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Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

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

KT Exam

June 2017

Max. Marks: 100 Duration: 03 Hours

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

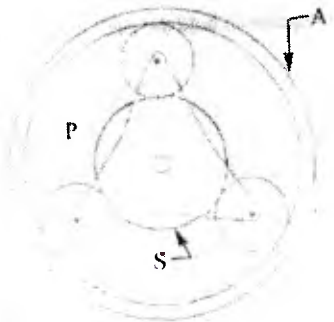
Name of the Course: Theory of Machines II Course Code : BTM 502

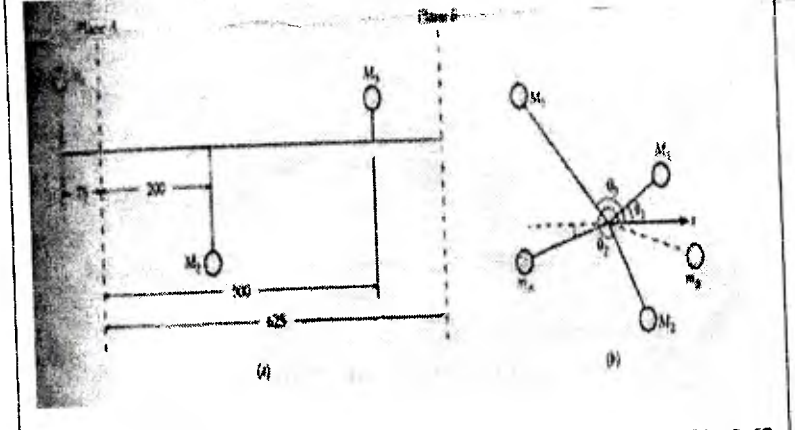
MASTER FILE.

Instructions:

- Solve any **FIVE** questions
- Answers to all sub questions should be grouped together
- Figures to the right indicate full marks
- Assume suitable data if necessary

Question No		Maximum Marks	Course Outcome Number	Module No.
Q1(a)	A single plate clutch consists 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.	06	I	1
(b)	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.	10	I	1
(c)	Explain 1. Prony Brake Dynamometer 2. Rope and Brake Dynamometer	04	I	1
Q2(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 30^0 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	I	2
(b)	Difference between Porter and Proell governor.	02	I	2

(c)	Define the following terms relating to governors : 1. Sensitiveness 2. Isochronism	02	I	2
Q3	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	I	3
Q 4	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	I	4
Q5 (a) (b) (c)	A vibrating system consists of a mass of 40 kg, a spring with a stiffness of 30KN/m and a damper. The damping provided is only 15% of the critical value. Determine the damping factor, critical damping coefficient, natural frequency of damped vibration and ratio of two consecutive amplitude. What are the types of vibrations and further compare them. Explore the steps involved in vibration analysis.	05 05 05	III, IV	5

(d)	Explain with neat sketch basic elements of vibratory system? What is the degree of freedom?	05		
Q6 (a)	A machine weighs 18kg and is supported on springs and dashpots. The total stiffness of the springs is 12N/mm and the damping is 0.2N/mm/s. The system is initially at rest and a velocity of 120mm/s is imparted to the mass. Determine the I) displacement and velocity of mass as a function of time II) displacement and velocity after 0.4s	10	III, IV	6
(b)	Discuss and derive the effect of damping on vibratory systems. What is meant by under-damping, over damping and critical damping?	10		
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 M_A in plane A and M_B in plane B at a radius of 250 mm each. Given that M_1 = 4.0 kg, M_2 = 6.4 kg and M3 = 2.0 kg. The location of centre of gravity of masses M_1, M_2 and M_3 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 30^0, 300^0 and 135^0 respectively as shown in figure  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 M_A and M_B and show their angular positions for static balance of motor.	15	II	7
(b)	Explain Balancing of 1. In Line Engine 2. V Engine	05	II	7

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End Semester KT Exam, 2018

Max. Marks: **100** Duration: **3 hrs**

Class: **T. Y. B. Tech.** Semester: **V** Program: **Mech. Engg.**

Name of the Course: **Heat and Mass Transfer** Course Code : **ME301**

Instructions:

- **Question No 1 is compulsory.**
- Attempt **any Four questions** out of Six 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

MASTER FILE

Q. No		Marks	CO NO	M No.
Q1	**Answer the following questions (any four)**	20		1-7
A.	Explain Fourier's Laws of Heat Conduction (one-dimensional) with proper assumptions.		2	
B.	What is meant by thermal boundary layer? State the relationship between thermal and velocity boundary layer.		1	
C.	What is Newton's law of viscosity? What is the relation between kinematic viscosity and dynamic viscosity?		1	
D.	State the examples of mass transfer in day-to-day life and industrial applications.		1	
E.	What are the advantages and limitations of the dimensional analysis?		2	
Q2 (A)	A steam pipe which is 150 mm external diameter carries wet steam at 3.6 MN/m^2. It is covered with two layers of insulation each 40 mm thick. The coefficients of thermal conductivity for two layers are 0.07 W/m-K for the inner layer and 0.1 W/m-K for the outer layer. The surface heat transfer coefficient for the outer surface is 3 W/m^2-K. Estimate the heat lost per hour for a 50 m length of the insulation pipe. The ambient temperature is 27°C. What would be the surface temperature of the insulation? Neglect the thickness of the steam pipe and its thermal resistance.	10	4	2
(B)	Derive an expression for temperature distribution, under one dimensional steady state heat conduction for a plane wall. State the assumptions made.	10	4	1
Q3 (A)	An aluminium alloy plate of 4 mm thick at 200°C is suddenly quenched into	10	4	3

