\alpha}{\tan\theta}\right)}}$$ where, α=guide blade angle at inlet, θ=runner vane angle at inlet. The turbine is having radial discharge at outlet. Also show that if the vanes are radial at inlet, then $$\eta_h = \frac{2}{2+\tan^2\alpha}$$	**(10)**
(b)	The impeller of a centrifugal pump has an outer diameter of 250 mm and an effective area of 0.017 m^2. The blades are bent backwards so that the direction of outlet relative velocity makes an angle of 148^0 with the tangent drawn in the direction of impeller rotation, the diameters of suction and delivery pipes are 150 mm and 100 mm respectively. The pump delivers 0.031 m^3/s at 1450 rpm when the gauge points on the suction and delivery pipes close to the pumps shows heads of 4.6 m below and 18 m above atmosphere respectively. The head losses in the suction and delivery pipes are 2 m and 2.9 m respectively. The motor driving the pump delivers 8.67 KW. Assuming that water enters the pump without shock and whirl, determine: (i) The manometric efficiency, and (ii) The overall efficiency of the pump.	**(10)**
4 (a)	The diameter and stroke of a single-acting reciprocating pump are 300 mm and 500 mm respectively. The pump takes its supply of water from a sump 3.2 m below the pump axis through a pipe 9 m long and 200 mm diameter. If separation occurs at 2.4 m of water absolute, determine: (i) The speed at which separation may take place at the beginning of suction	**(10)**

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Hydraulic Machinery - Dt. 26/11/15

	stroke, and (ii) The speed of the pump if an air vessel is fitted on the suction side 6.75 m along the length measured from the sump water level. Take atmospheric pressure head=10.3 m of water, and friction co-efficient, f=0.04 (Take $h_f=flv^2/2gd$).	
(b)	The critical Thoma cavitation parameter 'σ_{cr}' for a certain type of turbine varies in the following manner: Ns (power in KW) | 0 | 50 | 100 | 150 | 200 | 250 σ_{cr} | 0 | 0.04 | 0.1 | 0.18 | 0.28 | 0.41 The turbine runs at 300 rpm under a net head of 50 m and produces 2MW of power. If the runner is placed 4.7 m above the tail water level, will the turbine cavitate? Take saturation vapour pressure to be 0.04 bar absolute and atmosphere pressure to be equivalent to 10.3 m of water. What is the maximum safe height at which the turbine can be placed with reference to the tail race level?	**(10)**
5 (a)	Tests on a centrifugal pump gave the following results:- Q (lpm) | 0 | 200 | 400 | 600 | 800 | 1000 Hm (m) | 9.5 | 9.15 | 8.2 | 6.8 | 5.2 | 2 The pump supplies to two reservoirs A and B. The common pipe upto junction J is 300 m long and 15 cm diameter. The pipe from junction J to reservoir A is 150 m long and 10 cm diameter. The pipe from junction J to reservoir B is 100 m long and 10 cm diameter. The coefficient of friction for all pipes is 0.025 $\left(h_f=\frac{flv^2}{2gd}\right)$. The water levels in reservoir A and B are 4.6 m and 5.75 m above the suction tank level. Estimate the discharge to reservoirs A and B.	**(10)**
(b)	A hydro-turbine is required to give 25 MW at 50 m head and 90 rpm runner speed. The laboratory facilities available permit testing of 20 KW model at 5m head. What should be the model runner speed and model to prototype scale ratio?	**(10)**
6 (a)	The following data pertain to a Francis turbine: Net head=70 m, Speed=700 rpm, Shaft Power =330 KW, Overall efficiency=85%, Hydraulic efficiency=92% Flow ratio=0.22, Breadth ratio=0.1, Outer diameter of runner=2x inner diameter of runner Velocity of flow is constant with radial discharge at outlet. The thickness of vanes occupy 6% of circumferential area of the runner. Determine: (i) Diameters of runner at inlet an outlet (ii) Width of the wheel at inlet, (iii) Guide blade angle, and (iv) Runner vane angles at inlet and outlet.	**(10)**
(b)	Write short note on (i) Gear Pump (ii) Selection of turbines	**(10)**
7 (a)	In water power site, the available discharge is 340 m^3/s under a net head of 30 m. Assuming a turbine efficiency of 88% and rotational speed of 166.7 rpm, determine the least number of machines, all of the same size, that may be	**(10)**