	liquid oxygen which is at -183°C. Find the time required for the plate to reach the temperature of -70°C. Take h = 5000 W/m^2-k, plate dimensions = 40 cm × 40 cm, i) C_p= 0.8 kJ/kg-K, ρ = 3000 kg/m^3.			
(B)	Derive expression for LMTD for parallel flow heat exchanger.	10	3	6
Q4 (A)	What are the different applications of extended surfaces or fins? List the assumptions made while analyzing the heat flow from a finned surface. When is the use of fins not justified?	10	1	2
(B)	A refrigerated truck is moving at a speed of 90 km/hr where the ambient temperature is 50°C. The body of the truck is of rectangular shape of size 10m (length) x 4m (width) x 3m (height). Assume the boundary layer on the four walls is turbulent and the heat transfer takes place only from the four surfaces and the wall surface temperature of the truck is at 10°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. For turbulent flow over flat surfaces: $\overline{Nu}= 0.036\,(Re)^{0.8}\,(Pr)^{0.33}$ Average properties of air at T_b = 30°C: ρ = 1.165 kg/m^3, Cp = 1.005 kJ / kg.K, ν = 16 x 10^{-6} m^2/s, Pr = 0.701, K = 0.02673 W/m.k	10	4	4
Q5 (A)	Prove that total emissive power is π times the intensity of radiation.	05	3	5
(B)	Two large parallel plates are with emissivity = 0.5 each, are maintained at different temperatures and are exchanging heat only by radiation. Two equally large radiation shields with surface emissivity 0.05 are introduced in parallel to the plates. Find the percentage reduction in net radiative heat transfer.	05	4	5
(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^{2}K. Modelling the human body 30 cm diameter, 1.70 m long cylinder, calculate actual time of death of the person. Take thermo-physical properties of sphere as: K = 6.08 W/mK, ρ = 900 kg/m^3 and Cp = 4000 J/kgK	10	4	3
Q6. A.	A heat exchanger has 17.5 m^2 area available for heat transfer. It is used for cooling oil at 200°C by using water available at 20°C. The mass flow and specific heat of oil are 10000 kg/hr and 1.9 kJ/kg-K and mass flow and specific heat of water are 3000 kg/hr and 4.187 kJ/kg-K. If the overall heat transfer coefficient is 300 W/m^2-K, estimate the outlet temperature of oil and water for	10	4	6

	parallel flow and counter flow arrangements by using NTU method.			
B.	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**	**4**	**7**
Q7	**Write Short Notes on Following (Any Four)**	**20**	**1**	**1-6**
	A) Absorptivity, reflectivity, transmissivity and emissivity. B) Thermal contact resistance and the parameters on which resistance depend C) Physical significance of the thermal diffusivity D) Important boundary layer parameters which are linked by the Reynolds analogy E) Baffles used in a shell-and-tube heat exchanger and its effects on performance of heat exchanger F) Physical interpretation of the Biot number and Fourier number			

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Re-Exam

June 2017

Course code: BTM 504
Program: T. Y. B. Tech
Semester: V

Duration: 3 Hours
Maximum Marks: 100

Name of the Course: Thermal Systems

Instructions: 1. Question number ONE is compulsory and solve any FOUR questions out of remaining SIX.
2. Steam table and Mollier diagram is allowed to use.
3. All sub questions to be grouped together.
4. Assume suitable data and justify the same.

MASTER FILE.

Question No.		Maximum Marks	Course Outcome Number	Module No.
Q1				
a)	Discuss in detail multi-staging of a reciprocating air compressor.	05	1	2
b)	Derive equation for thermal efficiency of Rankin cycle	05	1	1
c)	Explain what is compounding in steam turbines and explain pressure compounding in steam turbine.	05	1	6
d)	Discuss advantages and disadvantages of gas turbine over internal combustion engines.	05	1	7
Q2				
a)	Differentiate between fire tube and water tube boiler.	08	2	4
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	4	2
Q3				
a)	Derive the condition of intermediate pressure for minimum work required per kg of air delivered by two stage compressor with intercooler.	10	1	2
b)	Explain evaporative condenser with neat sketch mentioning its advantages and disadvantages.	10	2	5

Q4				
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	1	6
b)	Enumerate the necessity of boiler accessories and explain in detail functions of economiser and air preheater with neat sketches.	12	2	4
Q5				
a)	Explain advantages and limitations of rotary verses reciprocating compressors and axial verses centrifugal compressors.	10	1	3
b)	Prove that condition for maximum blade efficiency of a reaction turbine is given by relation: $\eta_b = \frac{2\cos^2\alpha}{1+\cos^2\alpha}$	10	4	6
Q6				
a)	A steam power plant has boiler and condenser pressure of 60 bar and 0.1 bar, respectively. Steam coming out of the boiler is dry and saturated. The plant operates on the Rankine cycle. Calculate thermal efficiency.	08	1	1
b)	The following data refer to a single stage impulse turbine: Isentropic nozzle enthalpy drop = 210 kJ/kg, Nozzle efficiency = 90%, Nozzle angle =25°, Ratio of blade speed to whirl component of steam = 0.5, Blade velocity coefficient = 0.9, The velocity of steam entering the nozzle = 30 m/s. Find (a) the blade angles at inlet and outlet if the steam enters the blades without shock and leaves the blades in an axial direction, (b) blade efficiency, (c) power developed and (d) axial thrust if the steam flow rate is 10 kg/sec.	12	3	6
Q7				
a)	Discuss with neat sketches different methods of improving thermal efficiency of simple open cycle gas turbines.	08	4	7
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 turbine 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 γ = 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	3	7