T.Y.B.Tech. (Mech) sem V
Hydraulic Machinery Dt. 26/11/15

	installed if the selection rests with- (i) Francis turbine with Ns not greater than 230. (ii) Kaplan turbine with Ns not greater than 685, What will be the output of each unit? Which of the two installations will be more economical?	
(b)	Test on single stage centrifugal pump at 1450 rpm gave the following results:-	**(10)**

Q (m^3/s)	0	0.006	0.012	0.018	0.024	0.030	0.036
Hm (m)	22.6	21.9	20.3	17.7	14.2	9.7	3.9

When two such identical pumps are connected in parallel, the flow rate through the system is the same as when they are connected in series. Determine the flow rate that the individual pump would deliver if connected to the same system. Assume that the system characteristic is purely resistive with no static lift.

(4)

T.E - (Mech) Sem V, Dt - 28/11/15
Environmental Engineering & Management System.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Exam

November 2015

Max. Marks:50 Duration: 2HR

Class:TE(MECH) Semester:V Program: Mechanical Engineering.

Name of the Course: **Environmental Engineering and management System**

Course Code : **ME -306**

Master file.

Instructions:

1. Question No 1 is compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Q1(a)	Describe fundamental PRINCIPLES of GRIHA building in detail.	5
(b)	Write importance of management review in ISO 14001.	4
(c)	What is Eutrophication of Lakes? Describe with suitable diagram?	5
Q2(a)	State the method of disposal of waste. Also discuss of the concept of "energy recovery from waste".	4
(b)	What is concept used to build ISO 14001? Draw its frame? What is continual improvement in ISO 14001?	5
Q3(a)	Write power of central government to protect and improve the quality of environment.	3
(b)	Name the process which removes air from indoor space. Why this process required In building? Describe in detail about this process.	6
Q4(a)	Describe in detail ground water pollution. How we prevent ground water pollution?	4
(b)	Write different type of Community diversity in biodiversity. Describe in detail each of them.	5
Q5(a)	Organization whose aim is "To ensure that international trade in specimens of wild animals and plants do not threaten their survival" write the name of organization? How this organization work.	4
(b)	Why there is need of research and Training on Biological Diversity? Describe in detail about In-situ and Ex- situ conservation.	5
Q6(a)	Describe 'R' philosophy of sustainable development that use in constructing GRIHA building.	3
(b)	Describe Identification and Monitoring procedure for conserving biological species.	3
(c)	Write a short note on sick building syndrome.	3
Q7(a)	Suppose you appointed as GRIHA Engineer from Government of India, your work is to give plan for constructing govt. Company according to GRIHA criteria. Describe your plan in detail.	7
(b)	Describe SITE SELECTION AND SITE PLANNING criteria for GRIHA Building.	2

Lib Re-Exam
07/11/16

T.E (Mech) Sem V
Thermal systems.

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- JANUARY2016

CLASS/SEM: **T.E. (Mechanical)/V** TOTAL MARKS:**100**
SUBJECT: **Thermal Systems (ME-304)** DURATION: **3 HOUR**

Master file.

1. Question no **One** is compulsory.
2. Answer any **Four** questions out of **Six** questions.
3. Figures to the right indicate full marks.
4. Assume suitable data and justify the same.
5. Use of steam table and Mollier chart is permitted.

Q.1 Answer any Four of the followings **[20]**
(a) Explain multistaging of reciprocating air compressor.
(b) Differentiate between high and low pressure boiler.
(c) Differentiate between impulse and reaction turbine.
(d) Discuss different applications of gas turbine
(e) Discuss different applications of compressed air.

Q.2 (a) Derive the condition of intermediate pressure for minimum work per kg of air delivered by two stage compressor with intercooler. **[08]**

(b) A double acting two stage compressor delivers air at 25 bar. The pressure and temperature of the air at the beginning of compression in L.P. cylinder are 1 bar and 20°C. The temperature of air coming out from the inter-cooler between the two stages is 40°C and pressure is 7 bar. The diameter and stroke of L.P. cylinder are 60 cm and 80 cm respectively and RPM of the compressor is 100. The volumetric efficiency of both stages is 80%. Neglecting the pressure losses in the system, find the kW of an electric motor required to drive the compressor assuming the mechanical efficiency of 85%. Take the law of compression and expansion in both stages as $pv^{1.35}$ = constant. **[12]**

Q.3 (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]**

Q.4 (a) Explain evaporative 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]**

T.E.(Mech) sem V
Thermal Systems. Dt. 07/01/16.

Q.5 (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.6 (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.7 (a) Derive expression for optimum pressure ratio for maximum specific work output in actual simple gas turbine. **[08]**

(b) Air enters at 1 bar and 15°C into the compressor of a constant pressure open cycle gas turbine plant and leaves the compressor at 6 bar. Temperature of the gases entering the tubine is 700°C, pressure loss in the combustion chamber is 0.1 bar, efficiency of compressor and turbine is 80%. Also the combustion efficiency is 90%. By taking $\gamma = 1.4$ and $C_p = 1$ kJ/kg.K for air and gases Find (i) the quantity of air circulation in the system if the plant develops 940 kW (ii) Heat supplied per kg of air circulation and (iii) The thermal efficiency of the cycle. Neglect the mass of fuel. **[12]**

LiD – Re-Exam
08-01-16

T.Y.B.Tech (Mech) Sem V
Hydraulic Machinery

BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Re-Examination

January 2016 (Re-examination)

Maximum Marks: 100 **Duration: 3 Hrs**

Class: **T.Y. B. Tech. (Mechanical)** Semester: **V**

Program: **B. Tech. (Mechanical Engineering)** Master file.

Name of the Course: **Hydraulic Machinery**

Course Code: **ME305**

Instructions:

1. **Question No 1 is compulsory.**
2. **Attempt any four questions out of remaining six.**
3. **Draw neat diagrams**
4. **Assume suitable data if necessary**

Question No.		Max. Marks
1. (a)	List elements of hydro-electric power plant and explain advantages of hydroelectric power plant over other power plants.	(05)
(b)	Draw only the nature of indicator diagram for reciprocating pump having air-vessel connected on both suction and delivery side of the pump, at some distance away from the cylinder.	(05)
(c)	Explain only the need of governing of turbine.	(05)
(d)	With neat sketch explain working principle of centrifugal pump.	(05)
2. (a)	A centrifugal pump has a suction pipeline of 12.5 cm diameter and 10 m length. The static suction lift is 2m. Friction factor for pipe is 0.02. The pump delivers oil of specific gravity 0.8, the vapour pressure for oil at ambient temperature being 0.015 kg/cm^2 absolute. The NPSH characteristic of the pump is given by the equation $15Q+65Q^2$ where NPSH is in meters of water column absolute and Q is in m^3/s. If the ambient pressure is 1 bar (abs) determine the maximum discharge the pump can handle without cavitating.	(10)
(b)	A single jet Pelton wheel runs at 300 rpm under a head of 510 m. The jet diameter is 200 mm, its deflection inside the bucket is 165^0 and its relative velocity is reduced by 15% due to friction. Determine: (i) Water power (ii) Resultant force on the bucket, and (iii) Overall efficiency. Take: Mechanical losses=3%, co-efficient of velocity=0.98, and speed ratio=0.46. (1)	(10)

T.Y.B.Tech.(Mech) Sem V
Hydraulic Machinery. Dt. 08/01/16.

3 (a) In an inward flow reaction turbine the head on the turbine is 32 m. The external and internal diameters are 1.44 m and 0.72 m respectively. The velocity of flow through the runner is constant and equal to 3 m/s. The guide blade angle is 10^0 and the runner vanes are radial at inlet. If the discharge at outlet is radial, determine: (i) The speed of the turbine (ii) The vane angle at outlet of the runner, and (iii) Hydraulic efficiency. **(10)**

(b) A centrifugal pump impeller, having outlet diameter 0.35 m is running at 960 rpm. The velocity of flow (assumed constant throughout the system) is equal to 2.4 m/s. The vane angle at outlet is 28^0. The static suction lift is 4.03 m. The energy losses in suction pipe, impeller and volute casing are 0.88 m, 0.70 m and 1.26 m of water respectively. Determine the readings of vaccum or pressure gauges placed at: **(10)**
(i) Inlet to the pump, (ii) Impeller outlet (in clearance between impeller and outlet), and (iii) Pump outlet or deliver flange, 0.24 m above the centerline of the pump.

4 (a) A single acting reciprocating pump has a diameter (piston) of 150 mm and stroke length 350 mm. The centre of the pump is 3.5 m above the water surface in the sump and 22 m below the delivery water level. Both the suction and delivery pipes have same diameter of 100 mm and are 5 m and 30 m long respectively. If the pump is working at 30 rpm, determine: (i) The pressure heads on the piston at the beginning, middle, and end of the both suction and delivery strokes. **(10)**
(ii) The power required to drive the pump. Take atmospheric pressure as 10.3 m of water.

(b) A Kaplan turbine installation develops 18 MW under a net head of 14 m. The peripheral speed of the runner at the outermost radius is 40 m/s. The Thoma's cavitation parameter σ is related to the specific speed (power in KW) as given below: **(10)**

σ	0.5	0.75	1.25	1.8
Ns	385	515	685	857

What should be the minimum outer diameter of the runner if the turbine is set at 0m, 3 m from the tail water level?
Vapour pressure of water at ambient temperature is 0.026 kg/cm^2 (abs) and the atmospheric pressure is 1.03 kg/cm^2. [Extrapolate the graph if required].
Diameters are to be calculated for the nearest synchronous speed.

5 (a) A pump has the following characteristics when running at 1425 rpm **(10)**

Q (m^3/s)	0	0.225	0.335	0.425	0.545	0.65	0.75
H (m)	20	17	15	13	10	7	3

At zero head the discharge is 0.8 m^3/s. A system is designed where the static lift is 5 m and the operating point is H= 11.1 m and Q= 0.5 m^3/s for the above pump. The system is redesigned, the static lift being 5 m as before but the frictional and other losses increase by 40%.
Find the new pump speed so that the flow rate of 0.5 m^3/s can be maintained.

T.Y.B.Tech (Mech) Sem V
Hydraulic Machinery. Dt. 08/01/16.

(b) A 1/5 scale turbine model is tested under a head of 15 m. The actual turbine will work under head of 30 m and speed of 450 rpm. If model develops 100 KW of power using 1.1 m^3/s of water, then calculate: (i) speed of the model turbine (ii) Power developed by prototype **(10)**

6 (a) A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20^0 and 60^0 respectively with the tangential velocity. The turbine is having radial discharge at outlet. Determine (i) The volume flow rate, (ii) The power developed, and (iii) The hydraulic efficiency. **(10)**

(b) Write short note on (i) Selection of turbines (ii) Cavitation in turbines **(10)**

7 (a) In water power site, the available discharge is 340 m^3/s under a net head of 30 m. Assuming a turbine efficiency of 88% and rotational speed of 166.7 rpm, determine the least number of machines, all of the same size, that may be installed if the selection rests with- **(10)**
(i) Francis turbine with Ns not greater than 230.
(ii) Kaplan turbine with Ns not greater than 685,
What will be the output of each unit? Which of the two installations will be more economical?

(b) Table below shows head, discharge and efficiency of a centrifugal pump running at constant speed of 800 rpm. It delivers water through a static head of 16 m. The total length of pipe is 1200 m and the pipe diameter is 280 mm. Find the discharge and the input power when –(i) only one pump working, (ii) when two such pumps are working in parallel. Take f=0.026. **(10)**

Q (lpm)	0	1000	2000	3000	4000
Hm (m)	28.2	27.9	26.55	23.4	17.55
H (%)	0	48.5	72	75	71

(3)

Re. Exam - Lib
09-01-16

T.E.(Mech) Sem V
Environmental Engg. & management System.

BharatiyaVidyaBhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Re-Exam
January 2016

Max. Marks:50 Duration: 2 hours

Class: TE (MECH) Semester: V Program: Mechanical Engineering.

Name of the Course: **Environmental Engineering and management System**

Course Code : **ME -306**

Master file.

Instructions:

1. **Question No 1 is compulsory.**
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Q1(a)	Organization whose aim is "To ensure that international trade in specimens of wild animals and plants do not threaten their survival" write the name of organization? How this organization work.	5
(b)	What are the points that need to be consider while defining environmental policy statement of an organization.	4
(c)	Describe in detail Seventh Schedule to the Constitution of India.	5
Q2(a)	State the method of disposal of waste. Also discuss of the concept of "energy recovery from waste".	4
(b)	What is concept used to build ISO 14001? Draw its frame? What is continual improvement in ISO 14001?	5
Q3(a)	Write power of state government to protect and improve the quality of environment.	3
(b)	Name the process which removes air from indoor space. Why this process required In building? Describe in detail about this process.	6
Q4(a)	Describe in detail ground water pollution. How we prevent ground water pollution?	4
(b)	Write different type of Community diversity in biodiversity. Describe in detail each of them.	5
Q5(a)	Describe fundamental PRINCIPLES of GRIHA building in detail.	4
(b)	Why there is need of research and Training on Biological Diversity? Describe in detail about In-situ and Ex- situ conservation.	5
Q6(a)	Describe 'R' philosophy of sustainable development that use in constructing GRIHA building.	3
(b)	What is Biochemical oxygen demand? Draw figure clearly mentioning different zone in it.	3
(c)	What causes acid rain? How does it affect the environment? What is acid mine drainage?	3
Q7(a)	Suppose you appointed as GRIHA Engineer from Government of India, your work is to give plan for constructing govt. Company according to GRIHA criteria. Describe your plan in detail.	7
(b)	Write Potential list of environmental aspects?	2

Lib – Re-Exam
04-01-16

T.Y.B.Tech, Sem V (Mech)
Heat & Mass Transfer

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Re-Exam, Jan 2016

Max. Marks: **100** Duration: **3 Hrs.**
Class: **T. Y. B. Tech.** Semester: **V** Program: **Mechanical Engineering**
Name of the Course: **Heat and Mass Transfer** Course Code : **ME 301**

Instructions:

1. **Question No 1 is compulsory.**
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary
5. **Data Book Photocopies are allowed**

master file.

Q1. **Answer the following questions (Any Four)** **20**

(A). What is a radiation shield? Where is it used?

(B). Explain velocity and thermal boundary layer.

(C). Define Thermal Conductivity and explain its physical significance.

(D). Explain different types of modes of Mass Transfer.

(E). Differentiate between natural and forced convection.

Q2 (A). A furnace wall is of three layers, first layer of insulation brick of 12 cm thickness of conductivity 0.6 W/mK. The face is exposed to gases at 870°C with a convection coefficient of 110 W/m^{2}K. This layer is backed by a 10 cm layer of firebrick of conductivity 0.8 W/mK. There is a contact resistance between the layers of 2.6 × 10^{-4} m^2 °C/W. The third layer is the plate backing of 10 mm thickness of conductivity 49 W/mK. The contact resistance between the second and third layers is 1.5 × 10–4 m^2 °C/W. The plate is exposed to air at 30°C with a convection coefficient of 15 W/m^{2}K. Determine the heat flow, the surface temperatures and the overall heat transfer coefficient. **10**

(B). Give the assumptions to solve this derivation. 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**

Q3 (A). Steam enters a counter-flow heat exchanger, dry saturated at 10 bar and leaves at 350°C. The mass flow of steam is 800 kg/min. The gas enters the heat exchanger at 650°C and mass flow rate is 1350 kg/min. If the tubes are 30 mm diameter and 3 m long, determine the number of tubes required. Neglect the resistance offered by metallic tubes. Use the following data: **10**

For steam: t_{sat} = 180°C (at 10 bar); C_{ps} = 2.71kJ/kg°C; h_s = 600 W/m^2°C
For gas: C_{pg} = 1kJ/kg°C; h_g = 250 W/m^2°C

(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. **10**

Using equation: $\mathbf{Nu = 0.6\,\{(Gr.\ Pr)^{0.25}}$ (1)

T.Y. B.Tech. (Mech) Sem V

Heat & Mass Transfer Dt. 04/01/16.

Take properties of air at bulk mean temperature 75°C:
k = 0.03 W/mK, v = 20.55 × 10^{-6} m^2/s, Pr = 0.693

Q4 (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 53°C. **10**

K = 0.653 W/mk, ρ = 985.5 kg/m^3, v = 0.517 x 10^{-6} $\frac{m^2}{s}$ Cp = 4.19 kJ / kg.K

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

(B). A domestic hot water tank, 0.5 m diameter and one meter high, is located in a large space effectively forming black surrounding. The surface emissivity and temperature are 0.8 and 350 K, and the temperature of surrounding is 295 K. Estimate the heat loss by radiation from the tank, and suggests a possibility to reduce this heat loss. **10**

Q5 (A). Estimate the diffusion rate of water from the bottom of a test tube 1.5 cm in diameter and 15 cm long into dry atmospheric air at 25°C. **10**
Take D = 0.256 cm^2/sec

(B). A person is found dead at 5 pm in a room where temperature is 20°C. The temperature of the body is measured to be 25°C when found, and the heat transfer coefficient is estimated to be 8 W/m^2K. Modelling the human body 30 cm diameter, 1.70 m long cylinder, calculate actual time of death of the person. **10**
Take thermo-physical properties of sphere as:
K = 6.08 W/mK, ρ = 900 kg/m^3 and Cp = 4000 J/kgK

Q6 (A). A cubical room 4m x 4m x 4m is heated through the ceiling by maintaining it at uniform temperature of 350 K, while walls and the floor are at 300 K. Assuming that the all surfaces have an emissivity of 0.8, determine the rate of heat loss from ceiling by radiation. **10**

(B). Water at the rate of 3.783 kg/s is heated from 38 to 55°C in a shell and tube heat exchanger. On the shell side one pass is used with water as the heating fluid, 1.9 kg/s, entering the exchanger at 93°C. The overall heat transfer coefficient is 1420 W/m^2K and the average water velocity in the 1.9 cm diameter tubes is 0.37 m/s. Because of space limitations the tube length must not be longer than 2.5 meter. Calculate the number of tube passes, the number of tubes per pass, and the length of tubes, consistent with this restriction. **10**
Use heat transfer data book to calculate correction factor.

Q7 **Answer the following questions (Any Four)** **20**

(A) Define absorptivity, reflectivity, transmissivity and emissivity.

(B) What is meant by thermal contact resistance? Upon what parameters does this resistance depend?

(C) What is the physical significance of the thermal diffusivity? How it is defined and what is its unit?

(D) What important boundary layer parameters are linked by the Reynoids analogy?

(E) Why are baffles used in a shell-and-tube heat exchanger? What effect does fouling have on the overall heat transfer coefficient and hence the performance of a heat exchanger?

(F) What is the physical interpretation of the Biot number and Fourier number?

T.Y.B.Tech.(Mech) Sem V
Theory of Machine - II

Lib – Re-Exam
05-01-16

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

Re Exam
January 2016

Max. Marks: **100** Duration: **3 Hours**
Class: TY B.Tech Semester: V Program: **Mechanical Engg.**
Name of the Course: **Theory of Machine -II** Course Code : **ME302**

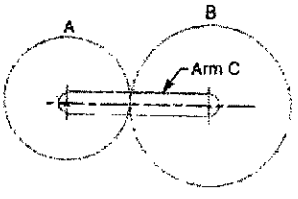
- Question No 1 is compulsory.
- Attempt any four questions out of remaining six
- Answers to all sub questions should be grouped together
- Figures to the right indicate full marks
- Assume suitable data if necessary

Master file.

Q.1
a) What do you mean by gear train? List down all types of gear train and give one application of each. **(20)**
b) Explain Dynamometer. Classify the same. How a dynamometer does differs from brake?
c) Explain the concept of ship stabalisation with gyroscopic effect
d) Explain the following terms related to governors:
i. Stability ii. Sensitivity iii. Isochronism iv. Hunting

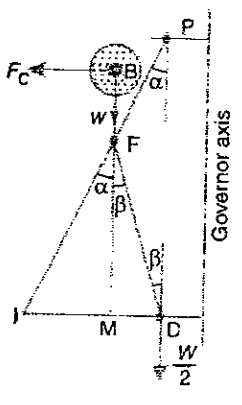
Q.2
a) The four masses A, B, C and D are 100 kg, 150 kg, 120 kg and 130 kg attached to a shaft and revolve in the same plane. The corresponding radii of rotations are 22.5 cm, 17.5 cm, 25 cm and 30 cm and the angles measured from A are 45°, 120° and 255°. Find the position and magnitude of the balancing mass, if the radius of rotation is 60 cm. **(12)**
b) What is condition for static balancing of a shaft rotor system? **(01)**
(i) $\Sigma M = 0$ and $\Sigma F = 0$ (ii) $\Sigma M = 0$
(iii) $\Sigma F = 0$ (iv) $\Sigma M = 0 + \Sigma F = 0$
c) Describe with neat sketch the working of single plate friction clutch. **(07)**

Q.3
a) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B ? **(08)**



b) In a clock mechanism, the gear train used to connect minute hand to hour hand, is **(01)**
(*i*) epicyclic gear train (*ii*) reverted gear train
(*iii*) compound gear train (*iv*) simple gear train
c)Explain working of Internal expanding shoe brake with neat sketch. **(06)**
d) Explain Torsion Dynamometer. **(05)**

Q.4
a) A Proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Determine the range of speed of the governor. **(12)**
b) A Hartnell governor is a **(01)**
(*i*) pendulum type governor (*ii*) spring loaded type
(*iii*) dead weight governor (*iv*) inertia governor
c) Write a short note on gyroscope. Write its equation for magnitude of couple **(07)**



(1)

T.Y.B.Tech.(Mech) Sem V
Theory of Machines - II · D+·05|01|16.

Q.5 a) A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of centre of gravity 500 mm above the ground level and lies at 1 metre from the front axle. Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m^2. The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel. **(14)**

b) The air screw of an aeroplane is rotating clockwise when looking from the front. If it makes a left turn, the gyroscopic effect will **(01)**
(*i*) tend to depress the nose and raise the tail
(*ii*) tend to raise the nose and depress the tail
(*iii*) tilt the aeroplane
(*iv*) none of the above

c) Distinguish between Watt, Porter and Proell. **(05)**

Q.6 a) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: **(12)**
1. maximum braking torque, 2. angular retardation of the drum, and 3. time taken by the system to come to rest from the rated speed of 360 r.p.m.
The coefficient of friction between blocks and drum may be taken as 0.25.

b) The brakes commonly used in railway trains is **(01)**
(*i*) shoe brake (*ii*) band brake
(*iii*) band and block brake (*iv*) internal expanding brake

c) Explain briefly the differences between simple, compound, and epicyclic gear trains. What are the special advantages of epicyclic gear trains ? **(07)**

Q.7 a) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 r.p.m. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2. Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear. **(10)**

b) Why is balancing of rotating parts necessary for high speed engines? **(04)**

c) Write short note on centrifugal governors. **(06)**

(2)